SmartCHEM-LAB

Dissolved Oxygen, Conductivity, TDS, Salinity, pH, mV/ORP, Specific Ion, Temperature Meter

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PRECISION MEASUREMENT™

Congratulations !

The **smart*CHEM*-LAB** is complete water quality lab in a single benchtop unit. It combines Dissolved Oxygen, Conductivity, TDS, Salinity, Temperature and two channels of pH, mV/ORP or Specific Ions.

Despite its impressive list of features, the **smart*CHEM*-LAB** is a breeze to operate. This manual has been designed to help you get started, and also contains some handy application tips. If at any stage you require assistance, please contact either your local TPS representative or the TPS factory in Brisbane.

The manual is divided into the following sections:

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

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

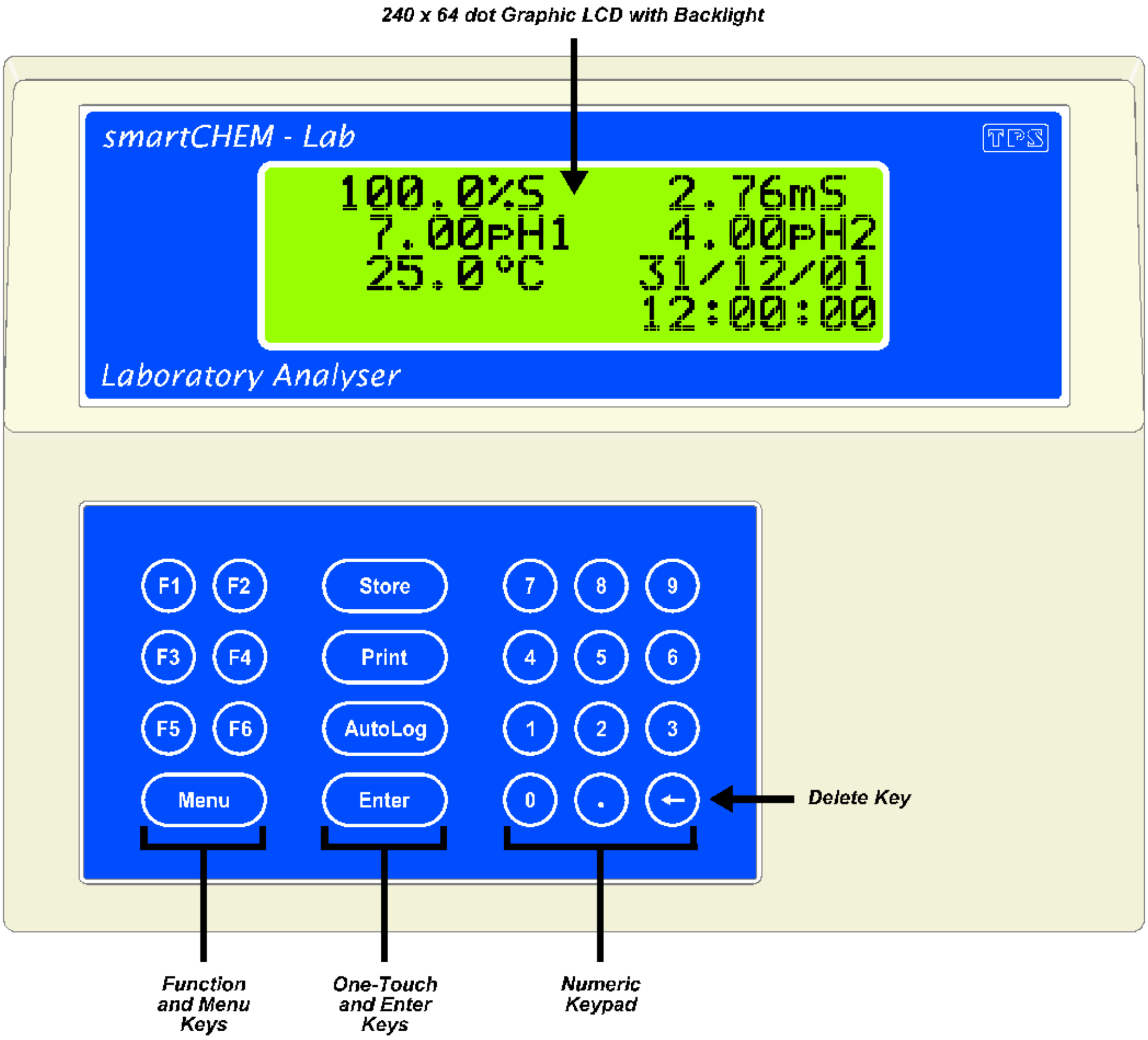
1. **Main Section**
   The main section of the handbook provides complete details of the **smart*CHEM*-LAB**, including operating modes, calibration, troubleshooting, specifications, and warranty terms.

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

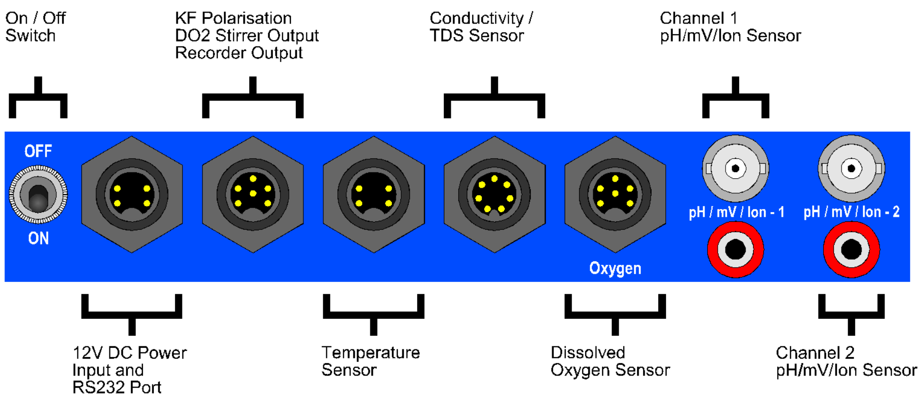
Contents

1. Introduction

1.1 smart*CHEM*-LAB Display and Controls



1.2 smart*CHEM*-LAB Rear Panel Connectors



Turn the retaining nut clockwise until it clicks into place when plugging in plastic connectors. This is essential to produce a waterproof seal.

Always replace the waterproof cap when a connector is not in use to maintain waterproof integrity.

1.3 Function and Menu Keys

Press (Menu) to enter the user-friendly menu system. (Menu) is also used to step backwards through the menu one level at a time, and as an "escape" key to quit functions such as calibration, data entry etc.

Press the (F1) to (F5) function keys to select desired options within the menu system.

Additionally, these keys perform the following function directly in normal measurement mode…

(F2) : Press to start and stop the optional Dissolved Oxygen stirrer. See section 3.2.2.

(F6) : Press to Zero Relative mV/ORP, when Relative mV/ORP is selected. See section 10.2.

(F5) : Press to start and stop the Automatic Stability Function. See section 12.

1.4 One-touch Keys

(Store) : Press to manually record readings into the Logger. See section 16.1.

(Print) : Press to transmit current reading plus date and time to the RS232 port. See section 17.2.

(AutoLog) : Press to start and stop Automatic Data logging. See section 16.2.

(Enter) : Press (Enter) to accept default values or those entered on the Numeric Keypad.

1.5 Numeric Keypad

Used to enter values during set-up and calibration. A decimal point is provided.

1.6 Delete Key

Press ⊖ to make corrections to values entered on the Numeric Keypad.

1.7 240 x 64 Dot Graphic Display

Graphic display with large, clear digits and letters. Features a user-friendly menu and context-sensitive help system. Shows Dissolved Oxygen, Conductivity/TDS/Salinity, Channel 1 pH/mV/ORP/Specific Ion, Channel 2 pH/mV/ORP/Specific Ion, Temperature, Date and Time simultaneously.

Backlight can be set to On, Off or Energy Saver modes. See section 13.

1.8 Unpacking Information

Before using your new **smart*CHEM*-LAB**, please check that the following accessories have been included:

		Part No
Standard Kit…		
1.	**smart*CHEM*-LAB** Laboratory Analyser	126124
1.	k=1 Conductivity Sensor	122230
2.	Plastic Body Combination pH Sensor	121207
3.	Temperature/ATC Sensor	121248
1.	pH7.00 Buffer, 200mL	121387
2.	pH4.01 Buffer, 200mL	121381
3.	2.76 mS/cm Conductivity Standard, 200mL	122306
4.	Plug-Pack Power Supply	130037
1.	Manual	

Optional sensors that may have been ordered with your smartCHEM-LAB…

1.	ED1 Dissolved Oxygen sensor	123400
2.	1m Cable for ED1 DO_2 sensor	123228
3.	YSI Non-stirring DO_2 sensor for BOD bottles	123214
4.	YSI Self-stirring DO_2 sensor for BOD bottles	123213
5.	YSI Field type DO_2 sensor	123204
6.	1m Cable for YSI Field DO_2 sensor	123212
7.	k=0.1 Conductivity Sensor	122232
8.	k=10 Conductivity Sensor	122234
9.	Intermediate Junction pH Sensor	121234
10.	Plastic Body Combination Redox Sensor	121262
11.	Intermediate Junction Redox Sensor	121263
12.	Double Platinum Karl Fischer Sensor	122209

Instrument Options…

1.	Flexible arm type sensor holder	130088
2.	RS232 Serial Interface Cable	130041
3.	Serial to USB adaptor cable (used with 130041).	130087
4.	Recorder Output Option (includes cable)	130028
5.	WinTPS RS232 Communication software for Windows 95, 98 and ME	130086
6.	Adaptor for 4.5V DC output for Oxygen Stirrers	123311

A complete range of Conductivity, Ion Selective, Reference, pH and Redox sensors are available from TPS.

1.9 Specifications

1.9.1 Dissolved Oxygen

Ranges	Resolution	Accuracy
ED1 Sensor		
0 to 20.00 ppM 20.0 to 40.0 ppM	0.01 ppM 0.1 ppM	±0.2% of full scale of selected range
0 to 250.0 % Saturation 250 to 450 % Saturation	0.1 % Saturation 1 % Saturation	±0.3 % Saturation
0 to 50.0 % Gaseous 50 to 100 % Gaseous	0.1 % Gaseous 1 % Gaseous	±0.1 % Gaseous
YSI Sensors		
0 to 25.00 ppM 25.0 to 40.0 ppM	0.01 ppM 0.1 ppM	±0.2% of full scale of selected range
0 to 300.0 % Saturation 300 to 450 % Saturation	0.1 % Saturation 1 % Saturation	±0.3 % Saturation
0 to 60.0 % Gaseous 60 to 100 % Gaseous	0.1 % Gaseous 1 % Gaseous	±0.1 % Gaseous
Note : ***Ranges are automatically selected. Exact auto-ranging points and full scales are subject to sensor performance.***		

Sensor Type Clark type polarographic sensor, with in-built ATC.

Salinity Correction Automatic, 0 to 50.0 ppK, using Conductivity/TDS/Salinity reading.

Temperature Compensation Automatic, -5 to 50 ^{O}C for membrane permeability and Dissolved Oxygen solubility in ppM mode.

Calibration Automatic zero and span calibration.

Sensor Span Range 65 to 200 %

1.9.2 Conductivity

Ranges	Resolution	Accuracy
k=0.1 Sensor		
0 to 2.000 µS/cm 0 to 20.00 µS/cm 0 to 200.0 µS/cm 0 to 2000. µS/cm	0.001 µS/cm 0.01 µS/cm 0.1 µS/cm 1 µS/cm	±0.5% of full scale of selected range at 25 °C
k=1.0 Sensor		
0 to 20.00 µS/cm 0 to 200.0 µS/cm 0 to 2000. µS/cm 0 to 20.00 mS/cm	0.01 µS/cm 0.1 µS/cm 1 µS/cm 0.01 mS/cm	±0.5% of full scale of selected range at 25 °C
k=10 Sensor		
0 to 200.0 µS/cm 0 to 2000. µS/cm 0 to 20.00 mS/cm 0 to 200.0 mS/cm	0.1 µS/cm 1 µS/cm 0.01 mS/cm 0.1 mS/cm	±0.5% of full scale of selected range at 25 °C
Note : ***Ranges are automatically selected. Exact auto-ranging points and full scales are subject to sensor performance.***		

Sensor Type Glass body with two platinised platinum plates.
In-built ATC.

Temperature Compensation Automatic, -5 to 70 °C

Calibration Automatic zero and span calibration.

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

1.9.3 TDS

Ranges	Resolution	Accuracy
k=0.1 Sensor		
0 to 1.000 ppM 0 to 10.00 ppM 0 to 100.0 ppM 0 to 1000. ppM	0.001 ppM 0.01 ppM 0.1 ppM 1 ppM	±0.5% of full scale of selected range at 25 °C
k=1.0 Sensor		
0 to 10.00 ppM 0 to 100.0 ppM 0 to 1000. ppM 0 to 10.00 ppK	0.01 ppM 0.1 ppM 1 ppM 0.01 ppK	±0.5% of full scale of selected range at 25 °C
k=10 Sensor		
0 to 100.0 ppM 0 to 1000. ppM 0 to 10.00 ppK 0 to 100.0 ppK	0.1 ppM 1 ppM 0.01 ppK 0.1 ppK	±0.5% of full scale of selected range at 25 °C
Note : ***Ranges are automatically selected. Exact auto-ranging points and full scales are subject to sensor performance.***		

Sensor Type Glass body with two platinised platinum plates. In-built ATC.

Temperature Compensation Automatic, -5 to 70 °C

TDS Factor 0.40 to 1.00 user selected.

1.9.4 Salinity

Ranges	Resolution	Accuracy
k=0.1 Sensor		
0 to 0.10 % or 0 to 1.0 PSU	0.01 % or 0.1 PSU	±0.5% of full scale of selected range at 25 °C
k=1.0 Sensor		
0 to 1.19 % or 0 to 11.9 PSU	0.01 % or 0.1 PSU	±0.5% of full scale of selected range at 25 °C
k=10 Sensor		
0 to 8.00 % or 0 to 80.0 PSU	0.01 % or 0.1 PSU	±0.5% of full scale of selected range at 25 °C
Note : Ranges are automatically selected. Exact auto-ranging points and full scales are subject to sensor performance.		

Sensor Type Glass body with two platinised platinum plates. In-built ATC.

Temperature Compensation Automatic, -5 to 70 °C

1.9.5 Specific Ions

Ranges	Resolution	Accuracy
Auto-ranging in units of ppM, ppK, % and Exponential Notation	User selectable for 3 significant digits, 2 significant digits or Auto-rounding.	± Least significant digit

Sensor Type Compatible with all combination and half cell Ion Selective Electrodes for monovalent or divalent anions or cations.

Input Impedance >3 x 10^{12} Ohms

Temperature Compensation Automatic, 0 to 100 °C

Calibration Automatic asymmetry and slope calibration in user-defined standards.

Sensor Asymmetry Range Auto detection at calibration.

Sensor Slope Range 50.0 to 110.0 %

1.9.6 pH

Ranges	Resolution	Accuracy
0 to 14.000 pH 0 to 14.00 pH	0.001 pH 0.01 pH	±0.002 pH ±0.01 pH

Sensor Type Glass bulb pH sensor, combination or half cell.
Input Impedance >3 x 10^{12} Ohms
Temperature Compensation Automatic, 0 to 100 ^{O}C
Calibration Automatic asymmetry and slope calibration.
Automatic Buffer Recognition pH4.01, pH6.86, pH7.00, pH9.18 & pH10.01.
Any other can be entered during calibration.
Sensor Asymmetry Range -1.00 to 1.00 pH
Sensor Slope Range 85.0 to 105.0 %

1.9.7 Absolute and Relative mV/ORP

Ranges	Resolution	Accuracy
0 to ± 400.0 mV 0 to ±1500 mV (auto-ranging)	0.1 mV 1 mV	±0.15 mV ±1 mV

Sensor Type Platinum tip ORP sensor, combination or half cell.
Ion Selective Electrodes can also be used in this mode.
Input Impedance >3 x 10^{12} Ohms

1.9.8 Temperature

Range	Resolution	Accuracy
-10.0 to 120.0 °C	0.1 °C	±0.2 °C

Sensor Type Silicon transistor
Calibration Automatic offset calibration
Sensor Offset Range -10.0 to 10.0 ^{O}C

1.9.9 General Specifications

Memory 1489 readings including date and time
Automatic Logging User-set for one reading every 2 to 90 seconds, minutes or hours.
RS232 Port 1200, 9600, 19200 & 38400 baud.
8 bits, no parity, 1 stop bit, XON/XOFF Protocol.
Clock Calendar clock displays date, month, year, hours, minutes & seconds.
Good Laboratory Practices Date, time and results of last calibration for all parameters are stored. This information can be recalled or sent to the RS232 port at any time.
Power 12V DC, 90 mA (backlight off) / 130 mA (backlight on). AC/DC adaptor to suit country of destination is included in standard kit.
Dimensions 240 x 180 x 105 mm
Mass Instrument only : Approx. 1.0 kg
Full Kit : Approx. 3.0 kg

Environment	Temperature	: 0 to 45 ^{O}C
	Humidity	: 0 to 90 % R.H.

