

Congratulations !

The **smartCHEM-Ion** is an advanced, high quality Specific Ion, pH, mV & Temperature instrument.

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

The manual is divided into the following sections:

1. Table of Contents

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

2. Introduction

The introduction has a diagram and explanation of the display and controls of the **smartCHEM-Ion**. 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.

3. Main Section

The main section of the handbook provides complete details of the **smartCHEM-Ion**, including operating modes, calibration, troubleshooting, specifications, and warranty terms.

4. Appendices

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

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smartCHEM-Ion
Specific Ion, pH, mV,
Temperature Meter

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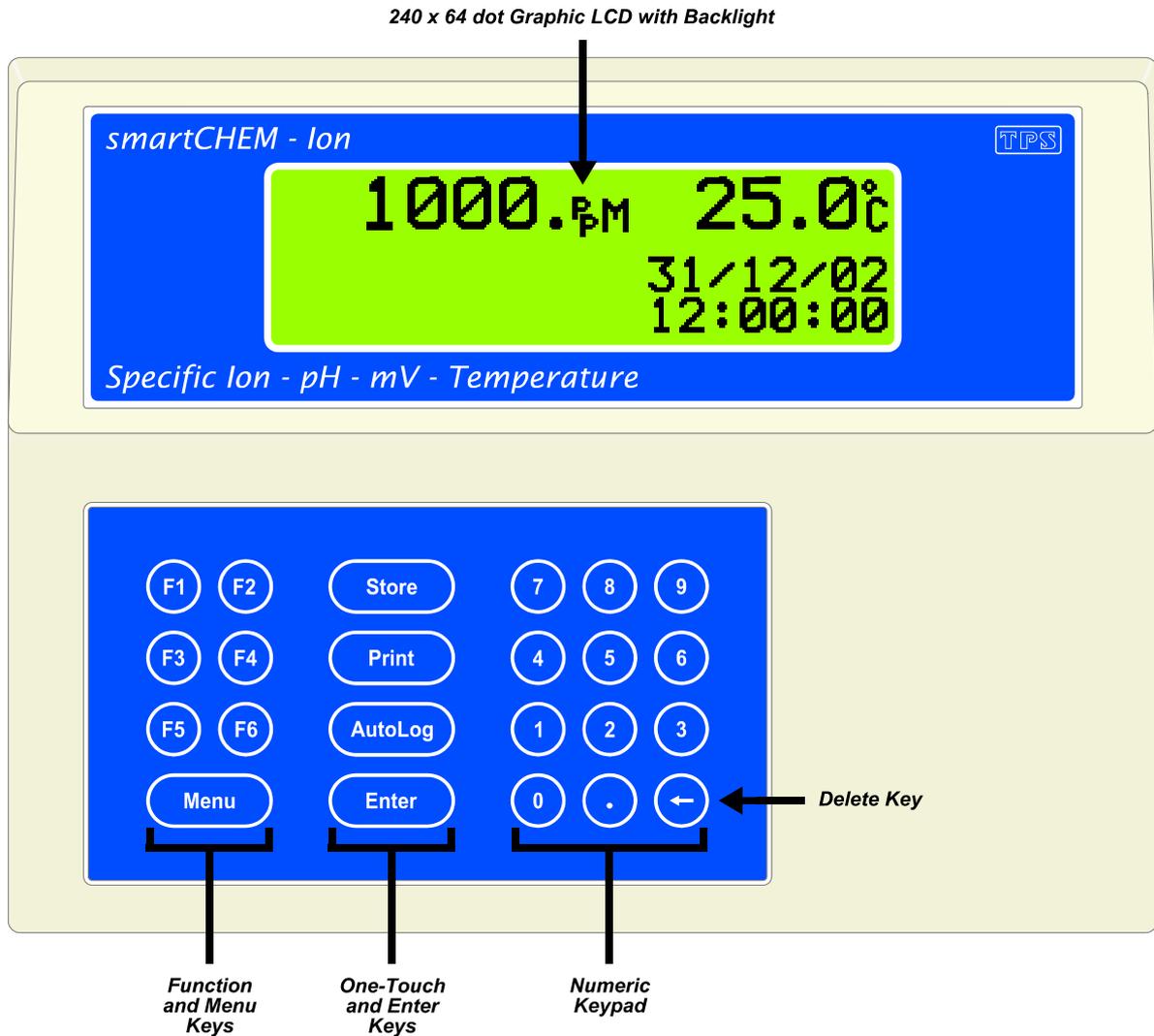
Contents

1.	Introduction	3
1.1	smartCHEM-Ion Display and Controls	3
1.2	smartCHEM-Ion Rear Panel Connectors	3
1.3	Function and Menu Keys	4
1.4	One-touch Keys.....	4
1.5	Numeric Keypad	4
1.6	Delete Key.....	4
1.7	240 x 64 Dot Graphic Display	4
1.8	Unpacking Information	5
1.9	Specifications	6
2.	smartCHEM-Ion Menu Structure.....	9
3.	Specific Ion Mode	10
3.1	Selecting Specific Ion Mode	10
3.2	Setting Specific Ion Standards	11
3.3	Specific Ion Calibration	14
3.4	Specific Ion Calibration Notes	16
3.5	Specific Ion Calibration Messages.....	17
4.	pH Mode.....	18
4.1	Selecting pH Mode.....	18
4.2	Selecting the pH Buffer Set.....	19
4.3	Calibration Buffer Sequence	20
4.4	pH Calibration.....	21
4.5	pH Calibration Notes	23
4.6	pH Calibration Messages	24
5.	Absolute Millivolt Mode.....	26
5.1	Selecting Absolute Millivolt Mode	26
5.2	Absolute Millivolt Calibration	26
5.3	mV Calibration Notes	27
5.4	mV Calibration Messages	28
6.	Relative Millivolt Mode	29
6.1	Selecting Relative Millivolt Mode	29
6.2	Relative Millivolt Calibration	29
6.3	Relative Millivolt Calibration Notes.....	30
7.	Temperature Mode.....	31
7.1	Temperature Calibration	31
7.2	Temperature Calibration Notes	32
7.3	Calibration Messages	32
7.4	Manual Temperature Setting.....	33
8.	Auto Stability Function (ASF).....	34
8.1	ASF During Normal Measurement	34
8.2	ASF During Calibration	34
8.3	ASF with Manual Datalogging	35
8.4	ASF with Automatic Datalogging.....	36
9.	Display Backlight	37
10.	Good Laboratory Practices (GLP).....	38
10.1	To recall GLP information on the display.....	38
10.2	Failed Calibration.....	38
10.3	Printing GLP Information to the RS232 Port.....	39
10.4	GLP Calibration Alarm	40
10.5	Instrument Serial Number	41
10.6	Additional GLP Features.....	41
11.	Access Code	42
11.1	Enabling the Access Code System	42
11.2	Using the Access Code System.....	42
11.3	Changing the Access Code.....	43

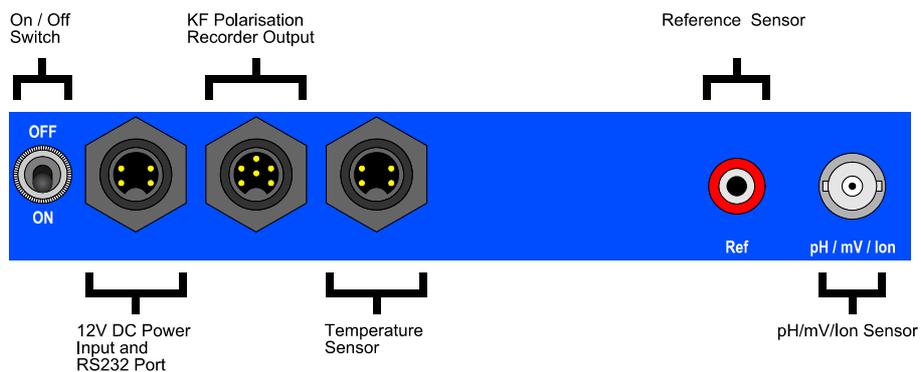
11.4	Disabling the Access Code System.....	43
12.	Datalogging	44
12.1	Manual Datalogging.....	44
12.2	Automatic Datalogging	44
12.3	Recalling Readings from the Logger	46
12.4	Erasing Records from the Logger	46
12.5	Printing Records from the Logger to the RS232 Port	47
13.	RS232 Port.....	48
13.1	Setting the Baud Rate.....	48
13.2	Sending Readings to the RS232 Port	48
13.3	RS232 Configuration	48
13.4	Communication and Statistical Software	48
13.5	Commands	49
13.6	Data Format.....	50
13.7	GLP Data Format	51
13.8	Importing Data into Microsoft Excel	52
14.	Recorder Port.....	54
14.1	Recorder Port Configuration	54
14.2	Recorder Port Specifications.....	54
15.	Setting the Clock	55
16.	Initialising the smartCHEM-Ion	56
17.	Instrument firmware version number	56
18.	Troubleshooting	57
18.1	General Errors.....	57
18.2	Specific Ion, pH and mV Troubleshooting	58
18.3	Temperature Troubleshooting	59
19.	Appendices	60
19.1	pH Sensor Fundamentals.....	60
20.	Warranty	63

1. Introduction

1.1 smartCHEM-Ion Display and Controls



1.2 smartCHEM-Ion 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  to enter the user-friendly menu system.  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  to  function keys to select desired options within the menu system.

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

 : Press to Zero Relative mV, when Relative mV is selected. See section 6.2.

 : Press to start and stop the Automatic Stability Function. See section 8.

1.4 One-touch Keys

 : Press to manually record readings into the Logger. See section 12.1.

 : Press to transmit current reading plus date and time to the RS232 port. See section 13.2.

 : Press to start and stop Automatic Datalogging. See section 12.2.

 : Press  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. Specific Ion/pH/mV/Relative mV, Temperature, Date and Time simultaneously.

Backlight can be set to On, Off or Energy Saver modes. See section 9.

1.8 Unpacking Information

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

Part No

Standard Kit...

1. smartCHEM-Ion Specific Ion pH, mV, Relative mV, Temperature Meter.....	121163
2. Temperature/ATC Sensor	121248
3. Plug-Pack Power Supply.....	130037
4. smartCHEM-Ion Handbook.....	130050

Optional sensors that may have been ordered with your smartCHEM-Ion...

1. Plastic Body pH Sensor, Porous Teflon Double Junction	121207
2. Intermediate Junction pH Sensor	121234
3. Plastic Body Combination Redox Sensor	121262
4. Intermediate Junction Redox Sensor	121263
5. 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 (must also have 130041 Serial Cable)	130087
4. Recorder Output Option (includes cable)	130028
5. WinTPS RS232 Communication software for Windows 95, 98 and ME.....	130086

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

1.9 Specifications

1.9.1 Specific Ion

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 TypeCompatible with all combination and half cell Ion Selective Sensors for monovalent or divalent anions or cations.

