

SmartCHEM-C

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Congratulations !

The **smartCHEM-C** is a precision, research grade Conductivity instrument and is designed to give you many years of reliable service.

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

The manual is divided into the following sections:

1. Table of Contents

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

1. Introduction

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

1. Main Section

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

1. Appendices

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

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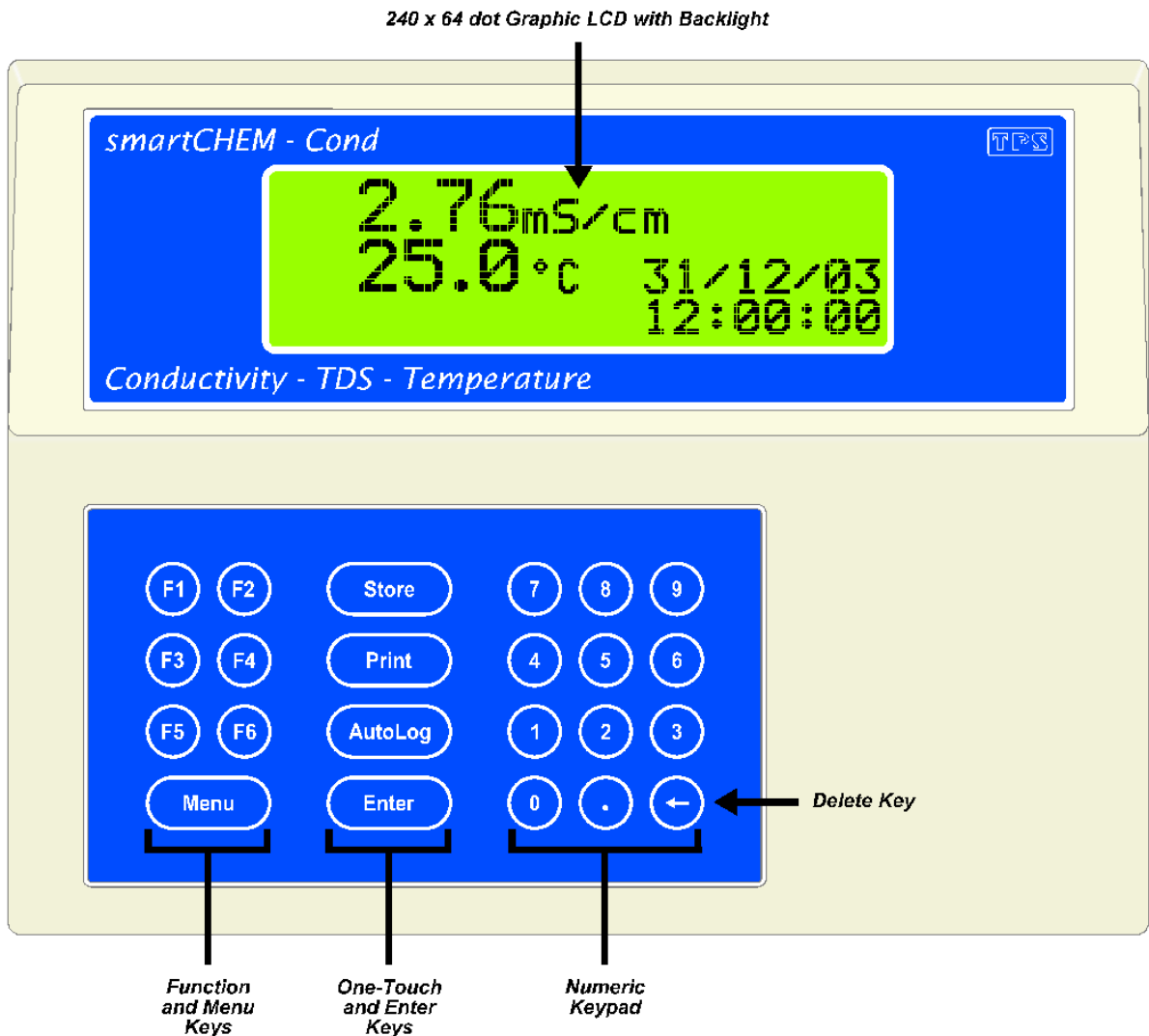
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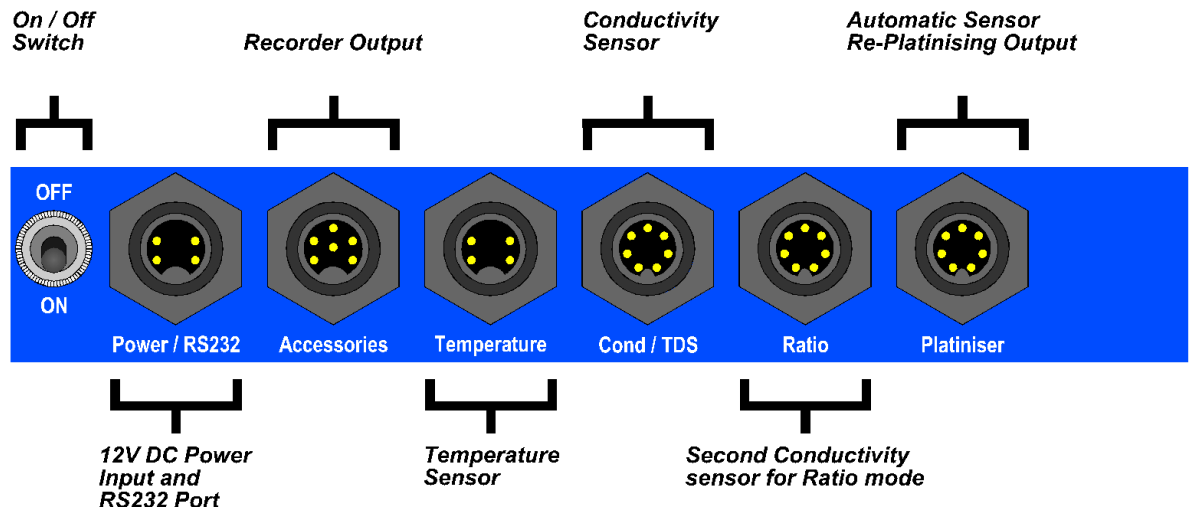
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1. Introduction