2. smart*CHEM*-LAB Menu Structure

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

Menu	→	F1:Calibrate	→	F1:Oxygen		
				F2:Conductivity		
				F3:pH-1, Ion-1 or mV-1		F3 & F4 do not appear in the menu when the channel is in Relative mV mode or is switched off.
				F4:pH-2, Ion-2 or mV-2		
				F5:Temp.		
	→	F2:Logger	→	F1:Recall		
				F2:Erase	→	F1:Erase All
						F2:Erase Last
				F3:Print		
				F4:Program	→	F1:Secs
						F2:Mins
						F3:Hours
	→	F3:Mode	→	F1:Oxygen	→	F1:ppM
						F2:ppM (Sal)
						F3:%Sat
						F4:%Gas
				F2:Cond/TDS/Sal	→	F1:Conductivity
						F3:TDS
						F4:Salinity
				F3:Chan-1	→	F1:pH
						F2:mV/ORP
						F3:Ion
						F4:Rel mV
						F5:OFF
				F4:Chan-2	→	F1:pH
						F2:mV/ORP
						F3:Ion
						F4:Rel mV
						F5:OFF
	→	F4:Setup	→	F1: Standards	→	F1:Cond.
						F3:Ion-1
						F4:Ion-2
						F5:pH Buffer
				F2:Clock		
				F3:Backlight	→	F1:On
						F2:Off
						F3:Energy Saver
				F4: Ports	→	F1:Baud Rate

						F3:Enable Stirrer
					or:	F3:Disable Stirrer
						F5:Recorder *
				F5:Initialise	→	F1:All
						F2:pH SlopeB
	→	F5:GLP	→	F1:Recall		
				F2:Alarm	→	F1:Daily
						F2:1 Week
						F3:2 Weeks
						F4:4 Weeks
						F5:OFF
				F3:Print		
		F6:Access	→	F1:Change code		
				F3:Enable & Enter code or F3:Disable Security		

* This function only available when Recorder Port option is fitted.

3. Dissolved Oxygen Mode

3.1 Selecting Dissolved Oxygen Mode

1. Select Dissolved Oxygen Mode (Menu → **F3:Mode** → **F1:Oxygen**).

2. The Dissolved Oxygen readout units selection screen is now displayed…

```
 OXYGEN MODE
>F1:ppM   F2:ppM (Sal)
 F3:%Sat  F4:%Gas
```

The arrow indicates the current selection.

Press F1 to select Dissolved Oxygen readout in ppM units. This selection will not apply Salinity correction to the displayed readings.

Press F2 to select Dissolved Oxygen readout in Salinity-corrected ppm units. This selection will use the Conductivity, TDS or Salinity reading for automatic Salinity correction.

Press F3 to select Dissolved Oxygen readout in % Saturation units.

Press F4 to select Dissolved Oxygen readout in % Gaseous units.

Press Menu to quit without changing the current setting.

3.2 Dissolved Oxygen Stirrer

The **smart*CHEM*-LAB** is equipped with a 4.5V DC output to power a stirrer for the Dissolved Oxygen sensor. This power output is suitable for the YSI self-stirring BOD sensor (part number 123213), or the TPS submersible DO_2 stirrer (part number 123305).

The 4.5V output is available at the **Accessories** connector on the rear of the **smart*CHEM*-LAB**. When using the YSI self-stirring BOD sensor (part number 123213), please use the optional adaptor cable (part number 123311).

The Control output is capable of supplying 150 mA, which is ample for the two stirrers detailed above.

3.2.1 Enabling and Disabling the Dissolved Oxygen Stirrer Output

1. Select the Ports menu (Menu → **F4:Setup** → **F4:Ports**).
2. Select **F3:Enable Stirrer** or **F3:Disable Stirrer** from the menu as required.

3.2.2 Starting and Stopping the Dissolved Oxygen Stirrer

1. Ensure that the Dissolved Oxygen stirrer output has been enabled, as per section 3.2.1.
2. Press F2 once in normal display mode to start the stirrer. The stirrer will stay on for 40 seconds and then stop. A countdown is provided on the screen. The unit will beep every second for the last five seconds.
3. Press F2 a second time any time during the 40 second period to set the Dissolved Oxygen stirrer to operate continuously. The stirrer icon plus the word "**ON**" is shown on the display.
4. Press F2 a third time to stop the Dissolved Oxygen stirrer.

The operator has the choice whether or not to operate the Dissolved Oxygen stirrer during automatic data logging. See section 16.2.

3.3 Dissolved Oxygen Calibration

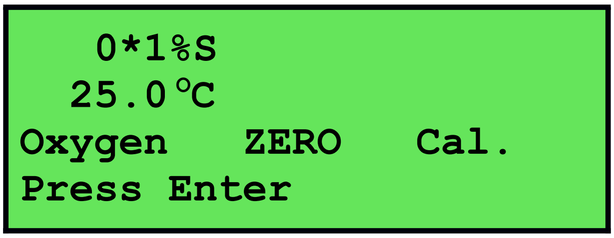
1. Plug the Dissolved Oxygen sensor into the **Oxygen** socket.
2. Switch the meter on.
3. Select the Dissolved Oxygen readout mode to be used, as detailed in section 3.1.
4. Ensure that the Temperature readout has been calibrated. When a separate Temperature sensor is connected, the **smart*CHEM*-LAB** will use it for Automatic Temperature Compensation in the ppM Dissolved Oxygen modes. When the Temperature sensor is not connected, the **smart*CHEM*-LAB** will use the Temperature sensor built into the tip of the Dissolved Oxygen sensor for Automatic Temperature Compensation in the ppM Dissolved Oxygen modes.

   It is vital that the correct Temperature sensor is calibrated. See section 11.1 for a detailed explanation.
5. Rinse the Dissolved Oxygen sensor (and Temperature sensor, if applicable) in distilled water and blot dry.

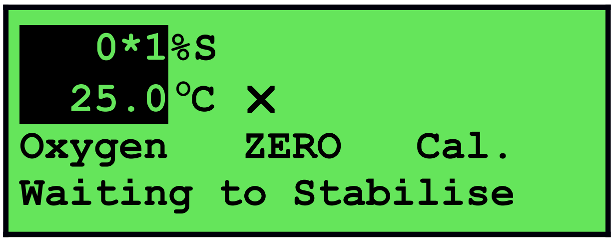
3.3.1 Zero Calibration

1. Place the sensor(s) 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 (part number 123302) is supplied with a new Dissolved Oxygen sensor for this purpose.
2. Allow the reading to stabilise at or near zero. This may take 2-3 minutes.
3. Select Oxygen Calibration. (Menu → `F1:Calibrate` → `F1:Oxygen`)

   When the reading is below approximately 25 % Saturation, 2 ppM or 5% Gaseous, the **smart*CHEM*-LAB** will display the ZERO calibration screen…



4. Press Enter to calibrate. The Automatic Stability Function will now show a ☒ and highlight any unstable readings…



   When the Dissolved Oxygen and Temperature readings have both stabilised, the unit will calibrate itself.

   To calibrate immediately without waiting for complete stability, press F5 to disable the Automatic Stability Function.

   A "*" will not be removed from the display after a Zero Calibration.
5. Remove the sensor(s) from the Zero solution, rinse well in distilled water and blot dry.

   The **smart*CHEM*-LAB** will now prompt you to perform an AIR calibration.

3.3.2 Span Calibration in Air (all Oxygen modes)

1. Hang the Dissolved Oxygen sensor (and Temperature sensor, if applicable) in air. The tip of the Dissolved Oxygen sensor should be pointing downwards.

   Allow the reading to stabilise. After a zero calibration, this may take up to 5 minutes.

2. Select Oxygen Calibration. (Menu → **F1:Calibrate** → **F1:Oxygen**)

   When the reading is above approximately 25% Saturation, 2 ppM or 5% Gaseous, the **smart*CHEM*-LAB** will display the AIR calibration screen…

```
 101*0%S
  25.0°C
Oxygen   AIR    Cal.
Press Enter
```

3. Press Enter to calibrate. The Automatic Stability Function will now show a ☒ and highlight any unstable readings…

```
 101*0%S
  25.0°C ✕
Oxygen   AIR    Cal.
Waiting to Stabilise
```

   When the Dissolved Oxygen and Temperature readings have both stabilised, the unit will calibrate itself.

   To calibrate immediately without waiting for complete stability, press F5 to disable the Automatic Stability Function.

   A "*" in the display will be replaced by a decimal point after a successful air calibration.

4. The **smart*CHEM*-LAB** is now calibrated and is ready for Dissolved Oxygen measurement. Rinse the Dissolved Oxygen sensor in distilled water and blot dry before placing into unknown samples.

3.3.3 Span Calibration in Solution (Salinity-corrected ppM Mode only)

This span calibration provides an alternative to calibrating the Dissolved Oxygen sensor in air. It is only available when the **smart*CHEM*-LAB** is in Salinity-corrected ppM mode. Please note that the normal AIR calibration (section 3.3.2) is still available for Salinity-corrected ppM mode.

1. Measure the Dissolved Oxygen content of the solution to be used for calibration. This is generally done with a Winkler titration. The **smart*CHEM*-LAB** span calibration should be performed immediately the Dissolved Oxygen content of the solution is known, as the value may not be stable.

2. Place the Dissolved Oxygen and Conductivity sensors (and Temperature sensor, if applicable) into the calibration solution. Ensure that the Conductivity sensor is immersed at least to the top of the vent hole in the side of the sensor.

   The solution must be stirred at a moderate rate.

   Allow the reading to stabilise. After a zero calibration, this may take up to 5 minutes.

3. Select Oxygen Calibration. (Menu → **F1:Calibrate** → **F1:Oxygen**)

   When the reading is above approximately 2 ppM, the **smart*CHEM*-LAB** will display the AIR/SPAN calibration screen. Note the cursor underlining the "**A**" in "**AIR**".

```
  9*00ppMs
  25.0°C
Oxygen AIR/SPAN Cal.
Press Enter
```

   Use the numeric keypad to enter the Dissolved Oxygen value of the solution. The words "AIR/SPAN" are deleted and the value being entered is displayed. The Conductivity, TDS or Salinity reading also appears as soon as the first numeric key is pressed.

   Press the ⊖ to correct any errors.

4. Press Enter to calibrate. The Automatic Stability Function will now show a ☒ and highlight any unstable readings…

```
  6.70ppMs    33.0ppK
  25.0°C  X
Oxygen  Cal.
Waiting to Stabilise
```

   When the Dissolved Oxygen and Temperature readings have both stabilised, the unit will calibrate itself.

   To calibrate immediately without waiting for complete stability, press F5 to disable the Automatic Stability Function.

   A "*" in the display will be replaced by a decimal point after a successful air calibration.

5. The **smart*CHEM*-LAB** is now calibrated and is ready for Dissolved Oxygen measurement. Rinse the Dissolved Oxygen sensor in distilled water and blot dry before placing into unknown samples.

3.4 Dissolved Oxygen Calibration Notes

1. The relationship of % Saturation and ppM depends on a number of variables, so ***always calibrate in the mode required***. Do not try to infer Oxygen content from one mode to another.
2. The **smart*CHEM*-LAB** automatically detects if a TPS ED1 or a YSI sensor is connected. When the unit has been calibrated for one type, and the other type is then connected, the message "**Sensor**" appears in the Dissolved Oxygen display. It is necessary to re-calibrate for the new sensor to obtain accurate readings.
3. 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.
4. An air calibration should be performed at least weekly. Of course, more frequent calibration will result in greater confidence in results.
5. All calibration information is retained in memory when the **smart*CHEM*-LAB** is switched off. This information can be recalled or printed later using the GLP function (see section 14).

3.5 Dissolved Oxygen Calibration Messages

1. If a Zero calibration has been successfully performed, the **smart*CHEM*-LAB** will display the following message and the Zero value of the sensor…

```
Calibration OK,
Zero=0.0%
```

2. If a Zero calibration has failed, the **smart*CHEM*-LAB** will display the following message and the failed Zero value of the sensor. The unit will return to normal display mode with a "*" in place of the decimal point in the Dissolved Oxygen reading.

```
Calibration Failed,
Zero=15.0%
```

3. If an Air/Span calibration has been successfully performed, the **smart*CHEM*-LAB** will display the following message and the Span value of the sensor…

```
Calibration OK,
Span=101.0%
```

4. If an Air/Span calibration has failed, the **smart*CHEM*-LAB** will display the following message and the failed Span value of the sensor. The decimal point will be replaced by a "*****" when the unit returns to normal display mode.

```
Calibration Failed,
Span=205.0%
```

5. The **smart*CHEM*-LAB** will display the following message if the calibration point is too high. The unit must be calibrated in the lower of the two ranges that are provided for each Oxygen mode.

```
Oxygen OvrRange
Not Calibrated
```

6. The allowable Span range for a Dissolved Oxygen sensor is 65.0 to 200.0 %. If calibration fails due to the Span value being outside these limits, then please consult the Troubleshooting guide (section 22.2) for possible remedies.

4. Conductivity Mode

4.1 Selecting Conductivity Mode

1. Press (Menu) → **`F3:Mode`** → **`F3:Cond/TDS/Sal`** → **`F1:Conductivity`**.

2. The **smart*CHEM*-LAB** now proceeds to Conductivity measurement mode. Note that a "*" is shown in place of the decimal point until a successful calibration has been performed (see section 4.4).

4.2 Setting the Conductivity calibration standard

***The factory default for this item is 2.76mS/cm. If this is satisfactory, go directly to section* 4.3.**

1. Select the Conductivity Standard entry

   ((Menu) → **`F4:Setup`** → **`F1:Standards`** → **`F1:Cond.`**).

   The following screen is now displayed…

```
Cond.
Standard:2760.uS
Range
20uS/cm to 200mS/cm
```

2. Type in the value of the Conductivity standard that is to be used for calibration, including the decimal point. Use the (⇐) key to make any corrections.

3. Press (Enter) to save the value of the standard solution.

   Alternatively, press (Menu) to quit without changing the current setting.

4. The **smart*CHEM*-LAB** will now ask you to enter the units for the Conductivity standard…

```
Cond.
Standard:2760
Select Units
F1:uS/cm   F2:mS/cm
```

   Press (F1) to set the Conductivity Standard as µS/cm.

   Press (F2) to set the Conductivity Standard as mS/cm.

5. The Conductivity standard is now programmed for use at calibration.

4.3 Conductivity sensor k factor

The **smart*CHEM*-LAB** automatically recognises whether a k=0.1, k=1.0 or k=10 Conductivity sensor is being used via links in the connector.

Calibration settings for the various k factors are NOT stored separately. The **smart*CHEM*-LAB** requires re-calibration when a new k factor sensor is connected.

If the **smart*CHEM*-LAB** has been calibrated on one k factor sensor and a different k factor sensor is subsequently connected, the word "**`Sensor`**" appears instead of the Conductivity reading. In this case, it is necessary to re-calibrate the Conductivity reading before proceeding.

4.4 Conductivity(TDS/Salinity) Calibration

To achieve accurate Conductivity/TDS/Salinity results, the **smartCHEM-LAB** requires calibration to a allowable 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 **smartCHEM-LAB** uses Automatic Temperature Compensation (ATC) referenced to the fixed temperature of 25°C.

A "*" in place of the decimal point indicates that the Conductivity or TDS or 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.

Before attempting a Conductivity calibration, ensure that the **smart*CHEM*-LAB** has been set up correctly according to sections 4.1 to 4.3.

1. Plug the Conductivity sensor into the **Cond / TDS** socket.
2. 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 PLATES.

Zero Calibration

3. Let the sensor dry in air.
4. Select Conductivity Calibration (Menu → **F1:Calibrate** → **F2:Cond.**).
5. The **smart*CHEM*-LAB** will recognise the low conductivity signal and attempt a Zero calibration. For example…

```
Cond.            0*01uS
ZERO      Calibration
Press Enter
```

6. Press Enter to calibrate. The Automatic Stability Function will now show a ☒ and highlight the reading while it is unstable…

```
Cond.     X      0*01uS
ZERO      Calibration

Waiting to Stabilise
```

When the Conductivity reading has stabilised, the unit will calibrate itself.

To calibrate immediately without waiting for complete stability, press F5 to disable the Automatic Stability Function.

The "*" will not be removed after a zero calibration.

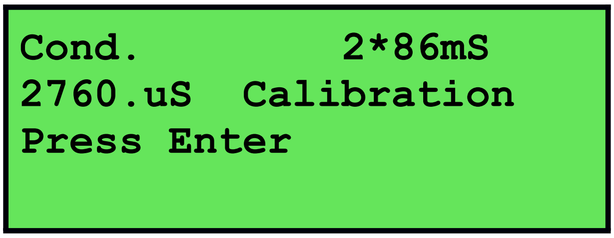
Continued over the page…

Standard Calibration

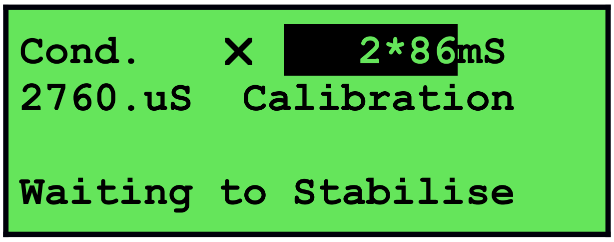
7. Place the Conductivity sensor into a sample of Conductivity standard. Ensure that it is immersed correctly at least to the top of the vent hole in the side of the sensor.

   DO NOT place the sensor directly into the bottle of standard. Discard the used sample of standard after use.

   Select Conductivity Calibration (Menu → **F1:Calibrate** → **F2:Cond.**). The calibration screen will be displayed with the Conductivity standard to be used. For example…



8. Press Enter to calibrate. The Automatic Stability Function will now show a ☒ and highlight the reading while it is unstable…



   When the Conductivity reading has stabilised, the unit will calibrate itself.

   To calibrate immediately without waiting for complete stability, press F5 to disable the Automatic Stability Function.

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

9. The **smart*CHEM*-LAB** is now calibrated for Conductivity and is ready for use in this mode.

4.5 Conductivity 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. All calibration information is retained in memory when the **smart*CHEM*-LAB** is switched off. This information can be recalled or printed later using the GLP function (see section 14).
4. The **smart*CHEM*-LAB** 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. Alter the Standards set-up if necessary (see section 4.2).
5. Calibration settings for k=0.1, k=1.0 and k=10 sensors are NOT stored separately.

   The **smart*CHEM*-LAB** requires re-calibration when a new k factor sensor is connected.