Input Impedance>3 x 10¹² Ohms

Temperature CompensationAutomatic, 0 to 100 °C

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

Sensor Asymmetry RangeAuto detection at calibration.

Sensor Slope Range.....50.0 to 110.0 %

1.9.2 pH

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

Sensor TypeGlass bulb pH sensor, combination or half cell.

Input Impedance>3 x 10¹² Ohms

Temperature CompensationAutomatic, 0 to 100 °C

Calibration.....Automatic asymmetry and slope calibration.

Automatic Buffer RecognitionpH4.01, 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 %

1.9.3 Absolute and Relative mV

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

Sensor TypePlatinum or Gold tip ORP sensor, combination or half cell.
Ion Selective Sensors can also be used in this mode.

Input Impedance>3 x 10¹² Ohms

1.9.4 Temperature

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

Sensor TypeSilicon transistor

Calibration.....Automatic offset calibration

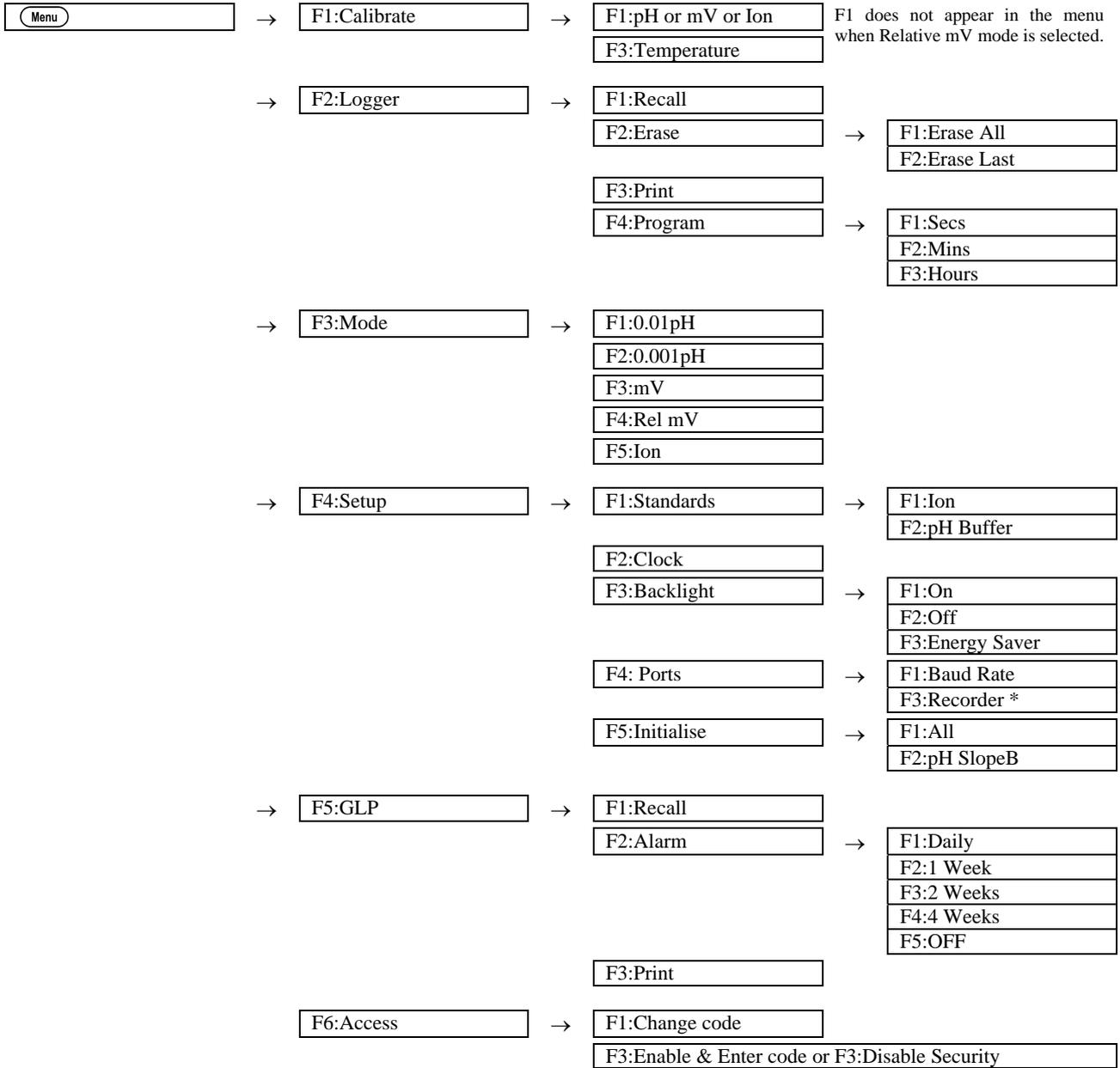
Sensor Offset Range.....-10.0 to 10.0 °C

1.9.5 General Specifications

Memory	2520 readings including date and time
Automatic Logging	User-set for one reading every 1 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. 2.0 kg
Environment	Temperature : 0 to 45 °C Humidity : 0 to 90 % R.H.

2. smartCHEM-Ion Menu Structure

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



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

3. Specific Ion Mode

3.1 Selecting Specific Ion Mode

1. Select Specific Ion Mode ( → **F3:Mode** → **F5:Ion**).
2. The Valency selection screen is now displayed...



The arrow indicates the current selection.

Press  to select Monovalent Cation (e.g. Na⁺).

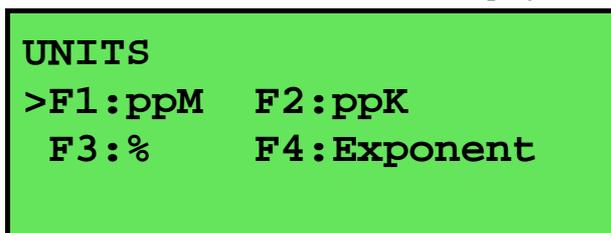
Press  to select Monovalent Anion (e.g. F⁻).

Press  To select Divalent Cation (e.g. Cu²⁺).

Press  to select Divalent Anion (e.g. S²⁻).

Press  to quit without changing the current setting.

3. The Units selection screen is now displayed...



The arrow indicates the current selection.

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

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

Press  to select readout in %.

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

Press  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.

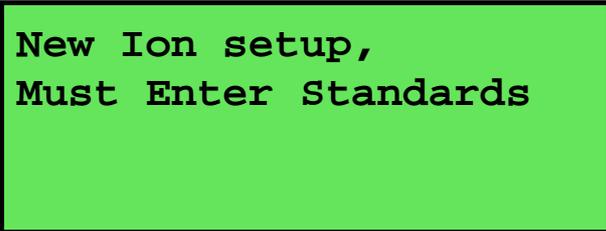
Press **F2** to select resolution to 2 significant digits. Readings in this mode are very stable, although 1 significant digit is lost.

Press **F3** to select Auto-rounding. Readings in this mode are displayed to 3 significant 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 **smartCHEM-Ion** 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

Proceed to section 3.2 for details on setting the Primary and Secondary Specific Ion standards.

3.2 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 **smartCHEM-Ion** is initialised.

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

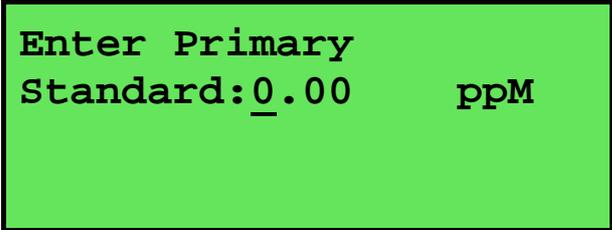
3.2.1 Setting Specific ion standards for ppm, ppK and % readouts

1. Select the Specific Ion standards set-up menu...

Menu → **F4:Setup** → **F1:Standards** → **F1:Ion**

(The **F1** option is only available on the menu when that **smartCHEM-Ion** is set to Specific Ion readout.)

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



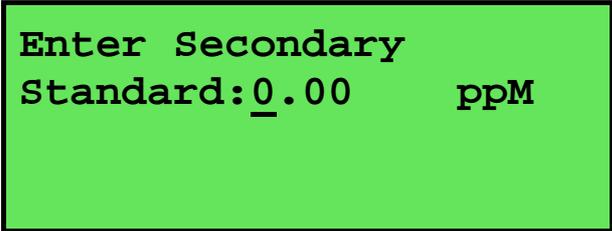
Enter Primary
Standard: 0.00 ppm

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

Press Enter to save the Primary standard.

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

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



Enter Secondary
Standard: 0.00 ppm

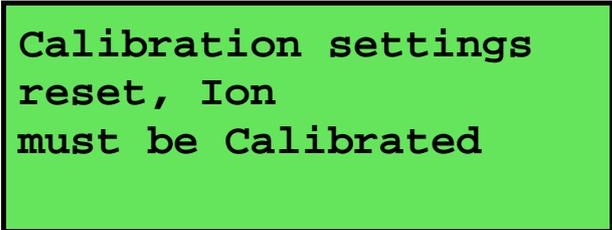
Type in the value of the Secondary standard, including the decimal point. Use the \ominus key to make any corrections.

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.

- If the Specific Ion standards were changed, the Specific Ion readout must be re-calibrated. The **smartCHEM-Ion** provides the following prompt as a reminder...



Calibration settings
reset, Ion
must be Calibrated

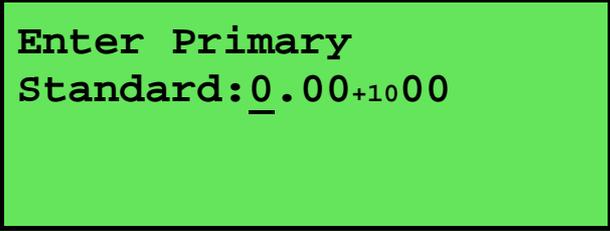
3.2.2 Setting Specific ion standards for Exponential readout

- Select the Specific Ion standards set-up menu...

Menu → **F4:Setup** → **F1:Standards** → **F1:Ion**

(The **F1** option is only available on the menu when the **smartCHEM-Ion** 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, 1.0010^{-04} should be read as 1.00×10^{-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^- .

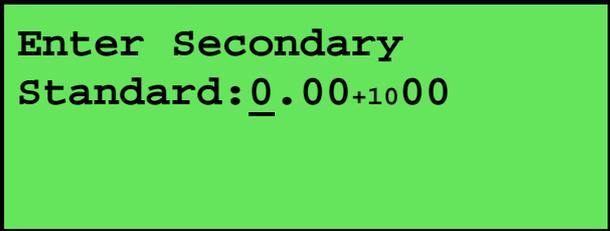
Enter the power. This can be entered as 1 or 2 digits (eg. “04” is treated the same as “4”).