1.1 smartCHEM-C Display and Controls



1.2 smartCHEM-C 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 start and stop the Automatic Stability Function. See section 9.

1.4 One-touch Keys

 : Press to manually record readings into the Logger. See section 13.1.

 : Press to transmit current reading plus date and time to the RS232 port. See section 14.2.

 : Press to start and stop Automatic Data logging. See section 13.2.

 : 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. Shows Conductivity/TDS/Salinity/Resistivity/Ratio, Temperature, Date and Time simultaneously.

Backlight can be set to On, Off or Energy Saver modes. See section 10.



1.8 Unpacking Information

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

	Part No
<i>Standard Kit...</i>	
1. smartCHEM-C Conductivity/TDS/Salinity/Resistivity/Ratio Meter	122105
2. k=1 Conductivity Sensor	122230
3. Temperature/ATC Sensor	121248
4. 2.76 mS/cm Conductivity Standard, 200mL	122306
5. Plug-Pack Power Supply	130037
6. Manual	
<i>Optional sensors that may have been ordered with your smartCHEM-C...</i>	
1. k=0.1 Conductivity Sensor	122232
2. k=10 Conductivity Sensor	122234
<i>Instrument Options...</i>	
1. Flexible arm type sensor holder	130088
2. RS232 Serial Interface Cable, 2m	130041
3. Serial to USB Adaptor (requires 130041 Serial Cable)	130087
4. Analogue Recorder Output Option (includes cable)	130028
5. WinTPS RS232 Communication software for Windows 95 and all later versions	130086
6. Platinising Solution, 20mL	122300