4.6 Conductivity Calibration Messages

1. If a Zero Calibration has been successfully performed, the **smart*CHEM*-LAB** will display the following message…

```
Calibration OK,
Zero=0.01uS
```

2. If a Standard Calibration has been successfully performed, the **smart*CHEM*-LAB** will display the following message and the calculated k factor of the sensor. For example…

```
Calibration OK,
k=0.99
```

3. If a Standard Calibration has failed, the **smart*CHEM*-LAB** will display the following message and the calculated k factor of the sensor. For example…

```
Calibrate Failure,
Check STD=2760.uS
k=3.64,Exceeds Limit
```

<u>Notes</u>

1. The allowable k factor range is +/-25% of nominal. This range is ample to allow for correctly functioning Conductivity sensors. If calibration fails due to the k factor being outside these limits, then please consult the Troubleshooting guide (section 22.3) for possible remedies.

5. TDS Mode

5.1 Selecting TDS Mode

1. Press (Menu) → **F3:Mode** → **F3:Cond/TDS/Sal** → **F3:TDS**.
2. The **smart*CHEM*-LAB** now proceeds to setting the TDS factor. The following screen is displayed…

```
TDS Factor : 0.65

Range
0.40 to 1.00
```

3. Type in the required TDS factor and press (Enter) or just press (Enter) if no change is required. The TDS factor will be reset to 0.65 when the meter is initialized.
4. The **smart*CHEM*-LAB** now proceeds to TDS measurement mode. Note that a "*" is shown in place of the decimal point until a successful Conductivity calibration has been performed (see section 4.4).

6. Salinity Mode

6.1 Selecting Salinity Mode

1. Press (Menu) → **F3:Mode** → **F3:Cond/TDS/Sal** → **F4:Salinity**.
2. The **smart*CHEM*-LAB** now proceeds to selecting the Salinity units. The following screen is displayed…

```
Salinity Units
>F1:%    F2:PSU
```

The arrow indicates the units currently selected.
Press (F1) to select readout in %.
Press (F2) to select readout in PSU (Practical Salinity Units).

If no change is required, simply press (Menu).

3. The smart*CHEM*-LAB now proceeds to Salinity measurement mode. Note that a "*" is shown in place of the decimal point until a successful Conductivity calibration has been performed (see section 4.4).

7. Specific Ion Mode

7.1 Selecting Specific Ion Mode

1. Select Specific Ion Mode for the desired pH/mV/ORP/Specific Ion channel…

   (Menu) → **F3:Mode** → **F3:Chan-1** → **F3:Ion**

   or

   (Menu) → **F3:Mode** → **F5:Chan-2** → **F3:Ion**

2. The Valency selection screen is now displayed…

```
VALENCY
>F1:+Mono    F2:-Mono
 F3:++Di     F4:--Di
```

   The arrow indicates the current selection.

   Press (F1) to select Monovalent Cation (e.g. Na^{+}).

   Press (F2) to select Monovalent Anion (e.g. F^{-}).

   Press (F3) To select Divalent Cation (e.g. Cu^{2+}).

   Press (F4) to select Divalent Anion (e.g. S^{2-}).

   Press (Menu) to quit without changing the current setting.

3. The Units selection screen is now displayed…

```
UNITS
>F1:ppM   F2:ppK
 F3:%     F4:Exponent
```

   The arrow indicates the current selection.

   Press (F1) to select readout in ppM (parts per Million).

   Press (F2) to select readout in ppK (parts per Thousand).

   Press (F3) to select readout in %.

   Press (F4) to select readout in Exponential units (e.g. Molar).

   Press (Menu) to quit without changing the current setting.

4. The Ion Resolution screen is now displayed…

```
Ion Resolution
 F1:3 Digit F2:2 Digit
>F3:Auto-Rounding
```

The arrow indicates the current selection.

Press (F1) to select resolution to 3 significant digits. In this mode, the readings may become slightly unstable towards the end of each decade, due to the logarithmic nature of the sensor signal.

Press (F2) to select resolution to 2 significant digits. Readings in this mode are very stable, although 1 signficant digit is lost.

Press (F3) to select Auto-rounding. Readings in this mode are displayed to 3 signficant digits for most of the decade, and automatically rounded for stability towards the end of the decade. Auto-rounding is recommended for most users.

Press (Menu) to quit without changing the current setting.

5. The **smart*CHEM*-LAB** now displays the following message, before proceeding to the Specific Ion standards setup for this channel.

This step is bypassed if there were no changes to the current Specific Ion setup.

```
New Ion setup,
Must Enter Standards
for this channel
```

Proceed to section 7.2 for details on setting the Primary and Secondary Specific Ion standards.

7.2 Setting Specific Ion Standards

The Primary and Secondary Specific Ion standards must be set before attempting Specific Ion calibration. The standards must be re-entered when changing Specific Ion modes or if the **smart*CHEM*-LAB** is initialised.

NOTE : When the Specific Ion standards are changed, the Specific Ion readout for that channel must be re-calibrated.

7.2.1 Setting Specific ion standards for ppM, ppK and % readouts

1. Select the Specific Ion standards set-up menu for the relevant channel…

(Menu) → **F4:Setup** → **F1:Standards** → **F3:Ion-1**

or

(Menu) → **F4:Setup** → **F1:Standards** → **F4:Ion-2**

(The **F3** and **F4** options are only available on the menu when that channel is set to Specific Ion readout.)

2. The Primary Standard set-up screen will now be displayed.

```
Enter Primary
Standard:0.00     ppM
```

Type in the value of the Primary standard, including the decimal point. Use the ⊖ key to make any corrections.

Press (Enter) to save the Primary standard.

Alternatively, press (Menu) to quit without changing the current setting.

3. The Secondary Standard set-up screen is now displayed.

```
Enter Secondary
Standard:0.00     ppM
```

Type in the value of the Secondary standard, including the decimal point. Use the ⊖ key to make any corrections.

The Secondary Standard must be at least 2 to 100 times higher or lower than the primary standard.

Press (Enter) to save the Secondary standard.

Alternatively, press (Menu) to quit without changing the current setting.

4. If the Specific Ion standards were changed, the Specific Ion readout for that channel must be re-calibrated. The **smart*CHEM*-LAB** provides the following prompt as a reminder…

```
Calibration settings
reset, Channel 1
must be Calibrated
```

7.2.2 Setting Specific ion standards for Exponential readout

1. Select the Specific Ion standards set-up menu for the relevant channel…

(Menu) → **F4:Setup** → **F1:Standards** → **F3:Ion-1**

or

(Menu) → **F4:Setup** → **F1:Standards** → **F4:Ion-2**

(The **F3** and **F4** options are only available on the menu when that channel is set to Specific Ion readout.)

2. The Primary Standard set-up screen will now be displayed.

```
Enter Primary
Standard:0.00+1000
```

Readings in Exponential mode are expressed in Scientific notation. For example, **1.00**$_{10}^{-}$**04** should be read as 1.00 x 10^{-4}, ie. 0.0001.

Type in 3 significant digits of the value of the Primary standard. The decimal point is fixed for you in this mode.

Now press (F1) for 10^{+} or press (F2) for 10^{-}.

Enter the power. This can be entered as 1 or 2 digits (eg. "**04**" is treated the same as "**4**").

Use the (⇐) key to make any corrections.

Press (Enter) to save the Primary standard.

Alternatively, press (Menu) to quit without changing the current setting.

3. The Secondary Standard set-up screen will now be displayed.

```
Enter Secondary
Standard:0.00+1000
```

The Secondary Standard must be at least 2 to 100 times higher or lower than the primary standard.

Type in 3 significant digits of the value of the Secondary standard. The decimal point is fixed for you in this mode.

Now press (F1) for 10^{+} or press (F2) for 10^{-}.

Enter the power. This can be entered as 1 or 2 digits (eg. "**04**" is treated the same as "**4**").

Use the (⇐) key to make any corrections.

Press (Enter) to save the Secondary standard.

Alternatively, press (Menu) to quit without changing the current settings.

4. If the Specific Ion standards were changed, the Specific Ion readout for that channel must be re-calibrated. The **smart*CHEM*-LAB** provides the following prompt as a reminder…

```
Calibration settings
reset, Channel 1
must be Calibrated
```

7.3 Specific Ion Calibration

1. Plug the Ion Selective Electrode into the **pH/mV/Ion-1** or **pH/mV/Ion-2** BNC socket.

   If a separate Reference Electrode is being used, plug this into the separate **pH/mV/Ion-1** or **pH/mV/Ion-2** 4mm Reference socket provided.

   Plug the Temperature sensor into the **Temperature** socket.

2. Switch the meter on.

3. Select and set up the Ion mode for the relevant channel, as detailed in section 7.1.

   Set up the Primary and Secondary Specific Ion standards, as detailed in section 7.2.

   For the purposes of this handbook, the **smart*CHEM*-LAB** has been set up for 10ppM as the Primary Standard and 100ppM as the Secondary Standard.

4. Ensure that temperature has already been calibrated (section 11.1) or manually set (section 11.4).

   NOTE: A "*" in place of the decimal point in the temperature readout indicates that temperature is not calibrated.

5. Remove the wetting caps from the Ion Selective and Reference electrodes, if fitted.

   Rinse the Ion Selective, Reference and Temperature sensors in distilled water and blot dry.

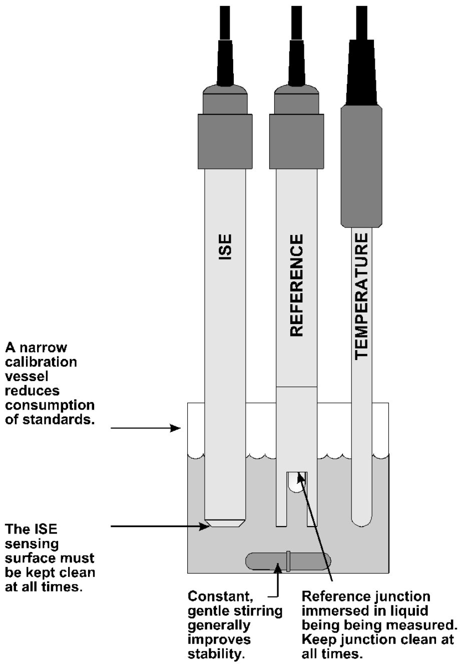
Primary Calibration

6. Place the Ion Selective, Reference and Temperature sensors into the Primary Standard.

   Ensure that the Ion Selective Electrode sensing surface and the reference electrode's reference junction are both covered, as per the diagram below.

   Add any Ionic Strength Adjusting Buffer (ISAB) that may be required (see the Ion Selective Electrode's handbook).

   A magnetic stirrer providing constant, gentle stirring generally improves stability.



Continued over the page…

7. Select Primary Calibration for the relevant channel…

Menu → **F1:Calibrate** → **F3:Ion-1** → **F1:Primary**

or

Menu → **F1:Calibrate** → **F4:Ion-2** → **F1:Primary**

The primary calibration screen is now displayed. If the **smart*CHEM*-LAB *is not*** currently Primary calibrated, the Specific Ion reading is replaced by the millivolt signal from the sensor, along with a flashing " **U** " (for **U**n-calibrated). If the **smart*CHEM*-LAB *is*** currently Primary calibrated, the current reading is displayed on the top left and the actual mV data coming from the sensor is displayed on the top right.

See the following examples…

Not Primary calibrated…	***Currently*** Primary calibrated…
U 0.0mV 25.0°C Ion 10.0ppM Cal. Press Enter	10*0ppM 0.0mV 25.0°C Ion 10.0ppM Cal. Press Enter

8. Press Enter to calibrate to the Primary Standard value. The Automatic Stability Function will now show a ☒ and highlight any unstable readings…

Not Primary calibrated…	***Currently*** Primary calibrated…
U 0.0mV 25.0°C ✕ Ion 10.0ppM Cal. Waiting to Stabilise	10*0ppM 0.0mV 25.0°C ✕ Ion 10.0ppM Cal. Waiting to Stabilise

When the Specific Ion and Temperature readings have stabilised, the unit will calibrate itself.

To calibrate immediately without waiting for complete stability, press F5 to disable the Automatic Stability Function.

The **smart*CHEM*-LAB** will then display the Offset of the Ion Selective Electrode, before returning to the Ion Calibration menu.

Note that the "*" will not removed from the Specific Ion readout until a Secondary calibration has been successfully performed

9. Rinse the Sensors in distilled water and blot dry.

Secondary Calibration

10. Place the Ion Selective, Reference and Temperature sensors into the Secondary Standard.

Ensure that the Ion Selective Electrode sensing surface and the reference electrode's reference junction are both covered as per the diagram in step 6.

Ensure that any Ionic Strength Adjusting Buffer (ISAB) that may be required has been added (see the Ion Selective Electrode's handbook).

A magnetic stirrer providing constant, gentle stirring generally improves stability.

11. Select Secondary Calibration for the relevant channel. Simply Select **F3:Secondary** if the unit is still in the Ion Calibration menu, or…

(Menu) → **F1:Calibrate** → **F3:Ion-1** → **F3:Secondary**

or

(Menu) → **F1:Calibrate** → **F4:Ion-2** → **F3:Secondary**

The secondary calibration screen is now displayed. The current reading is displayed on the top left, followed by the actual mV data coming from the sensor. A "*" in place of the decimal point indicates that the **smart*CHEM*-LAB** is currently not Secondary calibrated. For example…

```
   99*0ppM      58.5mV
  25.0°C  X
Ion 100ppM Cal.
Press Enter
```

12. Press (Enter) to calibrate to the Secondary Standard value. The Automatic Stability Function will now show a ☒ and highlight any unstable readings…

```
   99*0ppM      58.5mV
  25.0°C  X
Ion 100ppM Cal.
Waiting to Stabilise
```

When the Specific Ion and Temperature readings have stabilised, the unit will calibrate itself.

To calibrate immediately without waiting for complete stability, press (F5) to disable the Automatic Stability Function.

The **smart*CHEM*-LAB** will then display the Slope of the Ion Selective Electrode before returning to the calibration menu.

A " * " in the display will be replaced by a decimal point after a successful 2-point Slope calibration.

13. The **smart*CHEM*-LAB** is now calibrated and is ready for Specific Ion measurements. Rinse the Ion Selective, Reference and Temperature sensors in distilled water and blot dry before placing them into unknown samples.

7.4 Specific Ion Calibration Notes

1. A Primary Calibration should be performed at least weekly. In applications where the reference electrode junction can become blocked, such as dairy products, mining slurries etc, a Primary Calibration may have to be done daily.
2. A full Primary and Secondary 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 **smart*CHEM*-LAB** is switched off, even when the power supply is removed. This information can be recalled or printed later using the GLP function (see section 14).

4. The **smart*CHEM*-LAB** 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. Alter the Standards set-up if necessary (see section 7.2).

7.5 Specific Ion Calibration Messages

1. If a Primary Calibration has been successfully performed, the **smart*CHEM*-LAB** will display the following message and the Offset value of the electrode. For example…

```
Calibration OK,
mV @ STD1=0.1mV
```

2. If a Secondary Calibration has been successfully performed, the **smart*CHEM*-LAB** will display the following message and the slope value of the electrode. For example…

```
Calibration OK.
Slope=99.0%
```

3. If a Secondary Calibration has failed, the **smart*CHEM*-LAB** will display the following message and the failed slope value of the electrode. For example…

```
Calibration Failed
Slope=30.%
```

Notes

1. The **smart*CHEM*-LAB** has an unlimited Offset range, as long as the reading is not over-ranged. This is to allow for the large variety of Ion Selective Electrodes available.
2. The allowable Slope range is 50.0 to 110.0 %. This range is ample to allow for correctly functioning Ion Selective Electrodes. If calibration fails due to the Slope being outside these limits, then please consult the Troubleshooting guide (section 22.4) for possible remedies.

8. pH Mode

8.1 Selecting pH Mode

1. Select pH Mode for the desired pH/mV/ORP/Specific Ion channel…

   (Menu) → **F3:Mode** → **F3:Chan-1** → **F1:pH**

   or

   (Menu) → **F3:Mode** → **F5:Chan-2** → **F1:pH**

2. The pH Resolution screen is now displayed…

```
Select pH Resolution
>F1:0.01   F2:0.001
```

   The arrow indicates the current selection.

   Press (F1) to select 0.01 pH resolution.

   Press (F2) to select 0.001 pH resolution.

   Press (Menu) to quit without changing the current selection.

8.2 Selecting the pH Buffer Set

The **smart*CHEM*-LAB** can be programmed to automatically recognise any of the following buffer sets during pH calibration. All pH values listed below are at 25 ^{O}C.

1. pH4.01, pH7.00, pH9.18
2. pH4.01, pH7.00, pH10.01
3. pH4.01, pH6.86, pH9.18
4. pH4.01, pH6.86, pH10.01.

To select the pH buffer set for automatic recognition…

1. Select the pH Buffer set-up menu.

   (Menu → **F4:Setup** → **F1:Standards** → **F5:pH Buffer**).

2. The primary buffer selection menu is now displayed…

   ```
    Select Primary
    Buffer
   >F1:7.00pH
    F3:6.86pH
   ```

   The arrow indicates the current selection.

   Press F1 to select pH7.00 as the Primary Buffer.

   Press F2 to select pH6.86 as the Primary Buffer.

   Press Menu to quit without changing the current setting.

3. The secondary buffers selection menu is now displayed…

   ```
    Select Secondary
    Buffers
   >F1:4.01/9.18pH
    F3:4.01/10.01pH
   ```

   The arrow indicates the current selection.

   Press F1 to select pH4.01 and pH9.18 as the Secondary Buffers.

   Press F2 to select pH4.01 and pH10.01 as the Secondary Buffers.

   Press Menu to quit without changing the current setting.

Notes

1. The selected buffer set is kept in memory when the meter is switched off.
2. pH9.18 and pH10.01 buffers are unstable once the bottles have been opened. Discard immediately after use.
3. If you wish to use a pH buffer other than one of those listed above, its value can be keyed in during calibration. Make sure that pH versus Temperature data for the buffer is known.