Use the \leftarrow 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^- .

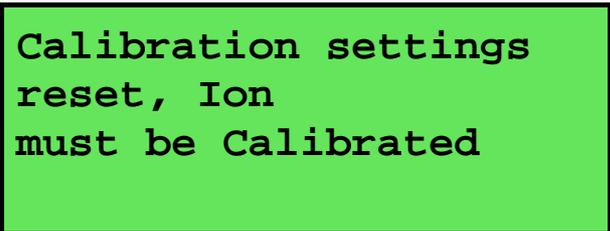
Enter the power. This can be entered as 1 or 2 digits (eg. “04” is treated the same as “4”).

Use the \leftarrow 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 must be re-calibrated. The **smartCHEM-Ion** provides the following prompt as a reminder...



Calibration settings
reset, Ion
must be Calibrated

3.3 Specific Ion Calibration

1. Plug the Ion Selective Sensor into the **pH/mV/Ion** BNC socket.

If a separate Reference Sensor is being used, plug this into the separate **pH/mV/Ion** 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 3.1.
Set up the Primary and Secondary Specific Ion standards, as detailed in section 3.2.

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

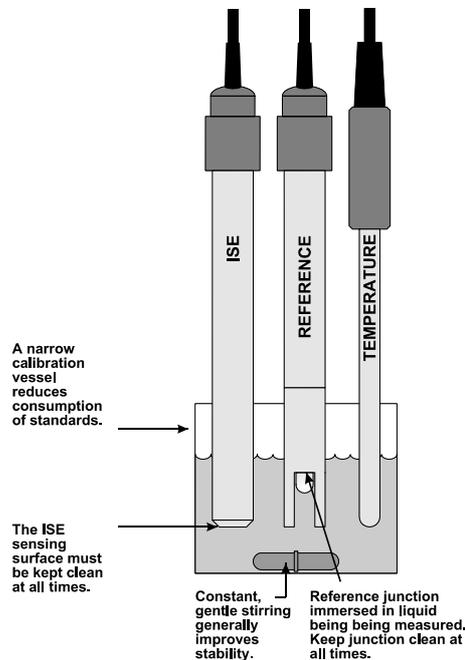
4. Ensure that temperature has already been calibrated (section 7.1) or manually set (section 7.4).
NOTE: A “ * ” in place of the decimal point in the temperature readout indicates that temperature is not calibrated.
5. Remove the wetting caps from the Ion Selective and Reference sensors, if fitted.
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 Sensor sensing surface and the reference sensor'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 Sensor's handbook).

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



Continued over the page...

7. Select Primary Calibration (Menu) → **F1:Calibrate** → **F1:Ion** → **F1:Primary**).

The primary calibration screen is now displayed. If the **smartCHEM-Ion** 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 **smartCHEM-Ion** 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...

```

U      0.0mV
      25.0 °C
Ion 10.0PPM Cal.
Press Enter
  
```

Currently Primary calibrated...

```

      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...

```

U      0.0mV
      25.0 °C X
Ion 10.0PPM Cal.
Waiting to Stabilise
  
```

Currently Primary calibrated...

```

      10*0PPM      0.0mV
      25.0 °C X
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 **smartCHEM-Ion** will then display the Offset of the Ion Selective Sensor, before returning to the Ion Calibration menu.

Note that the “*” will not be 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 Sensor sensing surface and the reference sensor's reference junction are both covered as per the diagram in step 6.

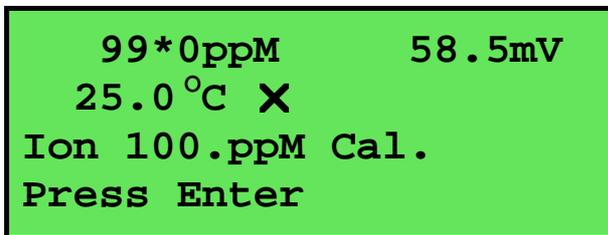
Ensure that any Ionic Strength Adjusting Buffer (ISAB) that may be required has been added (see the Ion Selective Sensor's handbook).

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

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

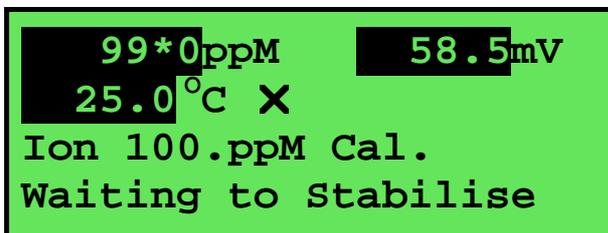
Menu → **F1:Calibrate** → **F1:Ion** → **F3:Secondary**

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 **smartCHEM-Ion** is currently not Secondary calibrated. For example...



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

12. Press **Enter** to calibrate to the Secondary Standard value. The Automatic Stability Function will now show a **X** and highlight any unstable readings...



99*0ppM 58.5mV
25.0°C X
Ion 100.ppM 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 **F9** to disable the Automatic Stability Function.

The **smartCHEM-Ion** will then display the Slope of the Ion Selective Sensor 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 **smartCHEM-Ion** 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.

3.4 Specific Ion Calibration Notes

1. A Primary Calibration should be performed at least weekly. In applications where the reference sensor 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 **smartCHEM-Ion** is switched off, even when the power supply is removed. This information can be recalled or printed later using the GLP function (see section 10).
4. The **smartCHEM-Ion** 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 3.2).

3.5 Specific Ion Calibration Messages

1. If a Primary Calibration has been successfully performed, the **smartCHEM-Ion** will display the following message and the Offset value of the sensor. For example...

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

2. If a Secondary Calibration has been successfully performed, the **smartCHEM-Ion** will display the following message and the slope value of the sensor. For example...

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

3. If a Secondary Calibration has failed, the **smartCHEM-Ion** will display the following message and the failed slope value of the sensor. For example...

```
Calibration Failed  
Slope=30.0%
```

Notes

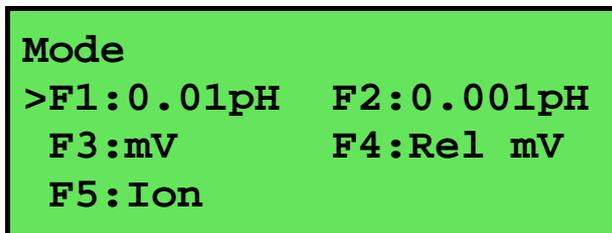
1. The **smartCHEM-Ion** has an unlimited Offset range, as long as the reading is not over-ranged. This is to allow for the large variety of Ion Selective Sensors available.
2. The allowable Slope range is 50.0 to 110.0 %. This range is ample to allow for correctly functioning Ion Selective Sensors. If calibration fails due to the Slope being outside these limits, then please consult the Troubleshooting guide (section 18.2) for possible remedies.

4. pH Mode

4.1 Selecting pH Mode

To select or change the pH Mode...

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



```
Mode
>F1:0.01pH  F2:0.001pH
  F3:mV      F4:Rel mV
  F5:Ion
```

The arrow indicates the current selection.

Press  to select pH mode with 0.01 pH resolution.

Press  to select pH mode 0.001 pH resolution.

Press  to quit without changing the current selection.

4.2 Selecting the pH Buffer Set

The **smartCHEM-Ion** can be programmed to automatically recognise any of the following buffer sets during pH calibration. All pH values listed below are at 25 °C.

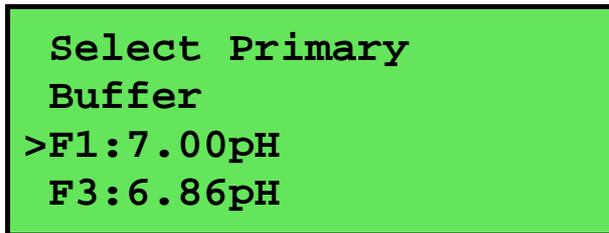
1. pH4.01, pH7.00, pH9.18
2. pH4.01, pH7.00, pH10.01
3. pH4.01, pH6.86, pH9.18
4. pH4.01, pH6.86, pH10.01.

To select the pH buffer set for automatic recognition...

1. Select the pH Buffer set-up menu.

(Menu) → **F4:Setup** → **F1:Standards** → **F2:pH Buffer**).