1.9 Specifications

1.9.1 Conductivity

Ranges	Resolution	Accuracy
k=0.1 Sensor		
0 to 2.000 $\mu\text{S}/\text{cm}$ 0 to 20.00 $\mu\text{S}/\text{cm}$ 0 to 200.0 $\mu\text{S}/\text{cm}$ 0 to 2000 $\mu\text{S}/\text{cm}$	0.001 $\mu\text{S}/\text{cm}$ 0.01 $\mu\text{S}/\text{cm}$ 0.1 $\mu\text{S}/\text{cm}$ 1 $\mu\text{S}/\text{cm}$	$\pm 0.2\%$ of full scale of selected range at 25 °C
k=1.0 Sensor		
0 to 20.00 $\mu\text{S}/\text{cm}$ 0 to 200.0 $\mu\text{S}/\text{cm}$ 0 to 2000 $\mu\text{S}/\text{cm}$ 0 to 20.00 mS/cm	0.01 $\mu\text{S}/\text{cm}$ 0.1 $\mu\text{S}/\text{cm}$ 1 $\mu\text{S}/\text{cm}$ 0.01 mS/cm	$\pm 0.2\%$ of full scale of selected range at 25 °C
k=10 Sensor		
0 to 200.0 $\mu\text{S}/\text{cm}$ 0 to 2000 $\mu\text{S}/\text{cm}$ 0 to 20.00 mS/cm 0 to 200.0 mS/cm	0.1 $\mu\text{S}/\text{cm}$ 1 $\mu\text{S}/\text{cm}$ 0.01 mS/cm 0.1 mS/cm	$\pm 0.2\%$ of full scale of selected range at 25 °C
<p>Notes : Ranges are automatically selected. Exact auto-ranging points and full scales are subject to sensor performance.</p> <p>All ranges listed can be displayed in equivalent Siemens/metre units.</p>		

Sensor Type

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

Temperature Compensation

Automatic, -5 to 70 °C.

ATC co-efficient can be set from 0 to 6.00% / °C individually for standard and sample.

ATC reference temperature is user-selectable for 25.0 °C or 20.0 °C.

Calibration

Automatic zero and span calibration. Any calibration standard from 20 $\mu\text{S}/\text{cm}$ to 200 mS/cm can be user set.

Sensor Span Range

k=0.1 : k=0.075 to k=0.133

k=1.0 : k=0.75 to k=1.33

k=10 : k=7.5 to k=13.3

1.9.2 TDS

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

Sensor Type

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

Temperature Compensation

Automatic, -5 to 70 °C.

ATC co-efficient can be set from 0 to 6.00% / °C individually for standard and sample.

ATC reference temperature is user-selectable for 25.0 °C or 20.0 °C.

TDS Factor

0.40 to 1.00 user selected.

1.9.3 Salinity

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

Sensor Type

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

Temperature Compensation

Automatic, -5 to 70 °C

1.9.4 Resistivity

Ranges	Resolution	Accuracy
<i>k=0.1 Sensor</i>		
0.50 to 99.00 MΩ.cm	0.01 MΩ.cm	±0.5% of full scale of selected range at 25 °C
50 to 9999 KΩ.cm	1 KΩ.cm	
5.0 to 999.9 KΩ.cm	0.1 KΩ.cm	
0.50 to 99.99 KΩ.cm	0.01 KΩ.cm	
<i>k=1.0 Sensor</i>		
50 to 9999 KΩ.cm	1 KΩ.cm	±0.5% of full scale of selected range at 25 °C
5.0 to 999.9 KΩ.cm	0.1 KΩ.cm	
0.50 to 99.99 KΩ.cm	0.01 KΩ.cm	
50 to 9999 Ω.cm	1 Ω.cm	
<i>k=10 Sensor</i>		
5.0 to 999.9 KΩ.cm	0.1 KΩ.cm	±0.5% of full scale of selected range at 25 °C
0.50 to 99.99 KΩ.cm	0.01 KΩ.cm	
50 to 9999 Ω.cm	1 Ω.cm	
5.0 to 999.9 Ω.cm	0.1 Ω.cm	
Note : Ranges are automatically selected. Exact auto-ranging points and full scales are subject to sensor performance.		

Sensor Type

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

Temperature Compensation

Automatic, 0 to 70 °C.

ATC co-efficient can be set from 0 to 6.00% / °C individually for standard and sample.

ATC reference temperature is user-selectable for 25.0 °C or 20.0 °C.

Calibration

Automatic zero and span calibration. Any calibration standard from 20 ppM to 500 ppK can be user set.

Sensor Span Range

k=0.1 : k=0.075 to k=0.133

k=1.0 : k=0.75 to k=1.33

k=10 : k=7.5 to k=13.3



1.9.5 Ratio

Ranges	Resolution	Accuracy
0.000 to 1.500 1.50 to 15.00 (exact ranges depend on span of sensors)	0.001 0.01	±0.001 ±0.01

Note : Allowable difference of k factors sensors is 50% to 200%, relative to reference sensor.
Actual Conductivity of sample and reference solutions must be within measurement range of the k factor sensor being used.