8.3 Calibration Buffer Sequence

Before proceeding to pH Calibration (section 8.4), please consider the sequence in which the buffers should be used. This will vary depending on whether a 1, 2 or 3 point pH calibration is required.

8.3.1 1 Point Calibration

A 1 point pH calibration can be performed in any buffer and will only adjust for the asymmetry of the pH sensor. See section 23.3.1 for a detailed explanation of asymmetry. A 1 point calibration will not remove the "*", which is shown in place of the decimal point when the channel is un-calibrated or has failed calibration.

8.3.2 2 Point Calibration

A 2 point calibration is performed automatically after a successful 1 point calibration, when the pH sensor is calibrated in a buffer that is at least 1.50pH higher or lower than the buffer that was used for the first point.

A 2 point calibration can be performed in any two pH buffers, and in any order, as long as they are at least 1.50pH apart.

8.3.3 3 Point Calibration

A 3 point calibration must be performed in the correct order.

For the pre-programmed buffers (see section 8.2), this order can be any one of the following…

First Point	Second Point	Third Point
pH7.00 or pH6.86	pH4.01	pH9.18 or pH10.01
pH4.01	pH7.00 or pH6.86	pH9.18 or pH10.01

When using buffers other than the pre-programmed buffers, please use the following guidelines to determine the correct order in which to perform a 3 point calibration…

1. ***Definitions***
   a) A neutral buffer must be between pH6.50 and pH7.50, inclusive.
   b) An acidic buffer must be 1.50pH or more lower than the neutral buffer that is being used.
   c) A basic buffer must be 8.50pH or higher.

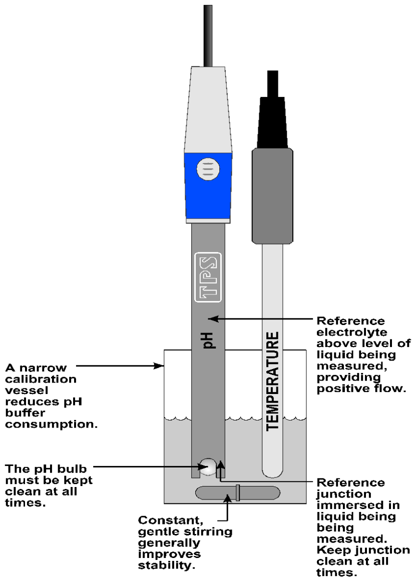
2. ***Buffer Order***
   a) Neutral → Acid → Base
   b) Acid → Neutral → Base

3. ***Notes***
   a) When using buffers other than the pre-programmed buffers, ensure that the pH versus Temperature characteristics are known. The buffer value corresponding to the calibration temperature must be keyed in correctly.
   b) pH sensors offer an extremely linear response over a wide range. A 2 point calibration would normally be sufficient for most measurements between pH2.00 and pH10.00.
   c) When a 3 point calibration has been successfully performed, an extra line appears in the GLP Recall (section 14.1) and the GLP print-out (section 14.3) labelled "**`SlopeB`**".

8.4 pH Calibration

1. Plug the pH sensor into the **pH/mV/Ion-1** or **pH/mV/Ion-2** BNC socket of the relevant channel and the temperature sensor into the **Temperature** socket. Switch the meter on.
2. Select pH Mode and the desired pH resolution for the relevant channel (see section 8.1).
3. Ensure that temperature has already been calibrated, or manually set (see sections 11.1 and 11.4).

   NOTE: For real temperature readings, the decimal point is shown by a "*", when the temperature readout is not calibrated.
4. Remove the wetting cap from the pH sensor. Rinse the pH and Temperature sensors in distilled water and blot them dry.
5. Ensure that the primary and secondary buffers to be used have been correctly selected for automatic buffer recognition. See section 8.2.
6. Place both sensors into a small sample of buffer so that the bulb and reference junction are both covered as per the diagram below. Choose the buffer to be used according to the details in section 8.3.



   DO NOT place the sensors directly into the buffer bottle.

7. Select pH Calibration for the relevant channel…

   Menu → **F1:Calibrate** → **F3:pH-1**

   or

   Menu → **F1:Calibrate** → **F4:pH-2**

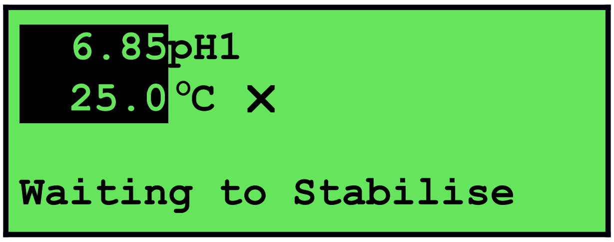
   The display should now look something like this…

```
  6*95pH1      7.00
  25.0°C      Buffer
Press Enter to Cal.
or Edit Buffer.
```

The current pH reading is shown on the left. Note the "*", indicating that pH is currently not calibrated.

The buffer that the **smart*CHEM*-LAB** has attempted to recognise is also displayed with the correct value at the current temperature.

8. Press (Enter) to calibrate to the displayed buffer. Otherwise, enter an alternative buffer using the Numeric Keypad, and then press (Enter). The Automatic Stability Function will now show a ☒ and highlight any unstable readings…



When the pH and Temperature readings have stabilised, the unit will calibrate itself.

To calibrate immediately without waiting for complete stability, press (F5) to disable the Automatic Stability Function.

9. The meter is now 1 point calibrated. Note that the "*" will not be removed until a 2 point calibration has been performed. Rinse the pH and Temperature sensors in distilled water and blot them dry.

10. Repeat steps 6 to 8 in a second buffer to perform a 2 point calibration. See section 8.3.2 for details on the correct sequence of buffers to ensure the instrument is correctly calibrated at the 2 points. If a "*" was shown in place of the decimal point, this will be removed after a successful 2 point calibration.

11. Repeat steps 6 to 8 in a third buffer to perform a 3 point calibration, if required. See section 8.3.3 for details on the correct sequence of buffers to ensure the instrument is correctly calibrated at the 3 points.

12. The **smart*CHEM*-LAB** is now calibrated for pH and is ready for use in this mode. Discard the used samples of buffer.

    Rinse the pH and Temperature sensors in distilled water and blot them dry before placing them into unknown samples.

8.5 pH Calibration Notes

1. **DO NOT** place the sensors directly into buffer bottles. Decant a small quantity and discard after use.

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

3. A 1 point calibration should be performed at least weekly. In applications where the sensor reference junction can become blocked such as dairy products, mining slurries etc, a 1 point calibration may have to be done daily.

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

5. All calibration information is retained in memory when the **smart*CHEM*-LAB** is switched off, even when the power supply is removed. This information can be recalled or printed later using the GLP function (see section 14).

6. When a 3 point calibration has been successfully performed, an extra line appears in the GLP Recall (section 14.1) and the GLP print-out (section 14.3) labelled "`SlopeB`".

7. To clear the Slope B from a 3 point calibration without losing all other calibration data, please refer to the section regarding Initialisation (section 20).

8.6 pH Calibration Messages

1. If a 1-point calibration has been successfully performed, the **smart*CHEM*-LAB** will display the following message and the asymmetry of the sensor.

```
Asymmetry
Calibration OK
+0.10pH Asym
```

2. If a 1-point calibration has failed, the **smart*CHEM*-LAB** will display the following message and the failed asymmetry value of the sensor.

```
Calibration Failed,
Repeat Cal. or
Initialise
1.1 pH Asymmetry
```

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

```
Slope & Asymmetry
Calibration OK
+0.10pH Asym
99.0% Slope
```

4. If a 2-point calibration has failed, the **smart*CHEM*-LAB** will display the following message and the failed slope value of the sensor.

```
Calibration Failed,
Repeat Cal. or
Initialise
80.0% Slope
```

5. If a 3-point calibration has been successfully performed, the **smart*CHEM*-LAB** will display the following message and the asymmetry and second slope of the sensor.

```
3 Point
Calibration OK
99.0% SlopeB
```

6. If a 3-point calibration has failed, the **smart*CHEM*-LAB** will display the following message and the failed slope value of the sensor.

```
Calibration Failed,
Repeat Cal. or
Initialise
80.0% SlopeB
```

7. If the **smart*CHEM*-LAB** has been 3-point calibrated and the incorrect buffer sequence is subsequently used, the following message will be displayed…

```
Cal. sequence wrong.
Cannot 3 Point Cal.
Change to 2 point ?
F1:Yes    F2:No
```

   Press (F1) to proceed with a 2 point calibration. The second slope currently in memory from the previous 3 point calibration will be deleted.

   Press (F2) to cancel, without re-calibrating. See

   See section 8.3.3 for details on the correct 3 point calibration buffer sequence.

8. The **smart*CHEM*-LAB** has an allowable Asymmetry range of –1.00 to +1.00 pH. The allowable Slope range is 85.0 to 105.0 %. If calibration fails due to either the Asymmetry or the Slope being outside these limits, then please consult the Troubleshooting guide (section 22.4) for possible remedies.

9. Absolute mV/ORP Mode

9.1 Selecting Absolute mV/ORP Mode

Select mV/ORP mode for the relevant channel…

(Menu) → **F3:Mode** → **F3:Chan-1** → **F2:mV/ORP**

or

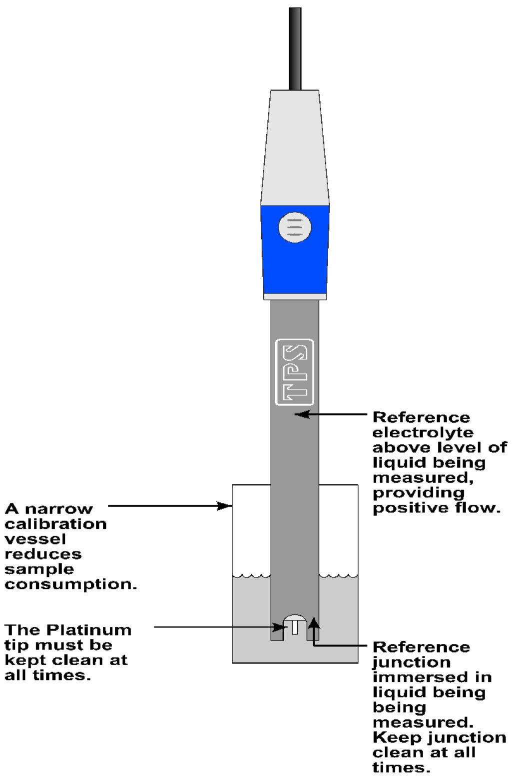
(Menu) → **F3:Mode** → **F5:Chan-2** → **F2:mV/ORP**

The **smart*CHEM*-LAB** will display the actual millivolts produced by the sensor in this mode.

9.2 Absolute mV/ORP Calibration

This calibration procedure uses a Redox/ORP sensor and ZoBell calibration as examples. For other types of sensors (eg. ISE's) and solutions, please substitute them when carrying out this procedure.

1. Plug the Redox sensor into the **pH/mV/Ion-1** or **pH/mV/Ion-2** BNC socket of the relevant channel. Temperature compensation is not applicable for mV/ORP mode, so it is not necessary to connect a Temperature sensor. Switch the meter on.
2. Select mV/ORP mode for the relevant channel (see section 9.1).
3. Remove the wetting cap from the sensor, if fitted. Rinse the sensor in distilled water and blot dry.
4. Place the sensor into a small sample of known millivolt solution so that the platinum tip and reference junction are both covered as per the diagram below. ZoBell Redox standard can be made with a 1:1 mixture of Part A and Part B. This solution produces +229mV of Redox potential at 25 ^{O}C. **Caution: ZoBell solution is poisonous and should be handled with care.**



5. Select mV Calibration for the relevant channel…

   (Menu) → **F1:Calibrate** → **F3:mV/ORP-1**

   or

   (Menu) → **F1:Calibrate** → **F4:mV/ORP-2**

   The display should now look something like this…

```
 220.0mV1
Enter Value: 220.0
```

   The current mV/ORP reading is shown on the top line.

   The **smart*CHEM*-LAB** displays the same value on the second line, on the assumption that the reading will be close to the expected calibration point.

6. Enter the value of the calibration solution using the Numeric Keypad, and then press (Enter). The Automatic Stability Function will now show a ⊠ and highlight any unstable readings…

```
 220.0mV1
Enter Value: 231.0
         X
Waiting to Stabilise
```

   When the mV/ORP reading has stabilised, the unit will calibrate itself.

   To calibrate immediately without waiting for complete stability, press (F5) to disable the Automatic Stability Function.

7. The **smart*CHEM*-LAB** is now calibrated for mV/ORP and is ready for use in this mode. Discard the used samples of standard.

   Rinse the Redox sensor in distilled water and blot dry before placing into unknown samples.

9.3 mV/ORP Calibration Notes

1. **DO NOT** place the sensor directly into stock bottles of standard. Decant a small quantity and discard after use.
2. **Redox standards are highly unstable. Discard immediately after use**.
3. A mV/ORP calibration should be performed at least weekly. In applications where the sensor reference junction can become blocked such as dairy products, mining slurries etc, calibration may have to be done daily.
4. All calibration information is retained in memory when the **smart*CHEM*-LAB** is switched off, even when the power supply is removed. This information can be recalled or printed later using the GLP function (see section 14).

9.4 mV/ORP Calibration Messages

1. If a mV/ORP calibration has been successfully performed, the **smart*CHEM*-LAB** will display the following message and the offset of the sensor.

```
Calibration OK
Offset=-10.0mV
```

2. If a mV/ORP calibration has failed, the **smart*CHEM*-LAB** will display the following message and the failed offset value of the sensor.

```
Calibration Failed,
Offset=-100.0mV
```

3. The **smart*CHEM*-LAB** has an allowable Offset range of –60 to +60 mV. If calibration fails due to the Offset being outside these limits, then please consult the Troubleshooting guide (section 22.4) for possible remedies.

10. Relative mV/ORP Mode

10.1 Selecting Relative mV/ORP Mode

Select Relative mV/ORP mode when measurements relative to a known standard are required.

To select Relative mV/ORP mode for the relevant channel…

(Menu) → **`F3:Mode`** → **`F3:Chan-1`** → **`F4:Rel mV`**

or

(Menu) → **`F3:Mode`** → **`F5:Chan-2`** → **`F4:Rel mV`**

The **smart*CHEM*-LAB** will display the mV/ORP data relative to a known, user-selectable zero point.

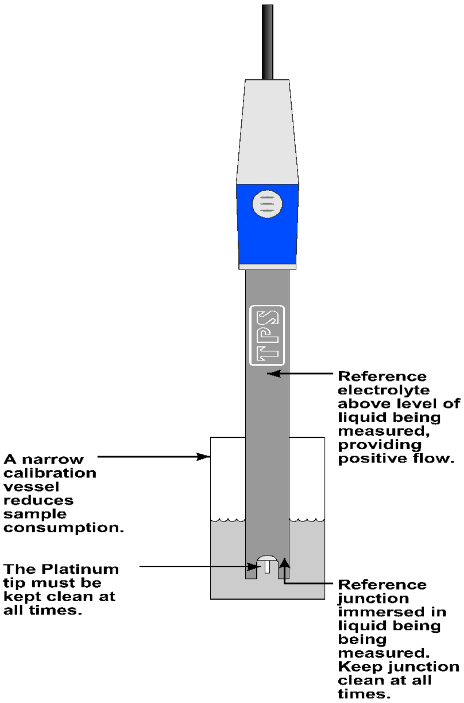
10.2 Relative mV/ORP Calibration

Calibration of the Relative mV/ORP mode is simply a matter of zeroing the reading when the sensor is in the known standard.

1. Plug the Redox sensor into the **pH/mV/Ion-1** or **pH/mV/Ion-2** BNC socket for the relevant channel. Temperature compensation is not applied in Relative mV/ORP mode, so the temperature sensor does not need to be connected. Switch the meter on.
2. Select Relative mV/ORP Mode for the relevant channel, as per section 10.1
3. The display now shows the mV/ORP data with the units "**`mVR`**" The "**`R`**" indicates Relative mV. The example below shows both pH/mV/Ion channels set for Relative mV/ORP…

```
10.00ppM    2760.uS
400.0mVR    400.0mVR
 25.0°C     31/12/11
            12:00:00
```

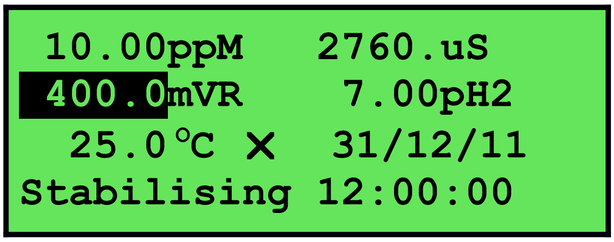
4. Remove the wetting cap from the Redox sensor.
5. Rinse the sensor in distilled water and blot dry.
6. Place the Redox sensor(s) into a sample of the known standard. Ensure that the platinum tip and reference junction are both covered as per the diagram below.



Reference electrolyte above level of liquid being measured, providing positive flow.
A narrow calibration vessel reduces sample consumption.
The Platinum tip must be kept clean at all times.
Reference junction immersed in liquid being being measured. Keep junction clean at all times.

7. ***Relative mV/ORP Calibration when 1 channel is in Relative mV/ORP mode***

Press (F6) to zero the Relative mV/ORP reading. The Automatic Stability Function will now show a ⊠ and highlight the Relative mV/ORP reading while it is unstable. For example…

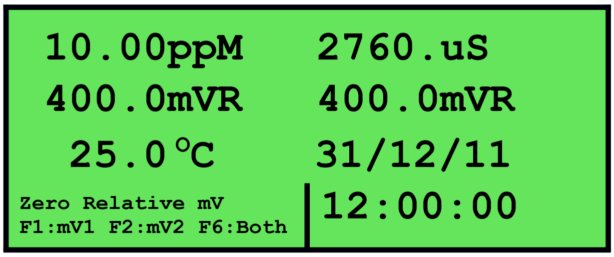


The Relative mV/ORP reading will automatically be zeroed once the reading becomes stable.