2. The primary buffer selection menu is now displayed...



```

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

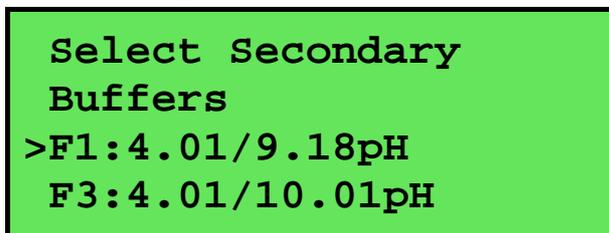
The arrow indicates the current selection.

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

Press (F3) 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 (F3) 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. 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.

4.3 Calibration Buffer Sequence

Before proceeding to pH Calibration (section 4.4), 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.

4.3.1 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 19.1.1 for a detailed explanation of asymmetry. A 1 point calibration will not remove the " * ", which is shown in place of the decimal point when pH is un-calibrated or has failed calibration.

4.3.2 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.

4.3.3 3 Point Calibration

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

For the pre-programmed buffers (see section 4.2), 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

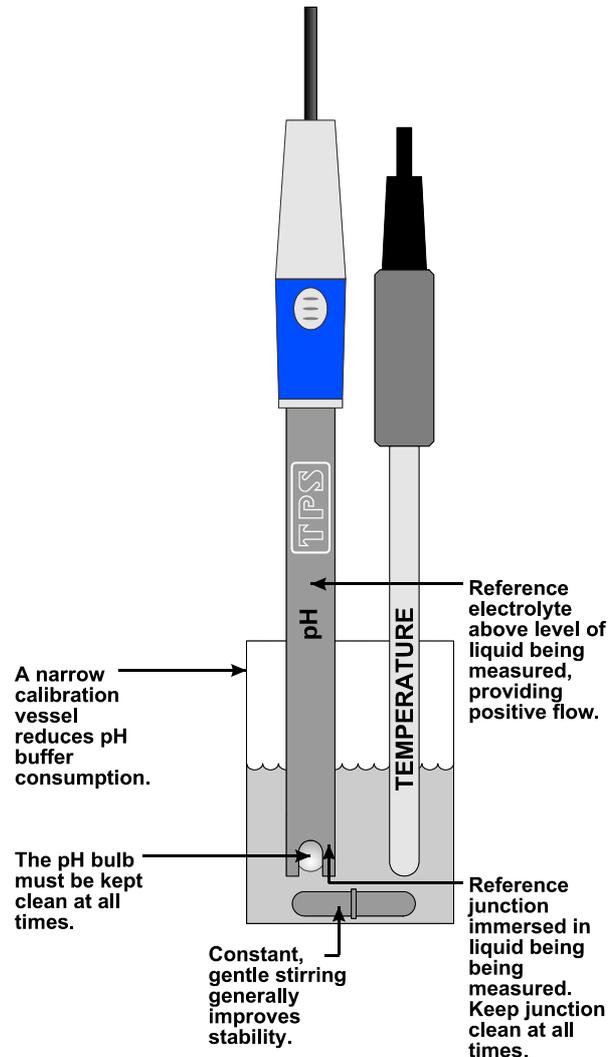
3. Notes

- 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 10.1) and the GLP print-out (section 10.3) labelled "SlopeB".

4.4 pH Calibration

A “ * ” in place of the decimal point indicates that the pH readout is not calibrated, or a past calibration has failed. The “ * ” will be removed once at least a two-point pH calibration has been successfully performed.

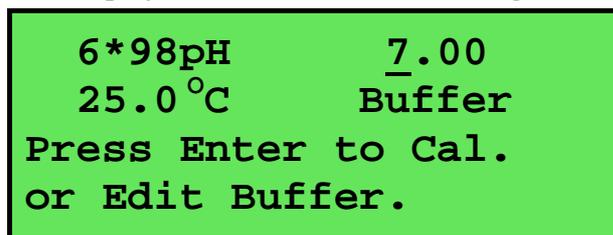
1. Plug the pH sensor into the **pH/mV/Ion** BNC socket and the temperature sensor into the **Temperature** socket. Switch the meter on.
2. Select the desired pH resolution (see section 4.1).
3. Ensure that temperature has already been calibrated, or manually set (see sections 7.1 and 7.4).
NOTE: For 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 4.2.
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 4.3.



DO NOT place the sensors directly into the buffer bottle.

7. Select pH Calibration (Menu) → **F1:Calibrate** → **F1:pH**).

The display should now look something like this...

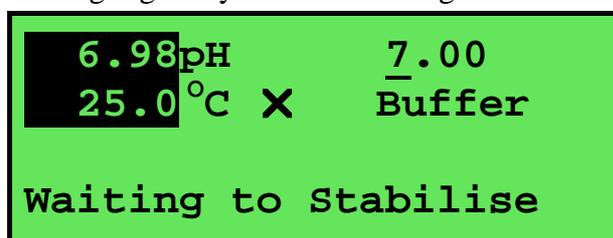


6*98pH 7.00
 25.0 °C Buffer
 Press Enter to Cal.
 or Edit Buffer.

The current pH reading is shown on the left. A “ * ” in place of the decimal point indicates that pH is currently not calibrated.

The buffer that the **smartCHEM-Ion** 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...



6.98pH 7.00
 25.0 °C X Buffer
 Waiting to Stabilise

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 a “ * ” 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 4.3.2 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 4.3.3 for details on the correct sequence of buffers to ensure the instrument is correctly calibrated at the 3 points.
12. The **smartCHEM-Ion** 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.

4.5 pH Calibration Notes

1. **DO NOT** place the sensors directly into buffer bottles. Decant a small quantity and discard after use.
pH9.18 and pH10.01 buffers are unstable once the bottles have been opened. Discard immediately after use.
2. A 1 point calibration should be performed at least weekly. In applications where the sensor junction can become blocked such as dairy products, mining slurries etc, a 1 point calibration may have to be done daily.
3. A full 2 point calibration should be performed at least monthly. Of course, more frequent calibration will result in greater confidence in results.
4. All calibration information is retained in memory when the **smartCHEM-Ion** is switched off, even when the power supply is removed. This information can be recalled or printed later using the GLP function (see section 10).
5. When a 3 point calibration has been successfully performed, an extra line appears in the GLP Recall (section 10.1) and the GLP print-out (section 10.3) labelled “**SlopeB**”.
6. To clear the Slope B from a 3 point calibration without losing all other calibration data, please refer to the section regarding Initialisation (section 16).

4.6 pH Calibration Messages

1. If a 1-point calibration has been successfully performed, the **smartCHEM-Ion** 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 **smartCHEM-Ion** 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 **smartCHEM-Ion** 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 **smartCHEM-Ion** 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 **smartCHEM-Ion** 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 **smartCHEM-Ion** 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 **smartCHEM-Ion** 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 section 4.3.3 for details on the correct 3 point calibration buffer sequence.

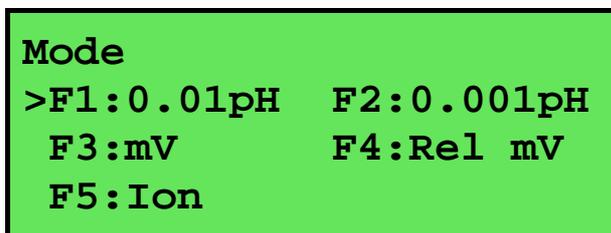
8. The **smartCHEM-Ion** has an allowable Asymmetry range of -1.00 to $+1.00$ pH. The allowable Slope range is 85.0 to 105.0 %. If calibration fails due to either the Asymmetry or the Slope being outside these limits, then please consult the Troubleshooting guide (section 18.2) for possible remedies.

5. Absolute Millivolt Mode

5.1 Selecting Absolute Millivolt Mode

To select Absolute Millivolt Mode...

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



The arrow indicates the current selection.

Press F3 to select Absolute Millivolt mode.

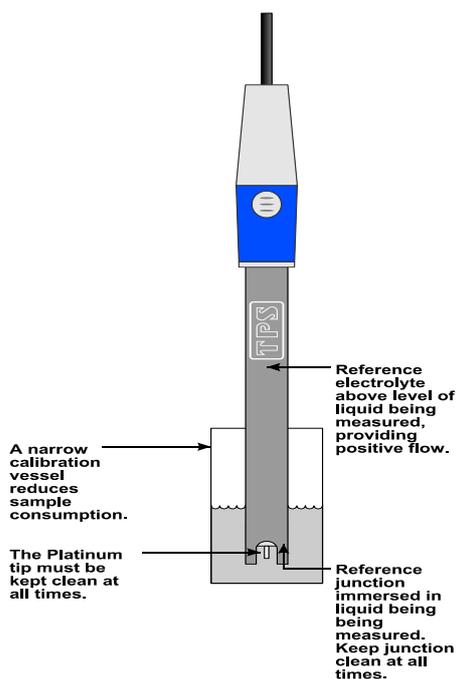
Press Menu to quit without changing the current selection.

2. The **smartCHEM-Ion** will display the actual millivolts produced by the sensor in this mode.

5.2 Absolute Millivolt Calibration

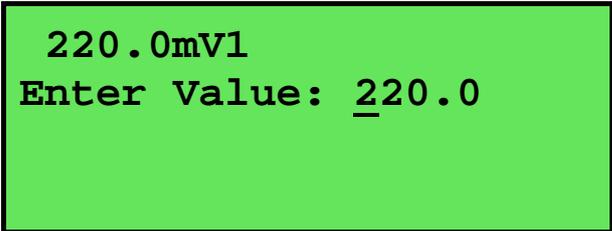
This calibration procedure uses a Redox/ORP sensor and ZoBell calibration as examples. For other types of sensors (eg. ISE's) and solutions, please substitute them when carrying out this procedure.

1. Plug the Redox sensor into the **pH/mV/Ion** BNC socket. Temperature compensation is not applicable for Millivolt mode, so it is not necessary to connect a Temperature sensor. Switch the meter on.
2. Select Millivolt mode (see section 5.1).
3. Remove the wetting cap from the sensor. 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 +231mV of Redox potential. **Caution: ZoBell solution is poisonous and should be handled with care.**



Select mV Calibration ( → **F1:Calibrate** → **F1:mV**).

The display should now look something like this...

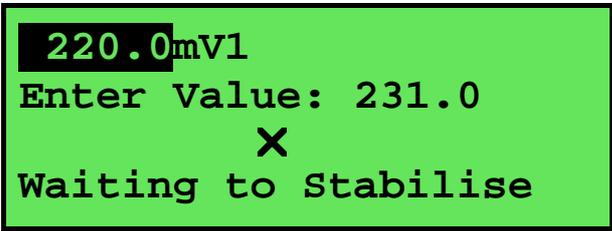


220.0mV1
Enter Value: 220.0

The current mV reading is shown on the top line.

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

5. Enter the value of the calibration solution using the Numeric Keypad, and then press . 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 Millivolt reading has stabilised, the unit will calibrate itself.

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

6. The **smartCHEM-Ion** is now calibrated for mV and is ready for use in this mode. Discard the used samples of standard.

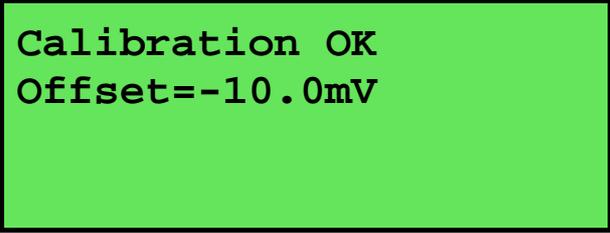
Rinse the Redox sensor in distilled water and blot dry before placing into unknown samples.

5.3 mV 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 calibration should be performed at least weekly. In applications where the sensor junction can become blocked such as dairy products, mining slurries etc, a 1 point calibration may have to be done daily.
4. All calibration information is retained in memory when the **smartCHEM-Ion** is switched off, even when the power supply is removed. This information can be recalled or printed later using the GLP function (see section 10).

5.4 mV Calibration Messages

1. If a mV calibration has been successfully performed, the **smartCHEM-Ion** will display the following message and the offset of the sensor.



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

2. If a mV calibration has failed, the **smartCHEM-Ion** will display the following message and the failed offset value of the sensor.



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

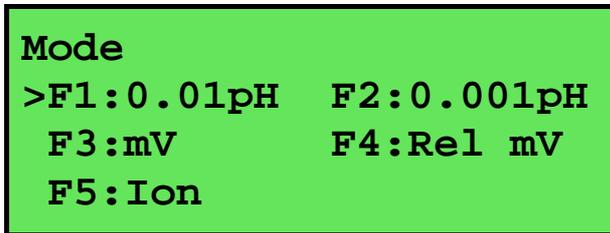
3. The **smartCHEM-Ion** has an allowable Offset range of -60 to $+60$ mV. If calibration fails due to the Offset being outside these limits, then please consult the Troubleshooting guide (section 18.2) for possible remedies.

6. Relative Millivolt Mode

6.1 Selecting Relative Millivolt Mode

To select Relative Millivolt Mode...

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