1.9.6 Temperature

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

Sensor Type	Silicon transistor
Calibration	Automatic offset calibration
Sensor Offset Range	-10.0 to 10.0 °C

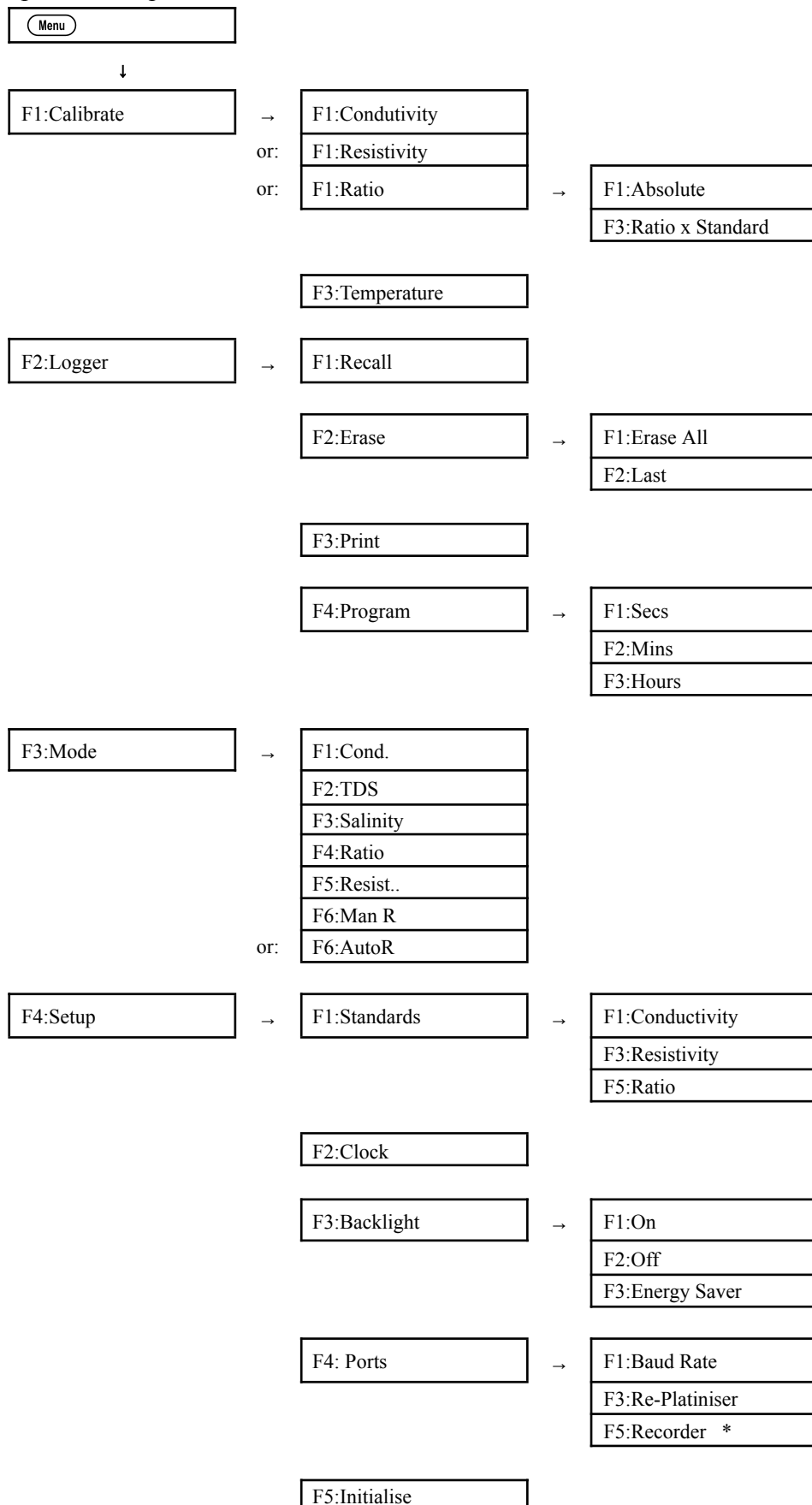


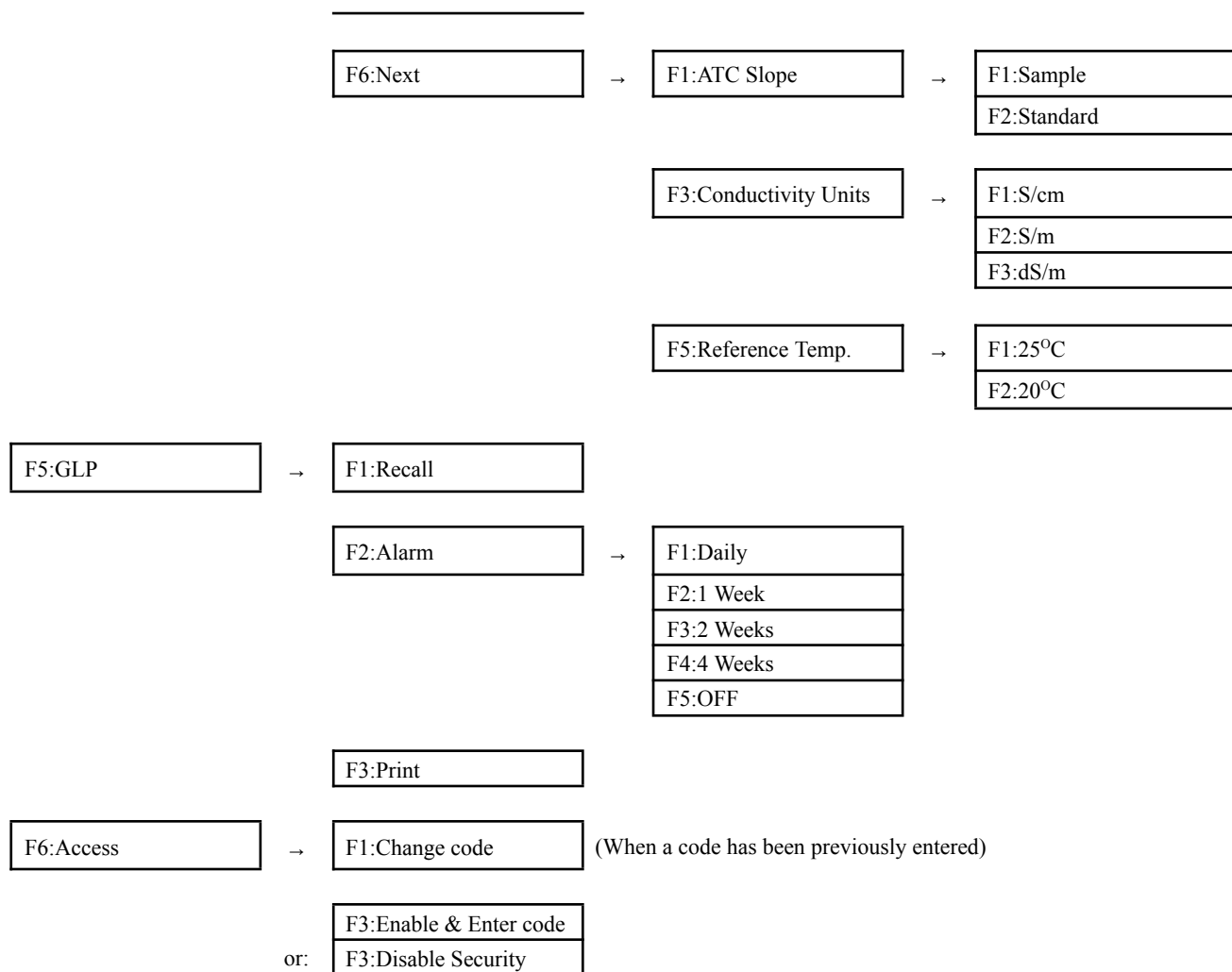
1.9.7 General Specifications

Memory	2730 readings including date and time
Sensor re-platinising output	Automatically detects k factor of sensor to be re-platinised and adjusts current and time accordingly.
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. 2.5 kg
Environment	Temperature : 0 to 45 °C Humidity : 0 to 95 % R.H.