To calibrate immediately without waiting for complete stability, press (F5) to disable the Automatic Stability Function.

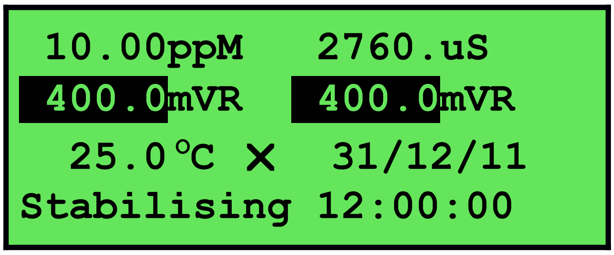
Relative mV/ORP Calibration when 2 channels are in Relative mV/ORP mode

Press (F6) to zero the Relative mV/ORP reading. The **smart*CHEM*-LAB** will offer a choice of Zeroing one Channel, or both Channels. For example…



Press (F1), (F2) or (F6) according to your requirements.

The Automatic Stability Function will now show a ⊠ and highlight whichever Relative mV/ORP readings are being calibrated while they are unstable. For example…



The Relative mV/ORP reading(s) will automatically be zeroed once the reading(s) become stable.

To calibrate immediately without waiting for complete stability, press (F5) to disable the Automatic Stability Function.

8. The **smart*CHEM*-LAB** Relative mV/ORP mode is now zeroed and is ready for use. The readout can be re-zeroed by pressing (F6) whenever required.

10.3 Relative mV/ORP Calibration Notes

1. Temperature compensation does not apply in Relative mV/ORP mode,
2. The Relative mV/ORP offset is retained in memory when the **smart*CHEM*-LAB** is switched off.
3. The Relative mV/ORP zero offset is reset when entering or leaving Relative mV/ORP mode.

11. Temperature Mode

The temperature readout must be calibrated or manually set before attempting Specific Ion, pH or ppM Dissolved Oxygen calibration.

The decimal point is replaced by a "*" if the reading is not calibrated.

The **smart*CHEM*-LAB** is able to take Temperature readings from the Temperature sensor, ED1 Dissolved Oxygen sensor or YSI Dissolved Oxygen sensor. If both the Temperature sensor and a Dissolved Oxygen sensor are connected at the same time, the Temperature reading is taken from the Temperature sensor.

If the **smart*CHEM*-LAB**'s Temperature readout was calibrated on an ED1 sensor and then a YSI sensor is connected, the unit displays "**Sensor**" instead of the Temperature data. The same occurs when an ED1 sensor is connected after the unit was calibrated on a YSI sensor. This warning is only displayed when the separate Temperature sensor is not connected. The Temperature readout must be re-calibrated if Temperature measurements from the new Dissolved Oxygen are required.

11.1 Temperature Calibration

1. To calibrate the separate Temperature sensor, plug the temperature sensor into the **Temperature** socket.

   To calibrate the Temperature readout from a Dissolved Oxygen sensor, plug the Dissolved Oxygen sensor into the **Oxygen** socket and ensure that the separate Temperature is not connected.
2. Switch the meter on.
3. Place the Temperature or Dissolved Oxygen 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:Calibrate** → **F5:Temp.**).

   The Temperature Calibration screen is now displayed. The bottom line provides confirmation of which sensor is being calibrated. The following example shows the Temperature sensor being calibrated.

   ```
   Enter Actual
   Temperature:_
    24*0°C
   Using Temp. Sensor.
   ```

   The current reading from the Temperature or Dissolved Oxygen sensor is displayed.
5. Type in the temperature as measured by the mercury thermometer using the Numeric Keypad and press (Enter). The Automatic Stability Function will now show a ☒ and highlight the Temperature reading while it is unstable…

   ```
   Enter Actual
   Temperature: 25.0
     24*0°C ✕
   Waiting to Stabilise
   ```

   When the Temperature reading has stabilised, the unit will calibrate itself.

To calibrate immediately without waiting for complete stability, press (F5) to disable the Automatic Stability Function.

6. The **smart*CHEM*-LAB** is now calibrated for Temperature and is ready for use in this mode.

11.2 Temperature Calibration Notes

1. Temperature calibration information is retained in memory when the **smart*CHEM*-LAB** is switched off, even when the power supply is removed. This information can be recalled later using the GLP function (see section 14).
2. Temperature does not need to be re-calibrated unless the Temperature or Dissolved Oxygen sensor is replaced or the meter is initialised.
3. The **smart*CHEM*-LAB** keeps the Temperature calibration data for the Temperature sensor and one type of Dissolved Oxygen sensor separately so these can be swapped as required.

11.3 Calibration Messages

1. If a temperature calibration has been successfully performed, the **smart*CHEM*-LAB** will display the following message and the offset of the sensor.

```
Calibration OK
Offset=0.1°C
```

2. If a temperature calibration has failed, the **smart*CHEM*-LAB** will display the following message and the failed offset value of the sensor.

```
Calibration Failed
Offset=11.0°C
```

3. The **smart*CHEM*-LAB** has an allowable Offset range of -10.0 to +10.0 °C. If calibration fails due to the Offset being outside these limits, then please consult the Troubleshooting guide (section 22.5) for possible remedies.

11.4 Manual Temperature Setting

If neither the Temperature or Dissolved Oxygen sensors are connected, the temperature of the sample solution must be set manually for accurate Specific Ion or pH measurements. A separate thermometer will be required for this.

1. Switch the meter on.
2. Measure the temperature of the sample.
3. Select Temperature Calibration (Menu → **F1:Calibrate** → **F5:Temp.**).
4. The current temperature setting is now displayed. For example…

```
Enter Manual
Temperature:25.0 °C

          Menu Quits
```

5. Enter the temperature of the sample using the Numeric Keypad.

   Press Enter to save the new value.

   Alternatively, press Menu to quit and retain the current setting.
6. When returning the **smart*CHEM*-LAB** to normal measurement mode, note the "**C**" in the temperature readout alternating with an "**M**" indicating that Manual Temperature Compensation is in use. For example…

```
 10.00ppM    2760.uS
  7.00pH1     7.00pH2
  25.0°M     31/12/11
             12:00:00
```

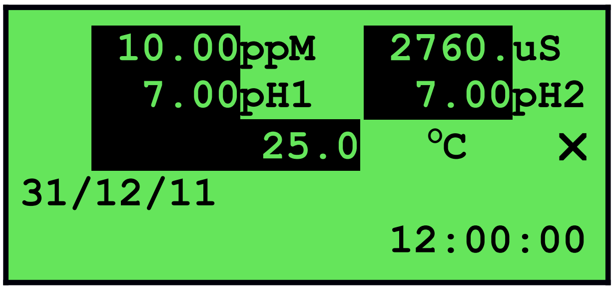
12. Auto Stability Function (ASF)

ASF adds an extra level of versatility to the **smart*CHEM*-LAB**. When ASF is activated, the **smart*CHEM*-LAB** monitors all parameters that are currently in use. When **ALL** parameters become stable, the readings are frozen on the display.

ASF can be used in the following ways…

12.1 ASF During Normal Measurement

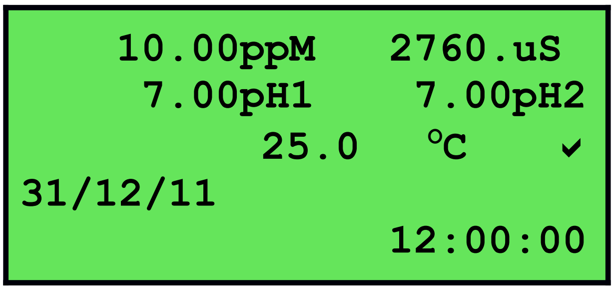
1. Press (F5) in normal measurement mode. All active parameters are highlighted and the ⊠ symbol appears in the display. For example…



As each parameter becomes stable, the highlighting is removed. If any parameter subsequently becomes unstable, the highlighting is applied again.

The highlighting is provided to give the operator a visual indication of exactly which parameters have not stabilised in case user intervention is required.

2. When ALL parameters have stabilised, all highlighting will be removed and the ⊠ will change to a ☑. All readings are now frozen. For example…



3. The operator can now make a note of the reading as required.

4. Press (F5) again to re-start the ASF sampling process.

5. Press (F5) a second time, while the ⊠ symbol is being displayed, to turn ASF off.

12.2 ASF During Calibration

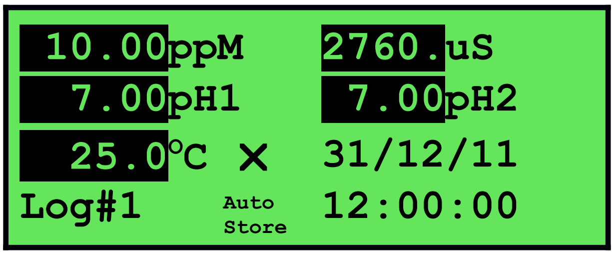
The Automatic Stability Function is automatically invoked during calibration. The stability parameters programmed into the **smart*CHEM*-LAB** have a finer tolerance during calibration than during normal measurement. This is done to ensure the most accurate possible calibration results.

Press (F5) while the ⊠ symbol is being displayed during calibration to turn ASF off and calibrate immediately, before the reading has stabilised.

See the calibration sections of this manual for further details on the ASF function during calibration.

12.3 ASF with Manual Data logging

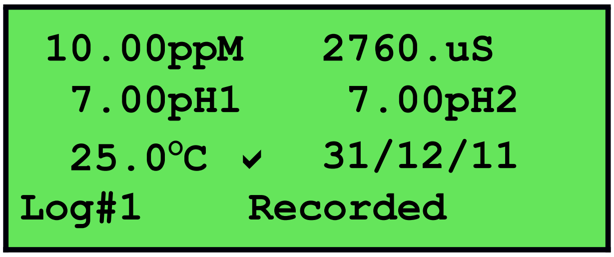
1. Press F5 then Store in normal measurement mode. All active parameters are highlighted and the ☒ symbol appears in the display, along with the message "Auto Store". For example…



As each parameter becomes stable, the highlighting is removed. If any parameter subsequently becomes unstable, the highlighting is applied again.

The highlighting is provided to give the operator a visual indication of exactly which parameters have not stabilised in case user intervention is required.

2. When ALL parameters have stabilised, all highlighting will be removed and the ☒ will change to a ☑. All readings are now frozen and will be recorded into memory. For example…



3. Press F5 and Store again to re-start the ASF Auto-Store process.
4. Press F5 a second time, while the ☒ symbol is being displayed, to turn ASF off.

12.4 ASF with Automatic Data logging

Using ASF with Automatic Data logging allows continuous logging until all readings are stable. This is useful in titrations etc, where logging is no longer required once an end point is reached.

See section 16.2 for details on programming the Automatic Data logging function.

1. Press (F5) then (AutoLog) in normal measurement mode. All active parameters are highlighted and the ☒ symbol appears in the display, along with the message "Auto Log". For example…

```
10.00ppM      2760.uS
 7.00pH1       7.00pH2
 25.0°C  ✕    31/12/11
Log#1   Auto  12:00:00
        Log
```

   As each parameter becomes stable, the highlighting is removed. If any parameter subsequently becomes unstable, the highlighting is applied again.

   The highlighting is provided to give the operator a visual indication of exactly which parameters are not yet stable in case user intervention is required.

2. When ALL parameters have become stable, all highlighting will be removed and the ☒ will change to a ☑. All readings are now frozen and automatic data logging has stopped. For example…

```
10.00ppM      2760.uS
 7.00pH1       7.00pH2
 25.0°C  ✔    31/12/11
              12:00:00
```

3. **To unfreeze the display in order to take the next reading, press (F5) and (AutoLog) again to re-start the ASF automatic data logging process.**

4. Press (F5) a second time, while the ☒ symbol is being displayed, to turn ASF off.

13. Display Backlight

The **smart*CHEM*-LAB** is fitted with an Electro-Luminescence ("EL") backlight. This can be set up according to your preferences as follows…

1. Switch the meter on.

2. Select the Backlight menu ((Menu) → `F4:Setup` → `F3:Backlight`).

3. The Backlight menu is now displayed…

```
BACKLIGHT
 F1:On              F2:Off
>F3:Energy Saver
```

   The arrow indicates the current selection.

   Press (F1) to set the Backlight to be on continuously.

   Press (F2) to set the Backlight to be off continuously.

Press (F3) to set the Backlight to turn on automatically whenever a key is pressed. It will turn off automatically if no key has been pressed for 5 minutes.

14. Good Laboratory Practices (GLP)

The **smart*CHEM*-LAB** keeps a record of the date and time of the last calibrations for all parameters as part of GLP guidelines.

14.1 To recall GLP information on the display

1. Switch the meter on.
2. Select the GLP menu (Menu → **F5: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…

```
smartCHEM-Lab V2.0 S1234   31/12/11 15:00

Oxygen Zero=0.1%           31/12/11 12:00
Oxygen Span=100.0%         31/12/11 12:10
Oxygen Calibrated


                                  F4:Next
```

5. Press F4 to sequentially scroll through the GLP information for all parameters. Press F2 to scroll back to previous data. The sequence of information displayed is shown below. Press Menu to abort at any time.

GLP Display sequence…

```
smartCHEM-Lab V2.0 S1234   31/12/11 15:00

Oxygen Zero=0.1%           31/12/11 12:00
Oxygen Span=100.0%         31/12/11 12:10
Oxygen Calibrated


                                  F4:Next
```

↑ F2 ↓ F4

```
Cond Zero=0.01uS           31/12/11 12:20
Cond k=1.01                31/12/11 12:30
Cond/TDS/Salinity Calibrated


                          F2:Back F4:Next
```

↑ F2 ↓ F4

```
Ion1 Offset=0.0mV          31/12/11 13:00
Ion1 Slope=100.0%          31/12/11 13:10
Ion1 Calibrated
 mV1 Offset=10mV           31/12/11 13:20
 pH1 Asymmetry=0.10pH      31/12/11 13:30
 pH1 Slope= 99.0%          31/12/11 13:40

 pH1 Calibrated           F2:Back F4:Next
```

↑ F2 ↓ F4

```
Ion2 Offset=0.0mV          31/12/11 13:50
Ion2 Slope=100.0%          31/12/11 14:00
Ion2 Calibrated
 mV1 Offset=10mV           31/12/11 14:10
 pH2 Asymmetry=0.10pH      31/12/11 14:20
 pH2 Slope= 99.0%          31/12/11 14:30

 pH2 Calibrated           F2:Back F4:Next
```

↑ F2 ↓ F4

GLP Display sequence, continued…

```
Temp Sensor Offset=1.0°c   31/12/11 14:40
Temp Sensor Calibrated

ED1 Temp Offset=1.0°c     31/12/11 14:50
Oxygen Temp Calibrated


                          F2:Back F4:Ends
```

14.2 Failed Calibration

If calibration has failed, the GLP function will reset the date and time for the failed parameter to zero. The **smart*CHEM*-LAB** still shows the results for the last successful calibration, as shown in the following example where the last pH calibration has failed…

```
Ion1 Offset=0.0mV          31/12/11 13:10
Ion1 Slope=100.0%          31/12/11 13:20
Ion1 Calibrated

 pH1 Asymmetry=0.10pH      00/00/00 00:00
 pH1 Slope= 99.0%          00/00/00 00:00

 pH1 Un-Calibrated        F2:Back F4:Next
```

14.3 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. Connect one end of the RS232 cable to the **Power/RS232** socket of the **smart*CHEM*-LAB**.
3. Connect the other end of the RS232 cable to an RS232 Printer, or to a Serial port on a PC.
4. Send the GLP information to the RS232 port:

   (Menu) → **F5:GLP** → **F3:Print**

   The message "**Printing GLP Data**" is displayed while sending the data to the RS232 port.

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

```
smartCHEM-Lab V2.0 S1234 @ 31/12/2011 15:00
Oxygen       Zero=      0.1%     @ 31/12/2011 12:00
Oxygen       Span=    100.0%     @ 31/12/2011 12:10
Conductivity Zero=     0.01uS    @ 31/12/2011 12:20
Conductivity k=        1.01      @ 31/12/2011 12:30
Ion 1        Offset=    0.0mV    @ 31/12/2011 13:00
Ion 1        Slope=   100.0%     @ 31/12/2011 13:10
mV   1       Offset=   10.0mV    @ 31/12/2011 13:20
pH   1       Asy=      0.10pH    @ 31/12/2011 13:30
pH   1       Slope=    99.0%     @ 31/12/2011 13:40
Ion 2        Offset=    0.0mV    @ 31/12/2011 13:50
Ion 2        Slope=   100.0%     @ 31/12/2011 14:00
mV   1       Offset=   10.0mV    @ 31/12/2011 14:10
pH   2       Asy=      0.10pH    @ 31/12/2011 14:20
pH   2       Slope=    99.9%     @ 31/12/2011 14:30
Temp. Sensor Offset=    1.0oC    @ 31/12/2011 14:40
Temp. ED1    Offset=    1.0oC    @ 31/12/2011 14:50
Ends
```

14.4 GLP Calibration Alarm

A new feature of the **smart*CHEM*-LAB** is the GLP calibration alarm. The operator can select how often they wish to be reminded that the instrument requires calibration, and for which parameters they wish to be reminded.

14.4.1 To set the GLP Calibration Alarm…

1. Select the GLP Calibration Alarm menu (Menu → **F5:GLP** → **F2:Alarm**).

2. The calibration alarm period can now be selected…

```
GLP ALARM
 F1:Daily    F2:1 Week
 F3:2 Weeks  F4:4 Weeks
>F5:OFF
```

   The arrow indicates the current selection.

   Press F1 to be reminded that calibration is due every day.

   Press F2 to be reminded that calibration is due every week.

   Press F3 to be reminded that calibration is due every 2 weeks.

   Press F4 to be reminded that calibration is due every 4 weeks.

   Press F5 to switch the GLP Calibration Alarm system off.

   Press Menu to quit and retain the current setting.