```

Mode
>F1:0.01pH   F2:0.001pH
  F3:mV       F4:Rel mV
  F5:Ion
  
```

The arrow indicates the current selection.

Press F to select Relative Millivolt mode.

Press Menu to quit without changing the current selection.

2. The **smartCHEM-Ion** will display the millivolt data relative to a known, user-selectable zero point.

6.2 Relative Millivolt Calibration

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

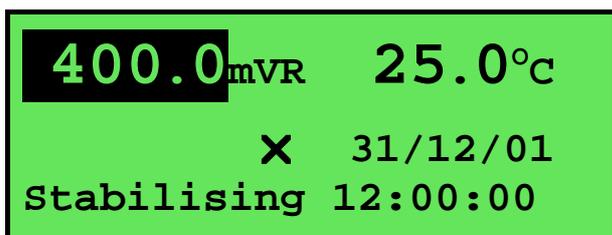
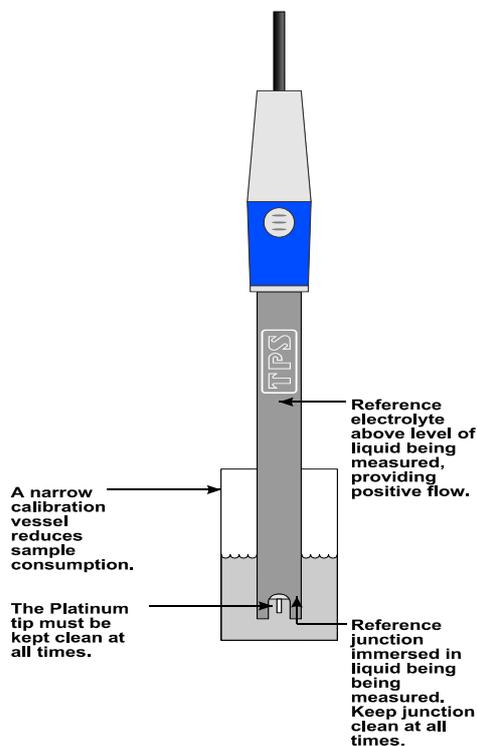
1. Plug the Redox sensor into the **pH/mV/Ion** BNC socket. Temperature compensation is not applied in Relative mV mode, so the temperature sensor does not need to be connected. Switch the meter on.
2. Select Relative mV Mode (see section 6.1).
3. The display now shows the millivolt data with the units “mVR” The “R” indicates Relative mV...



```

400.0mVR   25.0°C
              31/12/01
              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 into a sample of the known standard. Ensure that the platinum tip and reference junction are both covered as per the diagram over the page.
7. Press F to zero the Relative mV reading. The Automatic Stability Function will now show a \boxtimes and highlight the Relative mV reading while it is unstable. For example...



The Relative mV 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.

8. The **smartCHEM-Ion** Relative mV mode is now zeroed and is ready for use. The readout can be re-zeroed by pressing F6 whenever required.

6.3 Relative Millivolt Calibration Notes

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

7. Temperature Mode

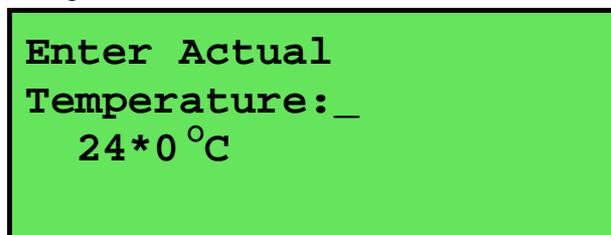
The temperature readout must be calibrated or manually set before attempting pH calibration.

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

7.1 Temperature Calibration

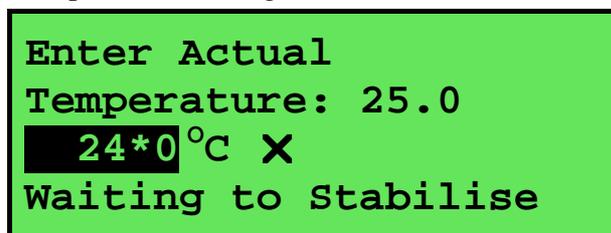
1. Plug the temperature sensor into the **Temperature** socket.
2. Switch the meter on.
3. Place the Temperature sensor into a beaker of room temperature water, alongside a good quality mercury thermometer. Stir the sensor and the thermometer gently to ensure an even temperature throughout the beaker.
4. Select Temperature Calibration ( → **F1:Calibrate** → **F3:Temperature**).

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.



The current reading from the Temperature sensor is displayed.

5. Type in the temperature as measured by the mercury thermometer using the Numeric Keypad and press (). The Automatic Stability Function will now show a  and highlight the Temperature reading while it is unstable...



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

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

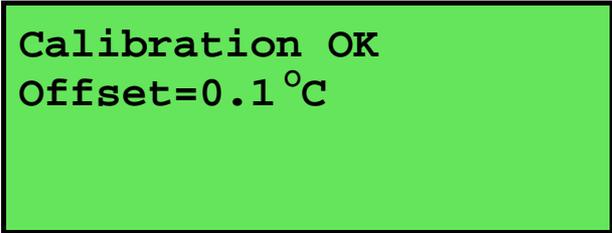
6. The **smartCHEM-Ion** is now calibrated for Temperature and is ready for use in this mode.

7.2 Temperature Calibration Notes

1. Temperature calibration information is retained in memory when the **smartCHEM-Ion** is switched off, even when the power supply is removed. This information can be recalled later using the GLP function (see section 10).
2. Temperature does not need to be re-calibrated unless the Temperature sensor is replaced or the meter is initialised.

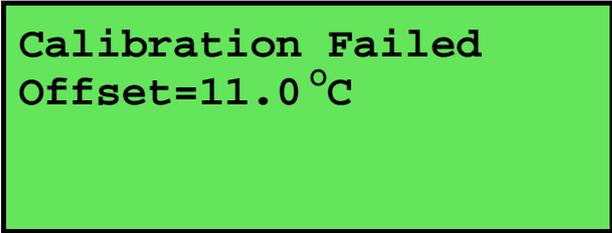
7.3 Calibration Messages

1. If a temperature calibration has been successfully performed, the **smartCHEM-Ion** 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 **smartCHEM-Ion** will display the following message and the failed offset value of the sensor.



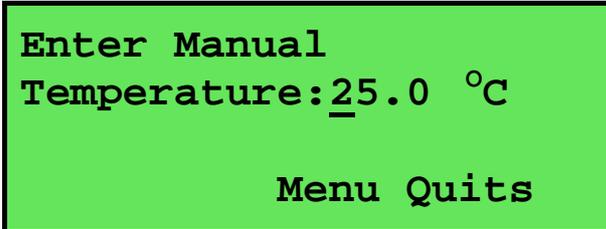
```
Calibration Failed  
Offset=11.0 °C
```

3. The **smartCHEM-Ion** 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 18.3) for possible remedies.

7.4 Manual Temperature Setting

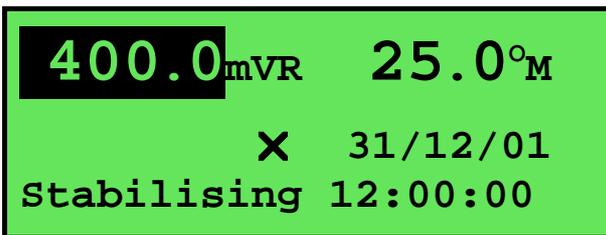
If the Temperature sensor is not connected, the temperature of the sample solution must be set manually for accurate pH measurements. A separate thermometer will be required for this.

1. Switch the meter on.
2. Measure the temperature of the sample.
3. Select Temperature Calibration (**Menu**) → **F1:Calibrate** → **F3: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 **smartCHEM-Ion** 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...



400.0_{mVR} 25.0^{°M}
X 31/12/01
Stabilising 12:00:00

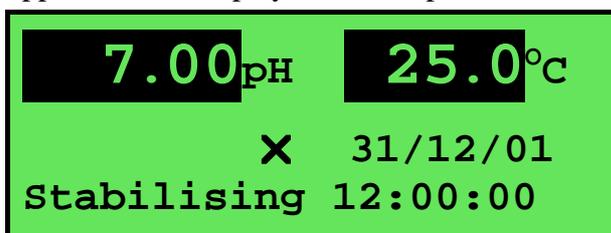
8. Auto Stability Function (ASF)

ASF adds an extra level of versatility to the **smartCHEM-Ion**. When ASF is activated, the **smartCHEM-Ion** 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...

8.1 ASF During Normal Measurement

1. Press F5 in normal measurement mode. All active parameters are highlighted and the \boxtimes 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 \boxtimes will change to a \boxcheck . All readings are now frozen. For example...



3. The operator can now make a note of the reading as required.
4. **To unfreeze the display in order to take the next reading, press F5 again to re-start the ASF sampling process.**
5. Press F5 a second time, while the \boxtimes symbol is being displayed, to turn ASF off.

8.2 ASF During Calibration

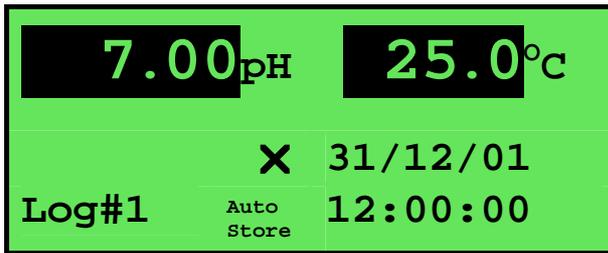
The Automatic Stability Function is automatically invoked during calibration. The stability parameters programmed into the **smartCHEM-Ion** have a finer tolerance during calibration than during normal measurement. This is done to ensure the most accurate possible calibration results.

Press F5 while the \boxtimes 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.

8.3 ASF with Manual Datalogging

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...



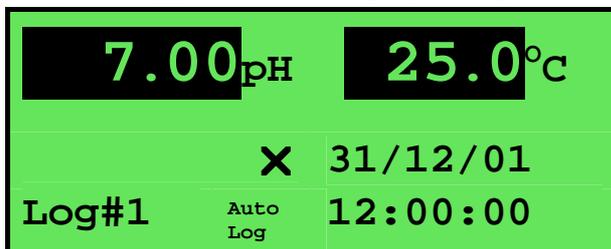
3. **To unfreeze the display in order to take the next reading, press **F5** and **Store** again to re-start the ASF Auto-Store process.**
4. Press **F5** a second time, while the **✘** symbol is being displayed, to turn ASF off.

8.4 ASF with Automatic Datalogging

Using ASF with Automatic Datalogging 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 12.2 for details on programming the Automatic Datalogging function.

1. Press F5 then AutoLog in normal measurement mode. All active parameters are highlighted and the \boxtimes symbol appears in the display, along with the message "Auto Log". 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 are not yet stable in case user intervention is required.

2. When ALL parameters have become stable, all highlighting will be removed and the \boxtimes will change to a \checkmark . All readings are now frozen and automatic datalogging has stopped. For example...