2. smartCHEM-C Menu Structure

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






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


3. Conductivity Mode

3.1 Selecting Conductivity Mode

1. Select Conductivity Mode ( → **F3:Mode** → **F1:Cond.**).
2. The **smartCHEM-C** now proceeds to Conductivity measurement mode. Note that a “*” is shown in place of the decimal point until a successful calibration has been performed (see section 3.8).

3.2 Selecting Conductivity readout units





The factory default setting for this item is S/cm. If this is satisfactory, go directly to section 3.3.

1. Select the Display Units configuration menu
( → **F4:Setup** → **F6:Next** → **F2:Units**).

The following screen is now displayed...


```

UNITS
>F1 : S/cm      F2 : S/m
  F3 : dS/m
  
```

2. Press  to display Conductivity in units of S/cm (Siemens per centimetre).
Press  to display Conductivity in units of S/m (Siemens per metre).
Press  to display Conductivity in units of dS/m (Decisiemens per metre).
Press  to quit without changing the current setting.

3.3 Setting the Conductivity calibration standard




The factory default for this item is 2.76mS/cm. If this is satisfactory, go directly to section 3.4.

1. Select the Conductivity Standard entry
( → **F4:Setup** → **F1:Standards** → **F1:Conductivity**).

The following screen is now displayed...

```

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

2. Type in the value of the Conductivity standard that is to be used for calibration, including the decimal point. Use the  key to make any corrections.
 3. Press  to save the value of the standard solution.
Alternatively, press  to quit without changing the current setting.
- 4 .** The **smartCHEM-C** will now ask you to enter the units for the Conductivity standard...