3. If F1, F2, F3 or F4 was pressed above, the **smart*CHEM*-Lab** will now allow the operator to select which parameters will be flagged with a calibration alarm…

```
Select Channels
 F1:Oxygen   F2:Cond.
 F3:pH/Ion1  F4:pH/Ion2
 F5:Temperature
```

   Press the relevant F1 to F5 function key to select which parameter or parameters you would like to be flagged with a calibration alarm whenever calibration is due. Note the "*" which appears next to the relevant parameter(s).

   Pressing the function key repeatedly adds and removes the "*".

4. Press Menu to exit and save the selection.

14.4.2 How the GLP Alarm Operates

On the day that calibration is due, the following message will be displayed the first time the **smart*CHEM*-LAB** is switched on…

```
GLP Alarm, Calibrate
Oxygen, Cond.,
Chan-1, Chan-2,
Temperature
```

Only those parameters that were selected (see section 14.4.1) will be displayed.

This message will not be displayed again until the next time calibration is due.

In addition to the message shown above, the **smart*CHEM*-LAB** also flashes the decimal point of each parameter that requires calibration, and flashes the message "**Cal Now**" on the display.

14.4.3 Notes on the GLP Calibration Alarm function

1. To remove the "**Cal Now**" message and flashing decimal points, each selected parameter must be correctly calibrated.
2. Switching the GLP Calibration Alarm function off will not clear "**Cal Now**" message and flashing decimal points. The relevant parameters must be calibrated.
3. When Weekly, 2 Weekly or 4 Weekly periods have been selected, the GLP Calibration Alarm will always be activated on the same day of the week as when the function was first activated, even if the unit is not calibrated on that day. For example, if the GLP Calibration Alarm is triggered weekly on a Monday and the meter is finally calibrated the following Wednesday, the next GLP Calibration Alarm will still be on the following Monday.

14.5 Instrument Serial Number

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

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

```
smartCHEM-Lab V2.0mr
S1234 © 2001 TPS P/L
Oxygen, Conductivity
/TDS, Dual pH/mV/Ion
```

   The "**m**" after **V2.0** is shown when the Dissolved Oxygen Stirrer output is enabled (section 3.2).

   The "**r**" after **V2.0** is shown when the Recorder Port option is fitted.

2. The serial number is displayed when recalling the GLP information (section 14.1).
3. The serial number is included on the print-out of GLP information (section 14.3).
4. The GLP information can be downloaded to a PC using the optional Windows® software (part number 130086).

14.6 Additional GLP Features

Another GLP requirement is to record the date and time of every reading. The **smart*CHEM*-LAB** does this for you whenever readings are recorded either with the Manual Data logging function (section 16.1) or the Automatic Logging function (section 16.2).

15. Access Code

The Access Code is system is provided for those users who need to ensure the integrity of recorded data, calibration settings and so forth. The Access Code function will prevent anyone who does not know the code from entering the menu system. Keys that are available during normal measurement, (Store , Print , AutoLog and F1 to F5) are still available without the Access Code. This means that others are still able to carry out day-to-day work.

15.1 Enabling the Access Code System

1. Select the Access Code menu (Menu → **`F6:Access`**).
2. Select **`F3:Enable & Enter Code`** from the menu.
3. The **smart*CHEM*-LAB** now prompts you to enter a new access code…

```
New Access code:_
```

   Enter a new code of up to 4 digits using the numeric keypad.

   If less than 4 digits are entered, press Enter to save the new code.

   If 4 digits are entered, it is not necessary to press Enter .

   Press Menu to quit without enabling the Access Code system.

4. The **smart*CHEM*-LAB** now prompts you to re-enter the access code for verification…

```
New Access code:_
Re-Enter to Verify
```

   Re-enter the access code as per the previous step.

   Press Menu to quit without enabling the Access Code system.

5. The **smart*CHEM*-LAB** now confirms that the Access Code system is enabled before returning to the Access Code menu.

15.2 Using the Access Code System

When the Access Code system is enabled (as per section 15.1), the **smart*CHEM*-LAB** prompts the operator to enter the access code whenever Menu is pressed in normal display mode. No further access code entry is required to access any of the menu functions. It is therefore imperative never to remain in any of the menus when leaving the unit. Always press Menu until the **smart*CHEM*-LAB** is in normal display mode before leaving the unit.

For access codes with less than 4 digits, you must press Enter after entering the code.

For access codes with 4 digits it is not necessary to press Enter .

Notes

1. Do not store your Access Code on or near the unit.

2. If you forget the Access Code, please contact TPS. Once we have established your ownership of the unit, we will be able to give you an access code. We will need the serial number of the unit to provide this code.

15.3 Changing the Access Code

1. Select the Access Code menu (Menu → **`F6:Access`**).

   (Of course, you will need to enter the current access code after pressing Menu .)

2. Select **`F1:Change Code`** from the menu.

3. The **smart*CHEM*-LAB** now prompts you to enter a new access code…

   ```
   New Access code:_
   ```

   Enter a new code of up to 4 digits using the numeric keypad.

   If less than 4 digits are entered, press Enter to save the new code.

   If 4 digits are entered, it is not necessary to press Enter .

   Press Menu to quit without changing the Access Code.

4. The **smart*CHEM*-LAB** now prompts you to re-enter the access code for verification…

   ```
   New Access code:_
   Re-Enter to Verify
   ```

   Re-enter the access code as per the previous step.

   Press Menu to quit without changing the Access Code.

5. The **smart*CHEM*-LAB** now confirms that the Access Code system is enabled before returning to the Access Code menu.

15.4 Disabling the Access Code System

1. Select the Access Code menu (Menu → **`F6:Access`**).

   (Of course, you will need to enter the current access code after pressing Menu .)

2. Select **`F3:Disable Security`** from the menu.

3. The **smart*CHEM*-LAB** now confirms that Access Code system has been disabled before returning to the Access Code menu.

16. Data logging

16.1 Manual Data logging

To manually record readings into the Logger memory…

1. Press (Store) in normal display mode to record all parameters plus Date and Time into the Logger. This will be labelled as reading number 1. For example…

```
 10.00ppM    2760.uS
  7.00pH1     7.00pH2
  25.0°C     31/12/11
Log#1     Recorded
```

2. Repeat as often as required. The maximum number of readings that can be stored in the Logger is 1489.

Hint : Press (F5) before (Store) to make the **smart*CHEM*-LAB** store the reading only when all the readings have stabilised. See section 12 for more details on the Auto Stability Function.

16.2 Automatic Data logging

The **smart*CHEM*-LAB** can automatically record records into the Logger. First the logging period must be programmed, then automatic logging can be started and stopped as required.

1. Select the Logger menu ((Menu) → **`F2:Logger`**)

2. Select **`F4:Program`** from the menu.

   The display should now look similar to that shown below. The current Logging/Printing Period is displayed.

```
Enter Logging/Print
Period: 0   secs
```

3. Use the Numeric Keypad to set the period at which the **smart*CHEM*-LAB** will automatically log records into memory or to the RS232 port.

   Press (Enter) to save the Logging/Printing Period.

   Press (Menu) to quit without changing the current setting.

4. After pressing (Enter), the **smart*CHEM*-LAB** will ask you to enter the units. The Logging/ Printing Period you have set is also displayed. For example…

```
      Logging/Print
Period: 2
Select Units F1:Secs
F2:Mins, F3:Hours
```

   Press (F1) to save the Logging/Printing Period as seconds.

   Press (F2) to save the Logging/Printing Period as minutes.

Press (F3) to save the Logging/Printing Period as hours.

5. The **smart*CHEM*-LAB** will ask if the records are to be logged into the instrument's memory, or sent directly to the RS232 port. The display will look like this…

```
F1:Log to Memory
F2:Send to RS232
```

Press (F1) to log records into the Logger (maximum of 1489 readings).

Press (F2) to send records directly to the RS232 port.

6. If the Dissolved Oxygen stirrer output is enabled (section 3.2.1), the **smart*CHEM*-LAB** will stir continuously if the logging period is ≤ 50 seconds, or ask if the stirrer is to be ON continuously while logging if the logging period is > 50 seconds.

```
Stir Continuously ?
F1:Yes   F2:No
```

Press (F1) to activate the Dissolved Oxygen stirrer continuously during automatic data logging.

Press (F2) to ***not*** activate the Dissolved Oxygen stirrer during automatic data logging. The stirrer output can still be activated manually during automatic data logging.

7. The automatic logging function is now programmed, and can be started and stopped as required.

8. To start automatic logging, press (AutoLog) in normal display mode.
When the **smart*CHEM*-LAB** is logging into its own memory, the display will look like this…

```
 10.00ppM    2760.uS
   7.00pH1     7.00pH2
   25.0°C    31/12/11
Log#1        12:00:00
```

The log number will increment and the **smart*CHEM*-LAB** will beep each time a reading is recorded.

If the **smart*CHEM*-LAB** is sending records directly to the RS232 port, the display will look like this…

```
10.00ppM     2760.uS
   7.00pH1     7.00pH2
   25.0°C    31/12/11
Sending      12:00:00
```

The **smart*CHEM*-LAB** will beep each time a record is sent to the RS232 port.

9. Press (AutoLog) to stop automatic logging.

Hint : Press Ⓕ5 before starting automatic logging to make the **smart*CHEM*-LAB** stop logging as soon as all the readings have become stable. See section 12 for more details on the Auto Stability Function.

Notes on Automatic Data logging

1. The clock must be set before the **smart*CHEM*-LAB** will allow automatic data logging to start. The message "**`Clock Not Set`**" is displayed if the clock is not set. See section 19 for details on setting the clock.
2. Pressing (Menu) during automatic data logging halts logging. Press (AutoLog) after returning to normal display mode to re-start automatic data logging.

16.3 Recalling Readings from the Logger

To recall records from the Logger onto the **smart*CHEM*-LAB** display…

1. Select the Logger menu ((Menu) → **`F2:Logger`**)
2. Select **`F1:Recall`** from the menu.

   Record number 1 is now displayed.

   For example…

```
 10.00ppM    2760.uS
  7.00pH1     7.00pH2
  25.0°C     31/12/11
Log#1     F2:↑   12:00:00
          F4:↓
```

3. Press (F2) and (F4) to move forwards and backwards through the records.

   Press and hold (F2) or (F4) to scroll continuously through the readings. The rate is slow enough to allow the operator to see trends in the data as it is scrolling.

   To display a specific record, type in the desired record number using the Numeric Keypad and press (Enter) .

   Press (F3) to send the displayed record to the RS232 port.

16.4 Erasing Records from the Logger

To erase records from the Logger…

1. Select the Erase Logger menu ((Menu) → **`F2:Logger`** → **`F2:Erase`**)
2. The **smart*CHEM*-LAB** now displays the Erase menu, for example…

```
Erase Logger,
1489 Readings
Select Option
Erase F1:All F2:Last
```

   The number of readings stored in the Logger is displayed. See the "**`1489`**" in the example above.

3. Press (F1) to erase all of the readings stored in the Logger.

   Press (F2) to erase the last recorded reading only.

   Press (Menu) to quit without erasing any records.

16.5 Printing Records from the Logger to the RS232 Port

1. Connect one end of the RS232 cable to the **Power/RS232** socket of the **smart*CHEM*-LAB**.
1. Connect the other end of the RS232 cable to an RS232 Printer, or to a Serial port of a PC.
2. Ensure that the baud rate for the printer or PC and the **smart*CHEM*-LAB** are the same. If necessary, alter the baud rate of the **smart*CHEM*-LAB** (see section 17.1).

   The **smart*CHEM*-LAB** uses XON/XOFF protocol. Ensure that the printer is set accordingly.

3. Select the Logger menu. (Menu → **F2:Logger**).
4. Select **F3:Print** from the menu.
5. Printing starts as soon as F3 is pressed. The display shows the word "**Printing**" until printing is completed.

17. RS232 Port

17.1 Setting the Baud Rate

1. Select the Ports Set-up menu (Menu → **F4:Setup** → **F4:Ports**)
2. Select **F1:Baud Rate** from the menu. The available baud rates are listed, along with the RS232 port configuration…

```
 Baud Rate
 F1:1200  F2:9600
>F3:19200 F4:38400

8 bits, No Parity, 1 Stop bit, XON/XOFF
```

   The arrow indicates the current selection.

3. Press F1 to select 1200 baud.
   Press F2 to select 9600 baud.
   Press F3 to select 19200 baud.
   Press F4 to select 38400 baud.
   Press Menu to quit and retain the current setting.

17.2 Sending Readings to the RS232 Port

Press Print to instantly send readings to the RS232 port whenever the **smart*CHEM*-LAB** is in normal display mode.

Records can be sent directly to the RS232 port rather than stored in memory during automatic data logging. See section 16.2 for details.

Press Print while recalling data on the display (see section 16.3) to send that record to the RS232 port.

17.3 RS232 Configuration

The **smart*CHEM*-LAB** RS232 configuration is 8 Bits, No Parity, 1 Stop Bit, XON/XOFF Protocol.

This information is displayed when setting the baud rate (see section 17.1)

17.4 Communication and Statistical Software

Communication between the **smart*CHEM*-LAB** and a PC can be handled with any RS232 communication software. A TPS communication software package for Windows® 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 **smart*CHEM*-LAB** is formatted in fixed-width columns that can be imported by programs such as Microsoft® Excel® and Lotus 123®.

Help on importing the data into Microsoft® Excel® is provided in section 17.8 and the "excel.txt" file in the folder where you installed the WinTPS program.

17.5 Commands

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

Action	Command	Notes
Request current data	?D<cr>	Returns the current data of all parameters plus date and time from the **smart*CHEM*-LAB**. The log number returned is set to Zero.
Request logged data	?R<cr>	Returns all logged records from the **smart*CHEM*-LAB** memory. The data ends with the message **`ENDS`**<cr>
Erase logged data	?E<cr>	Erases all logged records from the **smart*CHEM*-LAB** 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, for example… **`smartCHEM-Lab•V2.0•S1234•1489•m%<cr>,`** where • are spaces. Note that the number of logged readings is right-justified. The "**`m`**" is present when the Dissolved Oxygen stirrer is enabled (section 3.2.1) and the "`%`" is used internally by the WinTPS software.
Request GLP information	?G<cr>	Returns all calibration GLP information, plus the instrument model, serial number and current date (see section 17.7 for data format and hand-shaking).
Positions of Data Fields	?P<cr>	Returns the number of data fields, along with their position and length as follows… **`8,1,10,12,8,21,4,26,6,36,7,47,8,59,8,71,5`** This denotes 8 fields, the first of which is at column 1 and is 10 characters long. The second field is at column 12 and is 8 characters long and so on.
Data Column Header	?H<cr>	Returns a text string which can be used to provide headers for each data field. Spaces are included to ensure that the headers are correctly aligned with the data.

17.6 Data Format

Data is returned to the RS232 Port by the **smart*CHEM*-LAB** in the following format.

Please note that a "•" shown anywhere in this section denotes one space.

`dd/mm/yyyy•hh:mm:ss•LLLL•DDDDDDuuu•CCCCCCCuuu•11111111uuu•22222222uuu•TTTTTuuu`

where….

`dd/mm/yyyy`	is the date, month and year data.
`hh:mm:ss`	is the hours, minutes and seconds data.
`LLLL`	is the Log Number, 4 characters, right justified. The **smart*CHEM*-LAB** sends a Zero for instant readings (see section 17.2).
`DDDDDD`	is Dissolved Oxygen data. 6 characters, right justified.
`uuu`	is the Dissolved Oxygen units description, which can be any of the following…

`ppm`	for parts per Million readout without Salinity correction. Note the lower case "**`m`**".
`ppM`	for parts per Million readout with Salinity correction applied. Note the upper case "**`M`**".
`%S•`	for % Saturation readout.
`%G•`	for % Gaseous readout.

`CCCCCCC`	is Conductivity or TDS or Salinity data. 7 characters, right justified.
`uuu`	is the Conductivity/TDS/Salinity units description, which can be any of the following…

`uS•`	for µS/cm Conductivity readout.
`mS•`	for mS/cm Conductivity readout.
`ppM`	for parts per Million TDS readout.
`ppK`	for parts per Thousand TDS readout.
`%`	for % Salinity readout.
`PSU`	for PSU Salinity readout.

`11111111`	is Channel 1 pH/mV/ORP/Ion data. 8 characters, right justified.
	The **smart*CHEM*-LAB** sends "**`•••Uncal`**" when the **smart*CHEM*-LAB** has not been Primary Calibrated in Specific Ion mode.
`uuu`	is the pH/mV/ORP/Ion unit description, which can be any one of the following…

`pH•`	for pH readout.
`mV•`	for Absolute mV/ORP readout.
`mVR`	for Relative mV/ORP readout.
`ppM`	for parts per Million readout in Specific Ion mode.
`ppK`	for parts per Thousand readout in Specific Ion mode.
`%••`	for % readout in Specific Ion mode.
`•••`	for Exponential readout in Specific Ion mode.

UnCal	For Specific Ion mode when Primary Calibration has not been performed, or has failed.

Continued over the page…

Data format, continued…

22222222 is Channel 2 pH/mV/ORP/Ion data. 8 characters, right justified.

The **smart*CHEM*-LAB** sends "**•••Uncal**" when the **smart*CHEM*-LAB** has not been Primary Calibrated in Specific Ion mode.

uuu is the pH/mV/ORP/Ion unit description, which can be any one of the following…

pH•	for pH readout.
mV•	for Absolute mV/ORP readout.
mVR	for Relative mV/ORP readout.
ppM	for parts per Million readout in Specific Ion mode.
ppK	for parts per Thousand readout in Specific Ion mode.
%••	for % readout in Specific Ion mode.
•••	for Exponential readout in Specific Ion mode.
UnCal	For Specific Ion mode when Primary Calibration has not been performed, or has failed.

TTTTT is Temperature data, 5 characters, right justified.

uuu is the Temperature unit description, which can be either of the following…

oC•	for real Temperature data.
oCm	for manual Temperature compensation values.