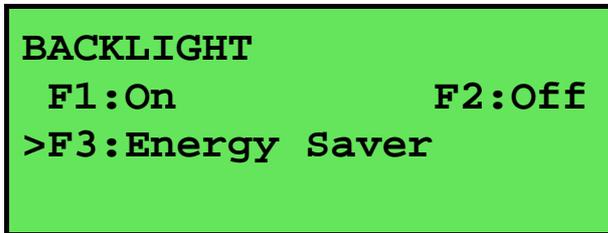


3. To unfreeze the display in order to take the next reading, press F5 and AutoLog again to re-start the ASF automatic datalogging process.
4. Press F5 a second time, while the \boxtimes symbol is being displayed, to turn ASF off.

9. Display Backlight

The **smartCHEM-Ion** 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...



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.

10. Good Laboratory Practices (GLP)

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

10.1 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 along with current Temperature calibration information. For example...

```
smartCHEM-I V1.3 S1234      31/12/02 13:00
Temp Probe Offset=1.0oC    31/12/02 13:00
Temp Probe Calibrated

F4:Next
```

5. Press (F4) to go on to the next screen, which contains the Specific Ion, pH and mV calibration information.

Alternatively, press (Menu) to quit and return to the GLP menu.

```
Ion Offset=10.0mV          31/12/02 12:00
Ion Slope=99.0%           31/12/02 12:10
Ion Calibrated
mV Offset=10mV            31/12/02 12:20
pH Asymmetry=0.10pH       31/12/02 12:30
pH SlopeA= 99.0%         31/12/02 12:40
pH SlopeB= 99.0%         31/12/02 12:50
pH Calibrated             F2:Back F4:Ends
```

6. Press (F2) to go back to the previous screen or press (F4) to quit and return to the GLP menu.

10.2 Failed Calibration

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

```
Ion Offset=10.0mV          31/12/02 12:00
Ion Slope=99.0%           31/12/02 12:10
Ion Calibrated
mV Offset=10mV            31/12/02 12:20
pH Asymmetry=0.10pH       00/00/00 00:00
pH SlopeA= 99.0%         00/00/00 00:00
pH Un-Calibrated          F2:Back F4:Ends
```

10.3 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 **smartCHEM-Ion**.
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-I V1.3 S1234 @ 31/12/2002 13:00
Ion           Offset=      0.0mV      @ 31/12/2001 12:00
Ion           Slope=       99.0%      @ 31/12/2001 12:10
mV           Offset=     10.0mV      @ 01/02/2002 12:20
pH           Asy=         0.10pH     @ 01/02/2002 12:30
pH           SlopeA=      99.0%      @ 01/02/2002 12:40
pH           SlopeB=      99.0%      @ 01/02/2002 12:50
Temp. Probe  Offset=       1.0oC      @ 01/02/2002 13:00
Ends
```

10.4 GLP Calibration Alarm

A new feature of the **smartCHEM-Ion** 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.

10.4.1 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 **smartCHEM-Ion** will now allow the operator to select which parameters will be flagged with a calibration alarm. The “**F1**” option will always correspond to the currently selected Ion, pH, mV or Relative mV mode.

```

Select Channels
F1:pH
F3:Temperature
  
```

Press the relevant **F1** or **F3** 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.

10.4.2 How the GLP Alarm Operates

On the day that calibration is due, the following message will be displayed the first time the **smartCHEM-Ion** is switched on...



GLP Alarm, Calibrate
pH, Temperature

Only those parameters that were selected (see section 10.4.1) will be displayed. The unit will show the currently selected Ion, pH or mV mode, regardless of which was selected at the time of setting the GLP alarm.

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

In addition to the message shown above, the **smartCHEM-Ion** also flashes the decimal point of each parameter that requires calibration, and flashes the message “**Ca1 Now**” on the display.

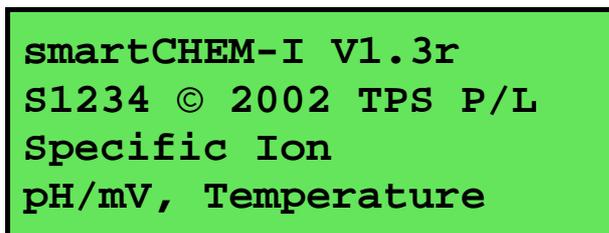
10.4.3 Notes on the GLP Calibration Alarm function

1. To remove the “**Ca1 Now**” message and flashing decimal points, each selected parameter must be correctly calibrated.
2. Switching the GLP Calibration Alarm function off will not clear “**Ca1 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.

10.5 Instrument Serial Number

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

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



smartCHEM-I V1.3r
S1234 © 2002 TPS P/L
Specific Ion
pH/mV, Temperature

The “**r**” after **V1.3** is shown when the Recorder Port option is fitted.

2. The serial number is displayed when recalling the GLP information (section 10.1).
3. The serial number is included on the print-out of GLP information (section 10.3).
4. The GLP information can be downloaded to a PC using the optional Windows[®] software (part number 130086).

10.6 Additional GLP Features

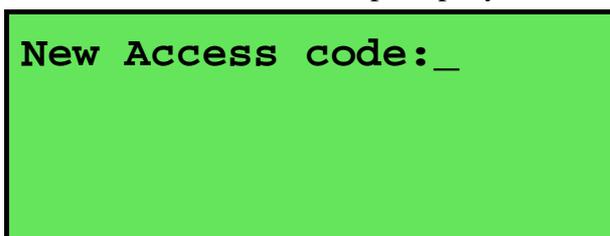
Another GLP requirement is to record the date and time of every reading. The **smartCHEM-Ion** does this for you whenever readings are recorded either with the Manual Datalogging function (section 12.1) or the Automatic Datalogging function (section 12.2).

11. Access Code

The Access Code 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 (F9) are still available without the Access Code. This means that others are still able to carry out day-to-day work.

11.1 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 **smartCHEM-Ion** now prompts you to enter a new access code...



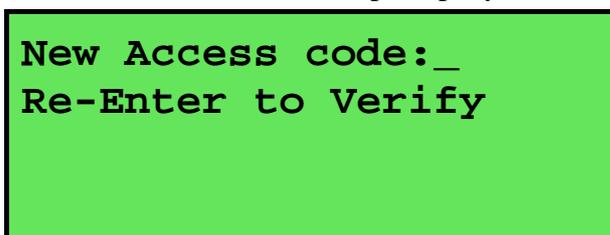
Enter a new code of up to 4 digits using the numeric keypad.

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 **smartCHEM-Ion** now prompts you to re-enter the access code for verification...



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

Press (Menu) to quit without enabling the Access Code system.

5. The **smartCHEM-Ion** now confirms that the Access Code system is enabled before returning to the Access Code menu.

11.2 Using the Access Code System

When the Access Code system is enabled (as per section 11.1), the **smartCHEM-Ion** 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 **smartCHEM-Ion** 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.

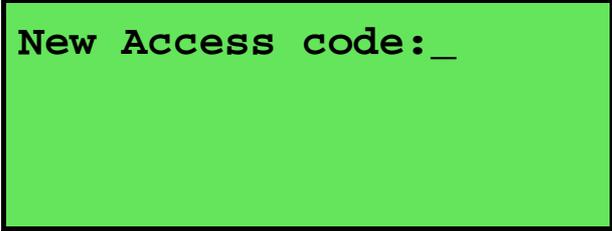
For access codes with 4 digits it is not necessary to press (Enter).

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.

11.3 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 **smartCHEM-Ion** now prompts you to enter a new access code...



New Access code: _

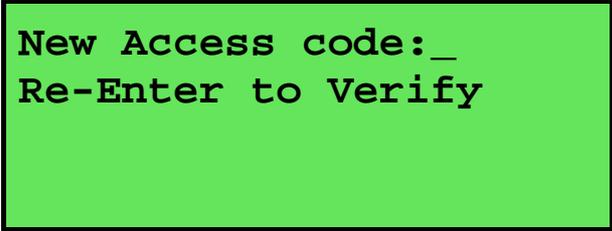
Enter a new code of up to 4 digits using the numeric keypad.

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 **smartCHEM-Ion** 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 **smartCHEM-Ion** now confirms that the Access Code system is enabled before returning to the Access Code menu.

11.4 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 **smartCHEM-Ion** now confirms that Access Code system has been disabled before returning to the Access Code menu.

12. Datalogging

12.1 Manual Datalogging

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...



2. Repeat as often as required. The maximum number of readings that can be stored in the Logger is 2730.

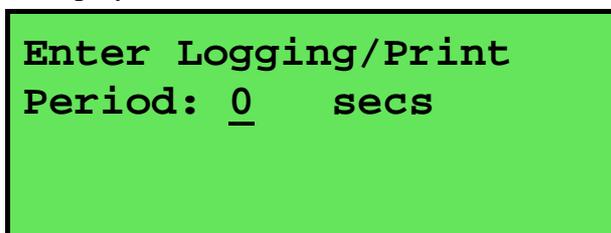
Hint : Press **(F5)** before **(Store)** to make the **smartCHEM-Ion** store the reading only when all the readings have stabilised. See section 8 for more details on the Auto Stability Function.

12.2 Automatic Datalogging

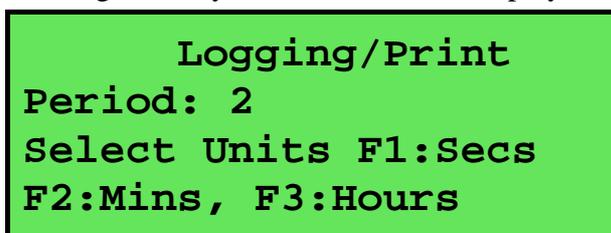
The **smartCHEM-Ion** can automatically record records into the Logger. First the logging period must be programmed, then automatic logging can be started and stopped as required.

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.



3. Use the Numeric Keypad to set the period at which the **smartCHEM-Ion** 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 **smartCHEM-Ion** will ask you to enter the units. The Logging/Printing Period you have set is also displayed. For example...



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 **smartCHEM-Ion** 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 2730 readings).

Press F2 to send records directly to the RS232 port.

6. The automatic logging function is now programmed, and can be started and stopped as required.
7. To start automatic logging, press AutoLog in normal display mode.

When the **smartCHEM-Ion** is logging into its own memory, the display will look like this...



7.00_{pH} 25.0°C
31/12/01
Log#1 12:00:00

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

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



7.00_{pH} 25.0°C
31/12/01
Sending 12:00:00

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

8. Press AutoLog to stop automatic logging.

Hint : Press F5 before starting automatic logging to make the **smartCHEM-Ion** stop logging as soon as all the readings have become stable. See section 8 for more details on the Auto Stability Function.

Notes on Automatic Datalogging

1. The clock must be set before the **smartCHEM-Ion** will allow automatic datalogging to start. The message “**Clock Not Set**” is displayed if the clock is not set. See section 15 for details on setting the clock.
2. Pressing **(Menu)** during automatic datalogging halts logging. Press **(AutoLog)** after returning to normal display mode to re-start automatic datalogging.

12.3 Recalling Readings from the Logger

To recall records from the Logger onto the **smartCHEM-Ion** display...

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

Record number 1 is now displayed.

For example...

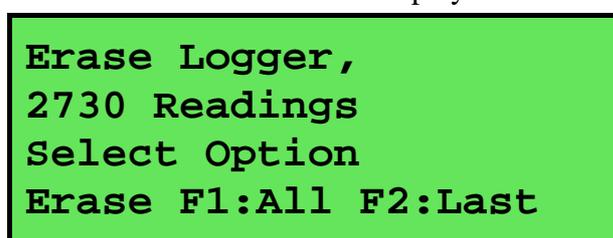


3. Press **(F2)** and **(F4)** to move forwards and backwards through the records. Press and hold **(F2)** or **(F4)** to scroll continuously through the readings. The rate is slow enough to allow the operator to see trends in the data as it is scrolling. To display a specific record, type in the desired record number using the Numeric Keypad and press **(Enter)**. Press **(F3)** to send the displayed record to the RS232 port.

12.4 Erasing Records from the Logger

To erase records from the Logger...

1. Select the Erase Logger menu (**(Menu)** → **F2:Logger** → **F2:Erase**)
2. The **smartCHEM-Ion** now displays the Erase menu, for example...



The number of readings stored in the Logger is displayed. See the “2730” 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.

12.5 Printing Records from the Logger to the RS232 Port

1. Connect one end of the RS232 cable to the **Power/RS232** socket of the **smartCHEM-Ion**.
2. Connect the other end of the RS232 cable to an RS232 Printer, or to a Serial port of a PC.
3. Ensure that the baud rate for the printer or PC and the **smartCHEM-Ion** are the same. If necessary, alter the baud rate of the **smartCHEM-Ion** (see section 13.1).

The **smartCHEM-Ion** uses XON/XOFF protocol. Ensure that the printer is set accordingly.

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

13. RS232 Port

13.1 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...



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.

13.2 Sending Readings to the RS232 Port

Press (Print) to instantly send readings to the RS232 port whenever the **smartCHEM-Ion** is in normal display mode.

Records can be sent directly to the RS232 port rather than stored in memory during automatic datalogging. See section 12.2 for details.

Press (Print) while recalling data on the display (see section 12.3) to send that record to the RS232 port.

13.3 RS232 Configuration

The **smartCHEM-Ion** RS232 configuration is 8 Bits, No Parity, 1 Stop Bit, XON/XOFF Protocol.

This information is displayed when setting the baud rate (see section 13.1)

13.4 Communication and Statistical Software

Communication between the **smartCHEM-Ion** 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 **smartCHEM-Ion** 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 13.8 and the “excel.txt” file in the folder where you installed the WinTPS program.

13.5 Commands

The following commands can be sent from a PC to the **smartCHEM-Ion**. 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 smartCHEM-Ion . The log number returned is set to Zero.
Request logged data	?R<cr>	Returns all logged records from the smartCHEM-Ion memory. The data ends with the message ENDS<cr>
Erase logged data	?E<cr>	Erases all logged records from the smartCHEM-Ion 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-I•V1.3•S1234•2730•%<cr> , where “•” are spaces. Note that the number of logged readings is right-justified. 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 13.7 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... 5,1,10,12,8,21,4,26,8,38,5 This denotes 5 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.

13.6 Data Format

Data is returned to the RS232 Port by the **smartCHEM-Ion** in the following format.

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

dd/mm/yyyy•hh:mm:ss•LLLL•IIIIIIIIuuu•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 **smartCHEM-Ion** sends a Zero for instant readings (see section 13.2).

IIIIIIII is Ion, pH, mV or Relative mV data. 8 characters, right justified.

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

pH•	for pH readout.
mV•	for Absolute Millivolts readout.
mVR	for Relative Millivolts 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 13.5), the data is terminated with a carriage return.

When the data is sent by the **smartCHEM-Ion** using the Print function (section 12.5) or the Instant Send function (section 13.2), the data ends with a carriage return and a line feed.

13.7 GLP Data Format

GLP information is returned as 18 lines terminated by a carriage return. When using the “?G” command (section 13.5), the computer must respond with a character after receiving each line.

For example...