```

Conductivity
Standard: 2760
  
```

Select Units

F1: $\mu\text{S}/\text{cm}$ F2: mS/cm

- (a) If the **smartCHEM-C** is set up for S/cm (section 3.2)...
 - Press F1 to set the Conductivity Standard as $\mu\text{S}/\text{cm}$.
 - Press F2 to set the Conductivity Standard as mS/cm .
 - or (b) If the **smartCHEM-C** is set up for S/m (section 3.2)...
 - Press F1 to set the Conductivity Standard as $\mu\text{S}/\text{m}$.
 - Press F2 to set the Conductivity Standard as mS/m .
 - Press F3 to set the Conductivity Standard as S/m.
 - or (c) If the **smartCHEM-C** is set up for dS/m (section 3.2), dS/m is set as the unit for the standard.
5. The Conductivity standard is now programmed for use at calibration.

3.4 Setting the Reference Temperature

The factory default setting for this item is 25°C. If this is satisfactory, go directly to section 3.5.

1. Select the ATC configuration menu.
 - (Menu → F4: Setup → F6: Next → F3: Reference Temp.)
2. Press F1 to reference all readings to 25°C for Automatic Temperature Compensation.
 Press F2 to reference all readings to 20°C for Automatic Temperature Compensation.
 Press Menu to quit without changing the current setting.

3.5 Setting the ATC Slope for unknown samples

The factory default setting for this item is 2.00 %/°C. If this is satisfactory, go directly to section 3.6.

The ATC Slope for the unknown sample solution is the rate at which the conductivity of the solution changes per degree Celsius. This Slope must be set correctly on the **smartCHEM-C** to enable the Automatic Temperature Compensation system to work correctly. If the ATC Slope is not known, please refer to section 20.2 for details on how it can be calculated.

The ATC Slope for Salinity Mode is defined by the formula for Salinity.

To set the ATC Slope for unknown samples...

1. Select ATC Slope entry.
 - (Menu → F4: Setup → F6: Next → F1: ATC Slope → F1: Sample).

The following screen is displayed...

Enter A.T.C. Slope
of sample: 2.00%

2. Type in the ATC Slope of the unknown sample, including the decimal point. Use the \ominus key to make any corrections. Enter 0.00% to obtain absolute readings, without any temperature correction being applied.



3. Press **Enter** to save the ATC Slope of the unknown solution.
Alternatively, press **Menu** to quit without changing the current setting.


3.6 Setting the ATC Slope for the Calibration Standard

The factory default setting for this item is 2.00 %/°C. If this is satisfactory, go directly to section 3.7.

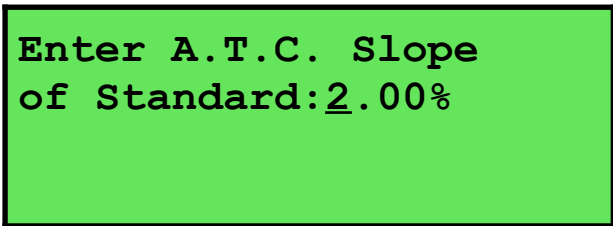
The ATC Slope for the Calibration standard is the rate at which the conductivity of the solution changes per degree Celsius. This Slope must be set correctly on the **smartCHEM-C** to enable the Automatic Temperature Compensation system to work correctly. If the ATC Slope is not known, please refer to section 20.2 for details on how it can be calculated.

To set the ATC Slope for the Calibration Standard...




1. Select ATC Slope entry for the Calibration Standard.

( → **F4:Setup** → **F6:Next** → **F1:ATC Slope** → **F2:Standard**).

The following screen is displayed...



**Enter A.T.C. Slope
of Standard: 2.00%**

2. Type in the ATC Slope of the Calibration Standard, including the decimal point. Use the  key to make any corrections. Enter 0.00% for absolute readings, without any temperature correction being applied.
3. Press  to save the ATC Slope of the Calibration Standard.
Alternatively, press  to quit without changing the current setting.

3.7 Conductivity sensor k factor

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

Calibration settings for the various k factors are stored separately. The **smartCHEM-C** does not require re-calibration when a different k factor sensor is connected, provided it has already been calibrated for the different sensor. A “*” is shown in place of the decimal point if the reading is not calibrated or if a past calibration has failed.

3.8 Conductivity (TDS/Salinity) Calibration

To achieve accurate Conductivity/TDS/Salinity results, the **smartCHEM-C** requires calibration to an allowable Conductivity standard. The TDS and Salinity values are derived from the Conductivity reading and do not require a separate calibration. The conductivity of a solution varies with temperature. The **smartCHEM-C** uses Automatic Temperature Compensation (ATC) referenced to the fixed temperature of 25°C or 20 °C (user selectable).

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


Before attempting a Conductivity calibration, ensure that the **smartCHEM-C** has been set up correctly according to sections 3.1 to 3.7. The calibration procedure detailed below uses the sample configurations shown in sections 3.1 to 3.7.

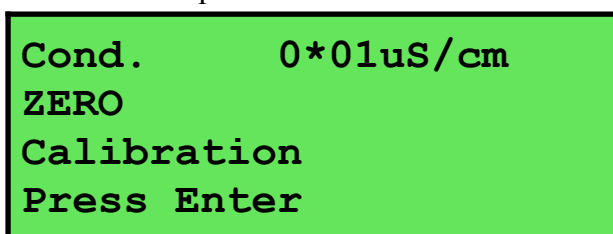
Automatic Temperature Compensation can be done via a temperature sensor inside the Conductivity sensor, or via the separate stainless steel temperature sensor. Using the Conductivity sensor for ATC is more convenient, but the separate temperature sensor has a faster response. If the separate temperature sensor is plugged in, the **smartCHEM-C** always uses this for temperature readout and ATC. To use the Conductivity sensor for Temperature readout and ATC, the separate temperature sensor must be disconnected. Please choose one or the other according to your preference.



Ensure that Temperature has been correctly calibrated (see section 8.1). A “*” in the Temperature readout in place of the decimal point indicates that Temperature is NOT calibrated.

1. Plug the Conductivity sensor into the **Cond / TDS** socket. If required, plug the separate Temperature sensor into the **Temperature** socket.
2. Rinse the sensor(s) in distilled water. Shake off as much water as possible. Blot the outside of the sensor(s) dry. **DO NOT BLOT THE CONDUCTIVITY SENSOR PLATES.**

Zero Calibration

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



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





Calibration
Waiting to Stabilise

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

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

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

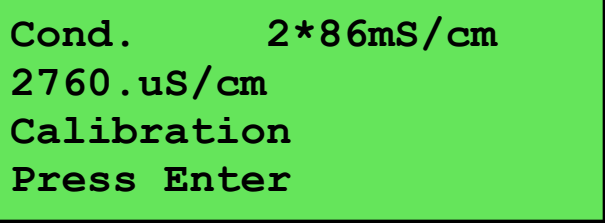
Standard Calibration

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

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

Select Conductivity Calibration (Menu → **F1:Calibrate** → **F1:Conductivity**).

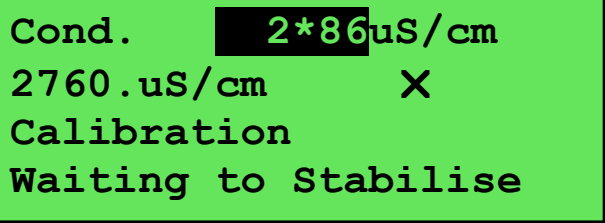
The calibration screen will be displayed with the Conductivity standard to be used. For example...