When requested by a PC with the ?D or ?R commands (section 17.5), the data is terminated with a carriage return.

When the data is sent by the **smart*CHEM*-LAB** using the Print function (section 16.5) or the Instant Send function (section 17.2), the data ends with a carriage return and a line feed.

17.7 GLP Data Format

GLP information is returned as 18 lines terminated by a carriage return. When using the "?G" command (section 17.5), the computer must respond with a character after receiving each line.

For example…

```
smartCHEM-Lab V2.0 S1234 @ 31/12/2011 15:00
Oxygen       Zero=      0.1%     @ 31/12/2011 12:00
Oxygen       Span=    100.0%     @ 31/12/2011 12:10
Conductivity Zero=     0.01uS    @ 31/12/2011 12:20
Conductivity k=        1.01      @ 31/12/2011 12:30
Ion 1        Offset=    0.0mV    @ 31/12/2011 13:00
Ion 1        Slope=   100.0%     @ 31/12/2011 13:10
mV  1        Offset=   10.0mV    @ 31/12/2011 13:20
pH  1        Asy=      0.10pH    @ 31/12/2011 13:30
pH  1        Slope=    99.0%     @ 31/12/2011 13:40
Ion 2        Offset=    0.0mV    @ 31/12/2011 13:50
Ion 2        Slope=   100.0%     @ 31/12/2011 14:00
mV  1        Offset=   10.0mV    @ 31/12/2011 14:10
pH  2        Asy=      0.10pH    @ 31/12/2011 14:20
pH  2        Slope=    99.9%     @ 31/12/2011 14:30
Temp. Sensor Offset=    1.0oC    @ 31/12/2011 14:40
Temp. ED1    Offset=    1.0oC    @ 31/12/2011 14:50
Ends
```

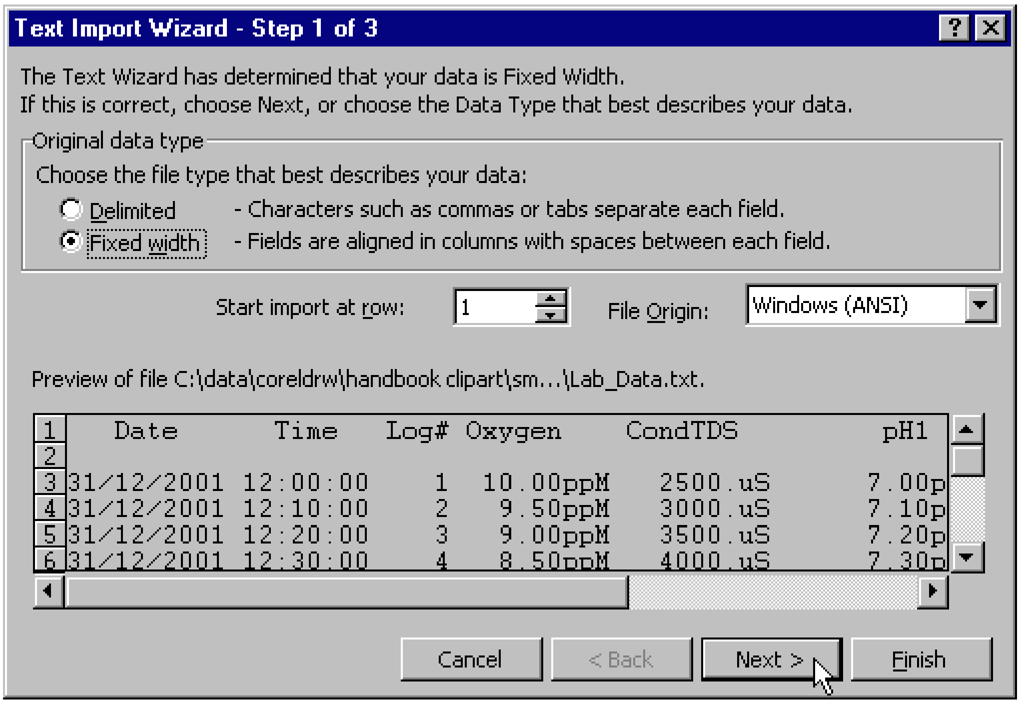
17.8 Importing Data into Microsoft Excel

The following procedure details the method for importing a **smart*CHEM*-LAB** 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 >".

   Note that the data column headers in row 1 appear only when the data is downloaded using the WinTPS software.

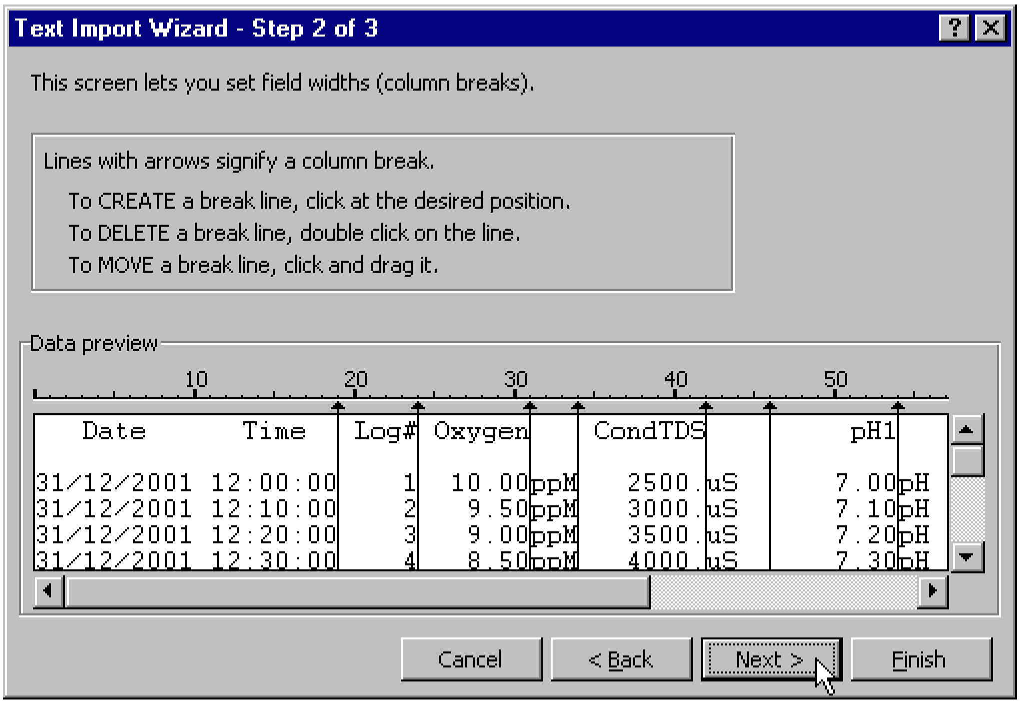


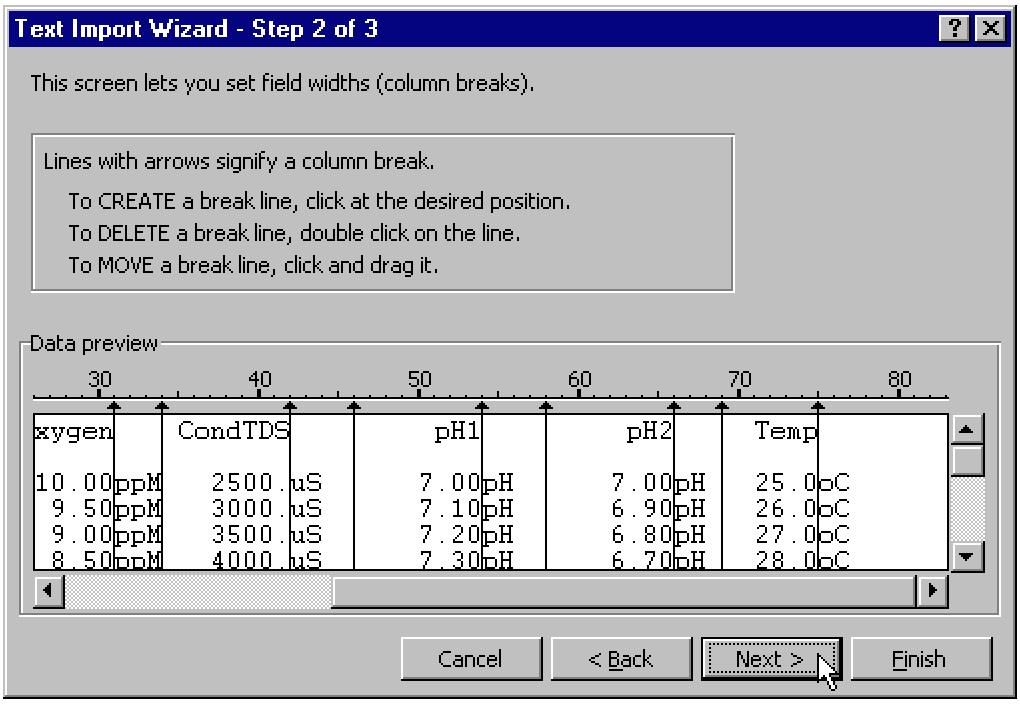
Continued over the page…

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. There are two screens, as the width of the data requires the window to be scrolled over.

   The date and time have been incorporated into a single column to ensure that the X-axis is correctly formatted if the data is to be charted later.

   Press "Next >" after all 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.

18. Recorder Port

This section is applicable if the optional Recorder port is fitted.

The optional Recorder Port can be used to send the data from any one parameter to a chart recorder or other analogue logging device.

18.1 Recorder Port Configuration

1. Select the Recorder set-up menu

   (Menu → **F4:Setup** → **F4:Ports** → **F5:Recorder**).

   The **smart*CHEM*-LAB** will now display the Recorder Port configuration screen…

```
RECORDER
>F1:Oxygen  F2:Cond.
 F3:pH-1    F4:pH-2
 F5:Temp.
```

   The arrow indicates the current selection.

2. Press F1 to set the Recorder output to Dissolved Oxygen data.

   Press F2 to set the Recorder output to Conductivity or TDS or Salinity data.

   Press F3 to set the Recorder output to Channel 1 pH/mV/ORP/Ion data.

   Press F4 to set the Recorder output to Channel 2 pH/mV/ORP/Ion data.

   Press F5 to set the Recorder output to Temperature data.

   Press Menu to quit and retain the current setting.

18.2 Recorder Port Specifications

Mode	Range	Output Range	Examples (Reading = mV Out)
Dissolved Oxygen	0.00 to 40.0 ppM 0.0 to 500 %Sat'n 0.0 to 100 %Gas	0 to 2000 mV	0.00 ppM = 0 mV 100.0 %Sat'n = 400 mV
Conductivity	0 to 3.000 µS/cm 0 to 30.00 µS/cm 0 to 300.0 µS/cm 0 to 3000 µS/cm 0 to 30.00 mS/cm 0 to 300.0 mS/cm	0 to 2000 mV for full scale of selected range.	0.000 µS/cm = 0 mV 2760 mS/cm = 1840 mV
TDS	0 to 2.000 ppM 0 to 20.00 ppM 0 to 200.0 ppM 0 to 2000 ppM 0 to 20.00 ppK 0 to 200.0 ppK	0 to 2000 mV for full scale of selected range.	0.00 ppM = 0 mV 1000 ppM = 1000 mV 36.0 ppK = 360 mV
Salinity	0 to 8.00 % 0 to 80.0 PSU	0 to 2000 mV 0 to 2000 mV	0.00 % = 0 mV 3.60 % = 900 mV 0.0 PSU = 0 mV 36.0 PSU = 900 mV
Specific Ion	The output for Specific Ion corresponds to the temperature compensated mV signal produced by the Ion sensor. The range for this is -1500 to +1500 mV	0 to 2000 mV	0.0 mV = 1000 mV +750 mV = 1500 mV -600 mV = 600 mV (mV output of sensor, regardless of concentration readout on display)
pH	0 to 14.000 pH 0 to 14.00 pH	0 to 2000 mV (for all resolutions)	7.00 pH = 1000 mV
Absolute mV	-1500 to +1500 mV	0 to 2000 mV	0.0 mV = 1000 mV +750 mV = 1500 mV -600 mV = 600 mV
Relative mV	-1500 to +1500 mVR	0 to 2000 mV	0.0 mVR = 1000 mV +750 mVR = 1500 mV -600 mVR = 600 mV

Note : The ranges shown above exceed the range specifications detailed in section 1.9 to allow for variations due to sensor performance.

Output Impedance : Approximately 1000 Ohms

Resolution : Approximately 2 mV

19. Setting the Clock

1. Select the Clock Set-up menu (Menu → **`F4:Setup`** → **`F2:Clock`**)
2. The display now shows the current time, for example…

```
Time is now 12:00
Enter Time  12:00
```

3. Use the Numeric Keypad to enter the current time, then press Enter .

   Alternatively, press menu to quit and retain the current setting.
4. If you pressed Enter above, the display will now show the current date, for example…

```
Date is now 04/09/11
Enter Date  04/09/11
            dd/mm/yy
```

5. Use the Numeric Keypad to enter the current date, then press Enter .

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

Notes

1. The **smart*CHEM*-LAB** tests that a valid day of the month is entered. If an invalid date is entered (eg. 31/02/2011), the **smart*CHEM*-LAB** beeps and displays the message "**`Invalid Date`**". The meter then returns to the clock setting screen so that the correct date can be entered.
2. The **smart*CHEM*-LAB** also tests for leap years.

20. Initialising the smart*CHEM*-LAB

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

Initialising the unit will reset all user setups to their factory default values and erase all readings logged in memory. ***Ensure that any valuable data has been noted or downloaded and saved before proceeding.***

To initialise the **smart*CHEM*-LAB**…

1. Select Initialise from the Setup menu (Menu → **F4:Setup** → **F5:Initialise**)

2. The **smart*CHEM*-LAB** now asks if you are sure that you wish to initialise ALL parameters, or just the Slope B from a 3 point pH calibration. The latter is only offered when a 3 point pH calibration has actually been performed…

```
Initialise

F1:All   F2:pH SlopeB
```

   Press F1 to initialise ALL parameters, reset all factory default settings and clear the memory.

   Press F2 to clear just the Slope B from a 3 point pH calibration.

3. When returning the meter to normal display mode, note that the decimal points have been replaced with a " * ", to indicate that each parameter requires re-calibration.

21. Instrument firmware version number

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

TPS

22. Troubleshooting

22.1 General Errors

Error Message	Possible Causes	Remedy
Factory Cal. Failure **Need Factory Service**	The EEPROM chip which contains the factory calibration information has failed.	The unit must be returned to TPS for service.
EEPROM Write Failure **Need Factory Service**	User calibration settings have been lost or corrupted.	Switch the meter OFF for 5 seconds and switch back ON. If the problem persists, return the unit to TPS for service.
Data Pointer Error **Logged Data Lost**	Data stored in memory has been lost or corrupted.	Switch the meter OFF for 5 seconds and switch back ON. If the problem persists, return the unit to TPS for service.

22.2 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 20.
• 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. 1. Gap between membrane and gold cathode is dry. 2. Incorrectly fitted membrane. 3. Sensor is empty. 4. Sensor is faulty.	Replace membrane and refill sensor. ED1 Undo the barrel 3 turns, then re-tighten to re-flush the filling solution. YSI Gently pump the pressure compensation diaphragm several times. Membrane should be smooth and convex with no wrinkles. Re-fit membrane if necessary. Replace membrane and re-fill sensor. Return sensor to factory for repair or replacement
Blackened Silver anode.	Sensor has been exposed to sulphides or other chemical poisoning.	ED1 Remove barrel and soak in 5% Ammonia solution for 10 minutes. If anode is still blackened, sand silver tube with #800 Wet & Dry sandpaper. YSI Remove pressure compensation diaphragm and membrane, then soak in 5% Ammonia solution for 10 minutes. If cleaning is unsuccessful, return the sensor to the TPS factory for cleaning and service.
Tarnished or scratched Gold cathode.	Sensor has been chemically poisoned or physically damaged.	Return to the TPS factory for cleaning and service.
Meters displays "`Sensor`" instead of Dissolved Oxygen data.	Meter has been calibrated on ED1 and then a YSI sensor is connected, or vice versa.	Re-calibrate the Dissolved Oxygen reading on the new sensor. Meter only keeps calibration data for one Dissolved Oxygen sensor.
Meter displays `OVR ppM` or `OVR%` instead of Dissolved Oxygen data.	1. Sensor has not yet polarised. 1. Sensor is faulty	Wait for 2-3 minutes for the sensor to polarise after the **smart*CHEM*-LAB** is switched on. Return sensor to factory for repair or replacement.
Reading does not change in any sample being measured	Auto Stability Function has frozen display (notice the ☑).	Turn Auto Stability Function OFF or re-start sampling (see section 12).
Display flashes "ATC" and "LIMIT"	The Temperature is not within the ATC limits.	Cool/Heat solution before taking measurements.