```
smartCHEM-I V1.3 S1234 @ 31/12/2002 13:00
Ion          Offset=      0.0mV      @ 31/12/2001 12:00
Ion          Slope=       99.0%      @ 31/12/2001 12:10
mV          Offset=     10.0mV      @ 01/02/2002 12:20
pH          Asy=         0.10pH      @ 01/02/2002 12:30
pH          SlopeA=      99.0%      @ 01/02/2002 12:40
pH          SlopeB=      99.0%      @ 01/02/2002 12:50
Temp. Probe Offset=       1.0oC      @ 01/02/2002 13:00
Ends
```

13.8 Importing Data into Microsoft Excel

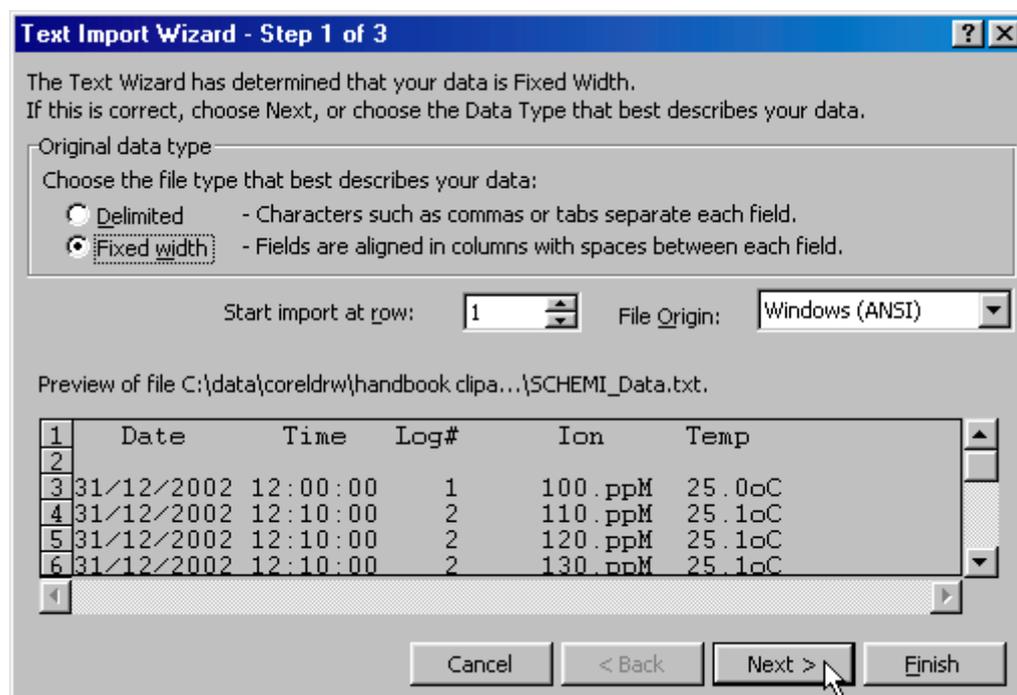
The following procedure details the method for importing a **smartCHEM-Ion** text data file into Microsoft® Excel®.

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.

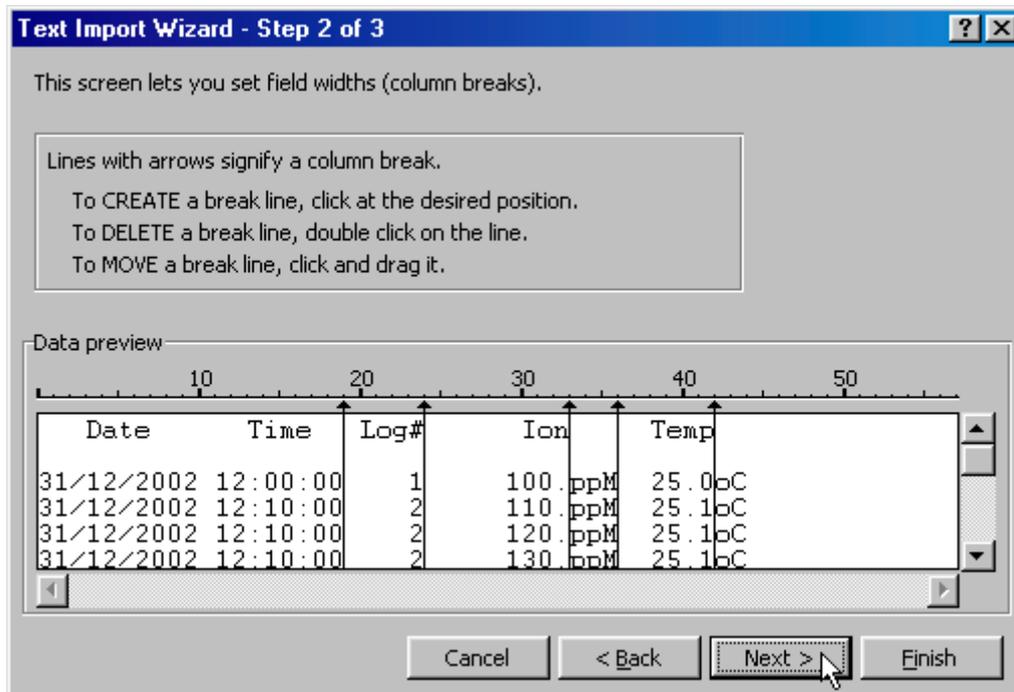


Continued over the page...

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.

14. 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.

14.1 Recorder Port Configuration

1. Select the Recorder set-up menu

( → **F4:Setup** → **F4:Ports** → **F3:Recorder**).

The **smartCHEM-Ion** will now display the Recorder Port configuration screen...



The arrow indicates the current selection.

The **smartCHEM-Ion** shows “**F1:Ion**”, “**F1:pH**” or “**F1:mV**”, depending on which mode is currently selected.

2. Press  to set the Recorder output to Specific Ion, pH, mV or Relative mV data, depending on current mode selection.

Press  to set the Recorder output to Temperature data.

Press  to quit and retain the current setting.

14.2 Recorder Port Specifications

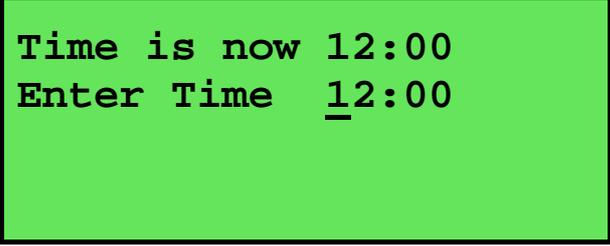
Mode	Range	Output Range	Examples (Reading = mV Out)
Specific Ion	The output for Specific Ion corresponds to the temperature compensated mV signal produced by the Ion sensor. The range for this is -1500 to +1500 mV	0 to 2000 mV	0.0 mV = 1000 mV +750 mV = 1500 mV -600 mV = 600 mV (mV output of sensor, 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

Output Impedance : Approximately 1000 Ohms

Resolution : Approximately 2 mV

15. Setting the Clock

1. Select the Clock Set-up 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 .
Alternatively, press menu to quit and retain the current setting.
4. If you pressed  above, the display will now show the current date, for example...