22.3 Conductivity / TDS / Salinity 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 20.
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. Clean the glass around the platinum plate area. DO NOT rub the black platinised surfaces.
Standard calibration fails, and k factor is greater than 25% ***above*** the nominal value.	1. Sensor is not immersed correctly. 2. Sensor may have a build-up of dirt or oily material on sensor plates. 3. Platinum-black coating has worn off. 4. Standard solution is inaccurate. 5. Sensor is faulty. 6. Faulty instrument.	Immerse sensor at least to the vent hole in the side of the sensor. Clean sensor as per the instructions detailed in section 23.2.1. Sensor requires replatinisation as per section 23.2.1. Alternatively, return to the factory for replatinisation. Replace standard solution. Return sensor to factory for repair or replacement. Return to factory for repair.
Standard calibration fails, and k factor is greater than 25% ***below*** the nominal value.	1. Standard solution is inaccurate. 2. Sensor may have a build-up of conductive material, such as salt. 3. Sensor is faulty. 4. Faulty instrument.	Replace standard solution. Clean sensor as per the instructions detailed in section 23.2.1. Return sensor to factory for repair or replacement. Return to factory for repair.
Inaccurate readings, even when calibration is successful.	1. Sensor may have a build-up of dirt or oily material on sensor plates. 1. Platinum-black coating has worn off.	Clean sensor as per the instructions detailed in section 23.2.1. Sensor requires replatinisation as per section 23.2.1. Alternatively, return to the factory for replatinisation.
Readings drift.	Sensor may have a build-up of dirt or oily material on sensor plates.	Clean sensor as per the instructions detailed in section 23.2.1.
Readings are low or near zero.	1. Sensor may have a build-up of dirt or oily material on sensor plates. 1. Sensor is not immersed correctly. 2. Sensor is faulty. 3. Faulty instrument.	Clean sensor as per the instructions detailed in section 23.2.1. Immerse sensor at least to the vent hole in the side of the sensor. Return sensor to factory for repair or replacement. Return to factory for repair.
Reading does not change in any sample being measured	Auto Stability Function has frozen display (notice the ☑).	Turn Auto Stability Function OFF or re-start sampling (see section 12).
Display flashes "ATC" and "LIMIT"	The Temperature is not within the ATC limits.	Cool/Heat solution before taking measurements.

22.4 Specific Ion, 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 20.
1 Point calibration fails. (Specific Ion offset causes over-range reading, pH asymmetry is greater than ±1.00 pH, or mV offset is greater than ±60mV).	1. Reference junction blocked. 1. Reference electrolyte contaminated.	Clean reference junction as per instructions supplied with the pH or reference sensor. Flush with distilled water and replace electrolyte.
2 Point calibration fails. (Specific Ion slope is less than 50%, or pH slope is less than 85.0%.) 3 Point pH calibration fails. (pH SlopeB is less than 85.0%).	1. Specific Ion standards or pH Buffers not correctly set. 1. Ion sensor surface or pH glass bulb not clean. 2. Sensor is aged. 3. Connector is damp. 4. Specific Ion standards or pH Buffers are inaccurate.	Ensure that you are using Specific Ion standards as per the Standards set-up (see section 7.2). For automatic pH buffer recognition, ensure that you are using buffers that match the selected buffer set (see section 8.2). Otherwise, ensure that the buffer value is entered correctly at pH calibration. Clean sensor surface or glass bulb as per instructions supplied with the sensor. Attempt rejuvenation as per instructions supplied with the sensor. If unsuccessful, replace sensor. Dry in a warm place. Replace standards or buffers.
Unstable readings.	1. Reference Electrolyte chamber needs to be refilled. 1. Reference junction blocked. 2. Ion sensor surface or pH glass bulb not clean. 3. Bubble in pH glass bulb. 4. Faulty connection to meter. 5. Reference junction not immersed. 6. KCl crystals around reference junction inside the electrolyte chamber.	Refill with saturated KCl filling solution. Clean reference junction as per instructions supplied with the sensor. Clean glass bulb as per instructions supplied with the sensor. Flick the sensor to remove bubble. Check connectors. Replace if necessary. Ensure that the reference junction is fully immersed. See diagrams in sections 7.3, 8.4, 9.2, & 10.2. Rinse electrolyte chamber with warm distilled water until dissolved. Replace electrolyte.
Inaccurate readings, even when calibration is successful.	Reference junction blocked.	Clean reference junction as per instructions supplied with the sensor.
Displays constant Ion reading or around pH7.00 or 0mV for all solutions.	Electrical short in connector.	1. Check connector. Replace if necessary. 1. Replace sensor.
Displays 4-5 pH for all solutions.	pH sensor glass bulb or internal stem cracked.	Replace pH sensor.
Reading does not change in any sample being measured	Auto Stability Function has frozen display (notice the ☑).	Turn Auto Stability Function OFF or re-start sampling (see section 12).
Display flashes "ATC" and "LIMIT"	The Temperature is not within the ATC limits.	Cool/Heat solution before taking measurements.

22.5 Temperature Troubleshooting

Symptom	Possible Causes	Remedy
Temperature inaccurate and cannot be calibrated.	1. Faulty connector. 1. Faulty Dissolved Oxygen or Temperature sensor, whichever is being calibrated. 2. Faulty Dissolved Oxygen cable if Dissolved Oxygen sensor is being used for Temperature readout.	Check the connector and replace if necessary. Return Dissolved Oxygen or Temperature sensor for repair, or replace sensor. Return Dissolved Oxygen cable for repair or replace cable.
Meters displays "**Sensor**" instead of Temperature data.	Meter has been Temperature-calibrated on ED1 and then a YSI sensor is connected, or vice versa.	Re-calibrate the Temperature reading on the new sensor. Meter only keeps Temperature calibration data for one Dissolved Oxygen sensor.
Displays flashing "**M**" when Temperature and/or Dissolved Oxygen sensor plugged in.	1. Faulty instrument socket. 2. Faulty Dissolved Oxygen or Temperature sensor, whichever is being calibrated. 3. Faulty Dissolved Oxygen cable if Dissolved Oxygen sensor is being used for Temperature readout.	Return the instrument to the TPS factory for service. Return Dissolved Oxygen or Temperature sensor for repair, or replace sensor. Return Dissolved Oxygen cable for repair or replace cable.
Reading does not change in any sample being measured	Auto Stability Function has frozen display (notice the ☑).	Turn Auto Stability Function OFF or re-start sampling (see section 12).

23. Appendices

23.1 Dissolved Oxygen

23.1.1 Dissolved Oxygen Sensor Fundamentals

The sensor 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 sensor 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 the Clark type sensor relies on the diffusion of oxygen through a suitable membrane into a constant environment of potassium chloride. Solution 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 (a few cm/sec is sufficient). 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.

23.1.2 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 0.001 inch PTFE (Teflon) sheet. 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 is +4.2%/°C at 25°C for this thickness membrane.

A polarising voltage of about 800 millivolts is applied between the two electrodes. The gold electrode is placed close to the membrane and because of the polarising 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 sensor itself, converts this current into a voltage proportional to the oxygen partial pressure. The thermistor provided within the body of the sensor has a temperature coefficient of -4.2%/°C. This gives an accurate temperature compensation for the temperature/permeability effect of the membrane, over a range of about 5 to 45 °C about a centre value of 25°C. Note this compensation is not for the solubility effects. A separate sensor also built into the tip of the electrode achieves this.

23.1.3 Sensor Storage

The Oxygen sensor 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 sensor can be stored with the tip in water or in a humid environment.

For long term storage of several weeks or more, remove the membrane and empty out the electrolyte. Replace the membrane without electrolyte to avoid contamination of the gold and silver surfaces. When the sensor is stored in this way, the membrane should be replaced and the sensor refilled before use.

23.1.4 Maintenance Of The Membrane

The membrane does not require replacement as long as it remains intact. If punctured or suspected of leaking around the edges, it must be replaced. To replace the membrane, please see the separate instruction leaflet supplied with your sensor.

23.1.5 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 (25ºC) 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.

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

With air at sea level, the 20.9% oxygen exerts about 15.5 cm of Mercury pressure. Water in equilibrium with air and with no oxygen demand (C.O.D., 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 sensor linear readout is then a linear function of % Saturation. Organic cell walls behave like the sensor 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. sensor).

If mass units are used for measurement of Dissolved Oxygen, the temperature problem of relating the linear partial pressure reading of the sensor 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 ;

(a) Solubility correction of Dissolved Oxygen with temperature and ;

(b) Salinity correction of Dissolved Oxygen by weight (Salinity has no effect on pressure units readout).

In the **smart*CHEM*-LAB** instrument,

(a) Membrane correction is achieved AUTOMATICALLY ;

(b) To provide the mass units (ppM) readout (so popular due to the Winkler process used in the past), the **smart*CHEM*-LAB** Meter has Solubility Correction via an additional temperature sensor in the sensor ;

(c) Salinity correction is performed automatically via the Conductivity/TDS sensor.

23.1.6 Equilibrium Conditions

Whilst Saline Water has a lower ppM than does Fresh Water, it does not mean it necessarily has less biologically available oxygen. 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 replenished 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.

23.1.7 Velocity Past The Membrane

Workers have shown that the relationship between the diffusion current (oxygen current) and the external velocity of the liquid is exponential. Some workers using thicker membranes have shown even less dependence of the diffusion current on liquid velocity. Because of the exponential nature of the relationship, 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 sensor 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 a different matter, however.

With the type of sensor to be used with this instrument, very little change in diffusion current is caused by altering the pH of the external environment. Pressure changes over a moderate range exerted on the membrane also cause no change. The ED1 Dissolved Oxygen sensor is sealed by glands for total immersion to a depth of 3 metres. The EDYSI has a pressure compensation diaphragm to allow submersion to 60 metres.

23.2 Conductivity/TDS/Salinity

23.2.1 Care, Cleaning and Maintenance of Conductivity Sensors

Care of Conductivity sensors

The conductivity section of the sensor supplied with your **smart*CHEM*-LAB** consists of two platinum plates 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 detail later in this section). You can help to maintain the platinum-black layer by following these simple rules:

1. **NEVER** touch or rub the electrode plates 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 electrode plates. 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.

Cleaning Conductivity of Sensors.

Platinised platinum Conductivity sensors can only be cleaned by rinsing in a suitable solvent.

DO NOT wipe the electrode plates, as this will remove the platinum-black layer.

1. Rinsing in distilled water will remove most build-ups of material on the electrode plates.
2. Films of oils or fats on the electrode plates 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 electrode plates, 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 (see detail later in this section).

Replatinising Conductivity Sensors

There are several ways to replatinise Conductivity sensors.

1. The simplest way is to return the electrode 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 electrodes for the right amount of time at the correct current. Ordering details are as follows…

Automatic Conductivity ensor Replatiniser	Part No 122160
20mL Platinising Solution (suitable 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.

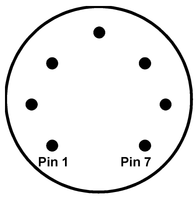
   (b) Rinse the sensor well in distilled water.

   (c) Immerse the sensor in platinising solution at least to the vent hole in the glass body. Platinising solution is available from TPS (part no 122300). 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. **Caution : This is a dangerous solution and should be handled with the utmost care.**

   (d) Apply a direct current of 10mA between pins 1 and 7 of the sensor plug, as per the diagram below. Reverse the polarity every 30 seconds. After approximately 8 minutes (4 minutes per electrode plate), they should have an even “sooty” appearance. Avoid excess current as this will cause incorrect platinising.

   (e) After platinising, rinse the sensor well in distilled water.

   (f) 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

23.3 pH and Specific Ions

pH sensors are generally combination electrodes, where the pH sensing membrane and the reference system are contained in a single body. 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 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.

Specific Ion Electrodes are commonly supplied as mono or combination sensors. Mono sensors contain just the Ion sensing membrane and must be used with a separate reference electrode. Combination Specific Ion sensors, like combination pH sensors, contain both the sensing membrane and the reference section in a single body.

23.3.1 Asymmetry of a pH or Specific Ion Electrode

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.

All Specific Ion electrodes produce 0 mV at different levels. This is why the **smart*CHEM*-LAB** has an unlimited Asymmetry range.

Figure 23 -1 illustrates how asymmetry is expressed for a pH sensor.

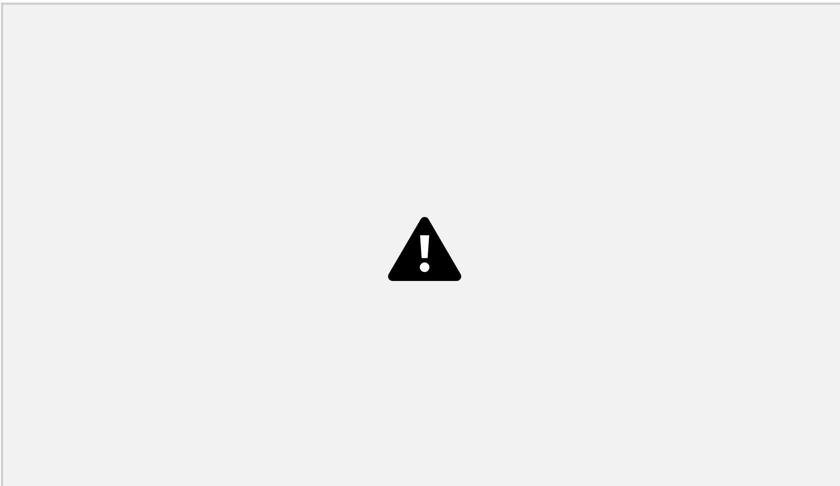


Figure 23-1

23.3.2 Slope of a pH or Specific Ion Electrode

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 –59.16mV/pH unit at 25 ^{O}C As the pH goes down, an ideal pH sensor produces +59.16mV/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 59.16mV/pH unit has “100% Slope”. An sensor that produces 50.15mV/pH unit has “85% Slope”.

Specific Ion electrodes that measure monovalent cations (+) produce 59.16mV per decade change in ion activity. As the concentration goes up, the output of the sensor goes down.

Specific Ion electrodes that measure monovalent anions (–)produce 59.16mV per decade change in ion activity. As the concentration goes up, the output of the sensor also goes up.

Specific Ion electrodes that measure divalent cations (2+) produce 28mV per decade change in ion activity. As the concentration goes up, the output of the sensor goes down.

Specific Ion electrodes that measure divalent anions (2–) produce 28mV per decade change in ion activity. As the concentration goes up, the output of the sensor goes up.

Specific Ion electrodes produce slightly less then these figures in real practice.

Figure 23 -2 illustrates the principle of electrode slope, using a pH sensor as an example.

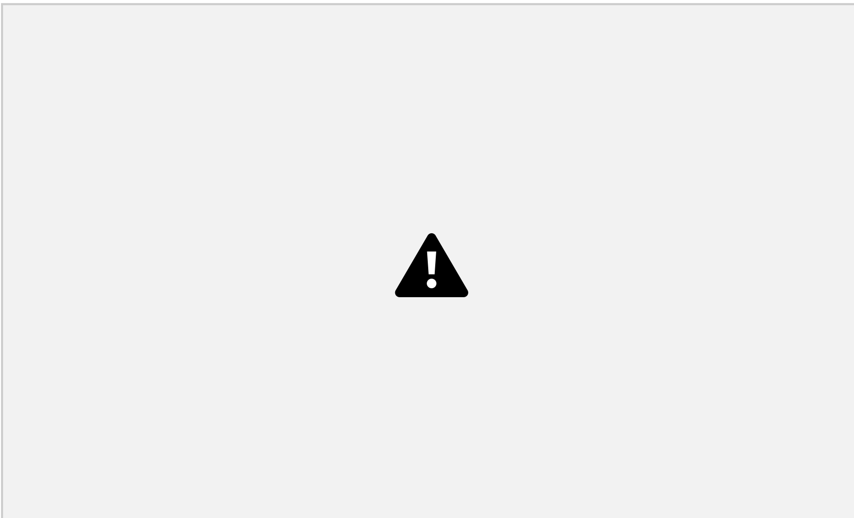


Figure 23-2

23.3.3 Temperature Compensation

The slope of a pH and Specific Ion electrodes 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 23 -3 shows the slope of a pH sensor at various temperatures.

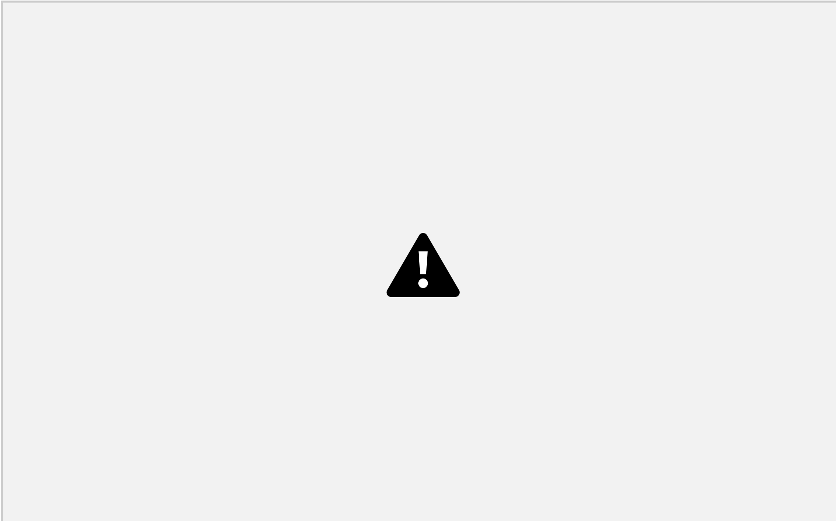


Figure 23-3

23.3.4 Polarisation Output

The **Accessories** connector on the rear panel of the **smart*CHEM*-LAB** contains a polarisation output for Karl Fischer titrations. This titration is a method for determining minute quantities of water in non-aqueous liquids.

The TPS Double Platinum electrode (part no 122209) has two connectors. The bayonet type BNC connector fits to the **pH/mV/Ion-1** or **pH/mV/Ion-2** socket and the black plastic connector fits to the **Accessories** socket.

When performing Karl Fischer titrations, ensure that the **smart*CHEM*-LAB** is in mV mode for the relevant channel.

24. Warranty

TPS Pty Ltd guarantees all instruments and sensors to be free from defects in material and workmanship when subjected to normal use and service. This guarantee is expressly limited to the servicing and/or adjustment of an instrument returned to the TPS Pty Ltd Factory Service Centre, freight prepaid, within twelve (12) months from the date of delivery, and to the repairing, replacing, or adjusting of parts which upon inspection are found to be defective. Warranty period on sensors is six (6) months.

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

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

Procedure for Service

Please read service details on our '**Service and Repair'** page at **www.tps.com.au.**

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

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

Please check that the following is enclosed with your equipment:

A TPS 'Service / Return Goods Form' – from our website

Your full name

Your company name

Your email address

Your return street address

A description of the fault. (Please be specific - "Please Repair" does not describe a fault.)

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

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