```
Date is now 31/12/02
Enter Date  31/31/02
           dd/mm/yy
```

5. Use the Numeric Keypad to enter the current date, then press .
Alternatively, press menu to quit and retain the current setting.

Notes

1. The **smartCHEM-Ion** tests that a valid day of the month is entered. If an invalid date is entered (eg. 31/02/2002), the **smartCHEM-Ion** 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 **smartCHEM-Ion** also tests for leap years.

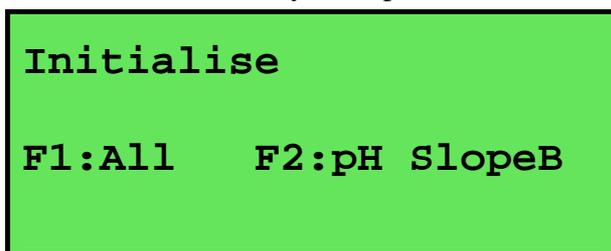
16. Initialising the smartCHEM-Ion

If the calibration settings of the **smartCHEM-Ion** 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 **smartCHEM-Ion**...

1. Select Initialise from the Setup menu (Menu) → **F4:Setup** → **F5:Initialise**)
2. The **smartCHEM-Ion** 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...



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.

17. Instrument firmware version number

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

18. Troubleshooting

18.1 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.

18.2 Specific Ion, pH and mV Troubleshooting

Symptom	Possible Causes	Remedy
Unit fails to calibrate, even with new probe.	Calibration settings outside of allowable limits due to previous failed calibration.	Initialise the unit. See section 16.
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 ± 60 mV).	<ol style="list-style-type: none"> Reference junction blocked. Reference electrolyte contaminated. 	<p>Clean reference junction as per instructions supplied with the pH or reference sensor.</p> <p>Flush with distilled water and replace electrolyte.</p>
<p>2 Point calibration fails. (Specific Ion slope is less than 50%, or pH slope is less than 85.0%.)</p> <p>3 Point pH calibration fails. (pH SlopeB is less than 85.0%).</p>	<ol style="list-style-type: none"> Specific Ion standards or pH Buffers not correctly set. Ion sensor surface or pH glass bulb not clean. Sensor is aged. Connector is damp. Specific Ion standards or pH Buffers are inaccurate. 	<p>Ensure that you are using Specific Ion standards as per the Standards set-up (see section 3.2).</p> <p>For automatic pH buffer recognition, ensure that you are using buffers that match the selected buffer set (see section 4.2). Otherwise, ensure that the buffer value is entered correctly at pH calibration.</p> <p>Clean sensor surface or glass bulb as per instructions supplied with the sensor.</p> <p>Attempt rejuvenation as per instructions supplied with the sensor. If unsuccessful, replace sensor.</p> <p>Dry in a warm place.</p> <p>Replace standards or buffers.</p>
Unstable readings.	<ol style="list-style-type: none"> Reference Electrolyte chamber needs to be refilled. Reference junction blocked. Ion sensor surface or pH glass bulb not clean. Bubble in pH glass bulb. Faulty connection to meter. Reference junction not immersed. KCl crystals around reference junction inside the electrolyte chamber. 	<p>Refill with saturated KCl filling solution.</p> <p>Clean reference junction as per instructions supplied with the sensor.</p> <p>Clean glass bulb as per instructions supplied with the sensor.</p> <p>Flick the sensor to remove bubble.</p> <p>Check connectors. Replace if necessary.</p> <p>Ensure that the reference junction is fully immersed. See diagrams in sections 3.3, 4.4, 5.2, & 6.2.</p> <p>Rinse electrolyte chamber with warm distilled water until dissolved. Replace electrolyte.</p>
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.	<ol style="list-style-type: none"> Check connector. Replace if necessary. 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 8).

18.3 Temperature Troubleshooting

Symptom	Possible Causes	Remedy
Temperature inaccurate and cannot be calibrated.	<ol style="list-style-type: none"> 1. Faulty connector. 2. Faulty Temperature sensor. 	<p>Check the connector and replace if necessary.</p> <p>Return Temperature sensor for repair, or replace sensor.</p>
Displays flashing “M” when Temperature sensor plugged in.	<ol style="list-style-type: none"> 1. Faulty instrument socket. 2. Faulty Temperature sensor. 	<p>Return the instrument to the TPS factory for service.</p> <p>Return Temperature sensor for repair, or replace sensor.</p>
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 8).

19. Appendices

19.1 pH Sensor Fundamentals

pH electrodes 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 electrode. 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 sensors 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.

19.1.1 Asymmetry of a pH Sensor

An “ideal” pH electrode produces 0 mV output at 7.00 pH. In practice, pH electrodes 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 **smartCHEM-LAB** has an unlimited Asymmetry range.

Figure 19-1 illustrates how asymmetry is expressed for a pH electrode.

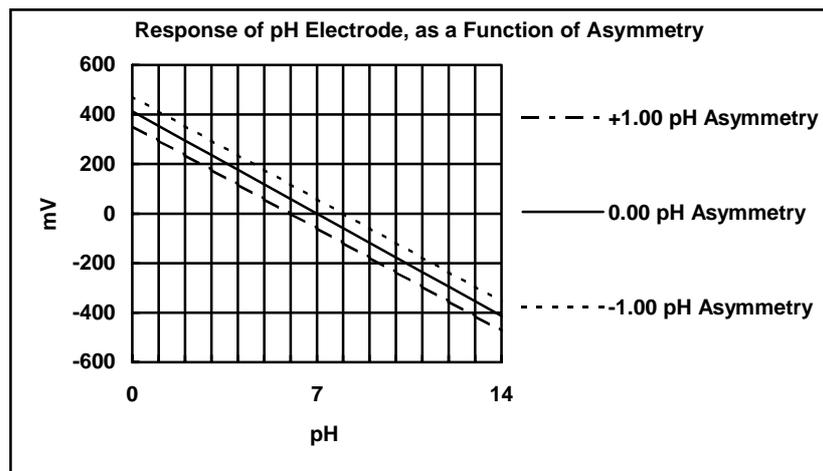


Figure 19-1

19.1.2 Slope of a pH or Specific Ion Sensor

As mentioned above, a pH electrode produces 0 mV output at around 7.00 pH. As the pH goes up, an “ideal” pH electrode produces -59.16mV/pH unit at 25°C . As the pH goes down, an ideal pH electrode produces $+59.16\text{mV/pH}$ unit. In practice, pH electrodes usually produce slightly less than this. The output of a pH electrode is expressed as a percentage of an ideal electrode. For example, an ideal electrode that produces 59.16mV/pH unit has “100% Slope”. An electrode 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.

As for pH electrodes, Specific Ion electrodes produce slightly less than these figures in real practice.

Figure 19-2 illustrates the principle of electrode slope, using a pH sensor as an example.

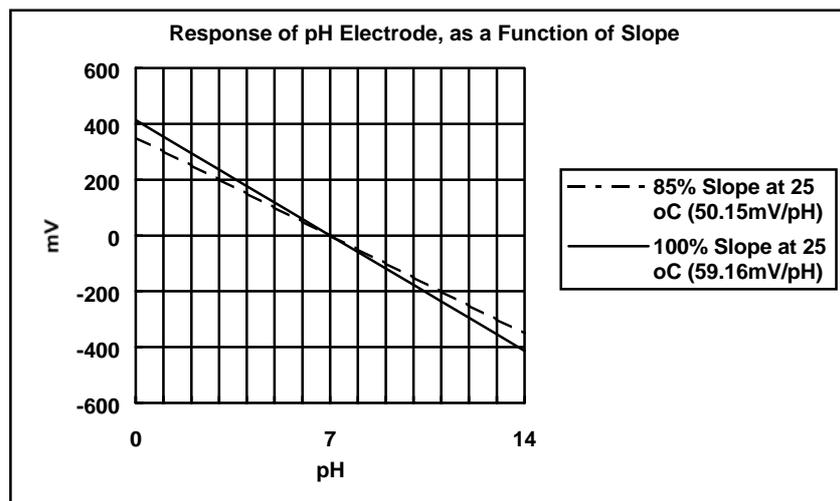


Figure 19-2

19.1.3 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) probe or by entering the sample temperature manually. Figure 19-3 shows the slope of a pH electrode at various temperatures.

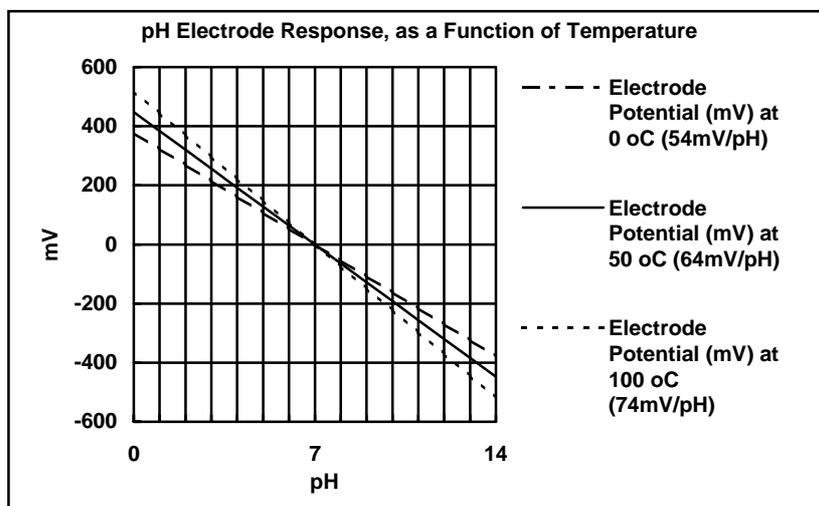


Figure 19-3

19.1.4 Polarisation Output

The **Accessories** connector on the rear panel of the **smartCHEM-Ion** 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 sensor (part no 122237) has two connectors. The bayonet type BNC connector fits to the **pH/mV/Ion** BNC socket and the black plastic connector fits to the **Accessories** socket.

When performing Karl Fischer titrations, ensure that the **smartCHEM-Ion** is in mV.

20. 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 Factory, or Authorised 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 three (3) months.

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

Shipping damage is not covered by this warranty.

PLEASE NOTE:

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

PROCEDURE FOR SERVICE

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

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

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

Please check that the following is enclosed with your equipment:

- **Your Name and daytime phone number.**
- **Your company name, ORDER number, and return street address.**
- **A description of the fault. (Please be SPECIFIC.)**
(Note: "Please Repair" does NOT describe a fault.)

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

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