```

Cond.      2*86mS/cm
2760.uS/cm
Calibration
Press Enter
    
```

- Press Enter to calibrate. The Automatic Stability Function will now show a \boxtimes and highlight the reading while it is unstable...



```

Cond.      2*86uS/cm
2760.uS/cm  X
Calibration
Waiting to Stabilise
    
```

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

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

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

- The **smartCHEM-C** is now calibrated for Conductivity.

3.9 Conductivity Calibration Notes

- A Zero calibration should be performed at least monthly. In low conductivity applications (where a zero error is particularly significant), a zero calibration may have to be done weekly.
- A Standard calibration should be performed at least weekly. Of course, more frequent calibration will result in greater confidence in results.
- Conductivity, Resistivity and Ratio calibration data is stored separately in memory. Ensure that the **smartCHEM-C** has been correctly calibrated for the mode in which it will be used. The



smartCHEM-C does not require re-calibration when alternating between modes, providing the instrument has been correctly calibrated for each mode on the k factor sensor to be used.

4. All calibration information is retained in memory when the **smartCHEM-C** is switched off. This information can be recalled or printed later using the GLP function (see section 11).
5. The **smartCHEM-C** 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).
6. Calibration settings for $k=0.1$, $k=1.0$ and $k=10$ sensors are stored separately. The meter does not require re-calibration when a different k factor sensor is connected, provided it has already been calibrated for the different sensor.

3.10 Conductivity Calibration Messages

1. If a Zero Calibration has been successfully performed, the **smartCHEM-C** will display the following message...

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

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

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

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

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

Notes

1. The allowable k factor range is +/-25% of nominal. This range is ample to allow for correctly functioning Conductivity sensors. If calibration fails due to the k factor being outside these limits, please consult the Troubleshooting guide (section 19.2) for possible remedies.

4. TDS Mode

4.1 Selecting TDS Mode

1. Press **Menu** → **F3:Mode** → **F1:Cond/TDS/Sal** → **F3:TDS**.
2. The **smartCHEM-C** now proceeds to setting the TDS factor. The following screen is displayed...



TDS Factor : 0.65



Range
0.40 to 1.00

3. Type in the required TDS factor and press **Enter** or just press **Enter** if no change is required. The TDS factor will be reset to 0.65 when the meter is initialized.
4. The **smartCHEM-C** now proceeds to TDS measurement mode. Note that a “*” is shown in place of the decimal point until a successful Conductivity calibration has been performed (see section 3.8).

5. Salinity Mode

5.1 Selecting Salinity Mode

1. Press **Menu** → **F3:Mode** → **F1:Cond/TDS/Sal** → **F4:Salinity**.
2. The **smartCHEM-C** now proceeds to selecting the Salinity units. The following screen is displayed...



Salinity Units
>F1:% F2:PSU

The arrow indicates the units currently selected.

Press **F1** to select readout in %.


Press **F2** to select readout in PSU (Practical Salinity Units).

If no change is required, simply press **Menu**.

3. The **smartCHEM-C** now proceeds to Salinity measurement mode. Note that a “*” is shown in place of the decimal point until a successful Conductivity calibration has been performed (see section 3.8).

6. Resistivity Mode

6.1 Selecting Resistivity Mode

1. Select Resistivity Mode ( → **F3:Mode** → **F3:Resist.**).
2. The **smartCHEM-C** now proceeds to Resistivity measurement mode. Note that a “*” is shown in place of the decimal point until a successful calibration has been performed (see section 6.7).

6.2 Setting the Resistivity calibration standard



The factory default for this item is 362.3Ωcm (equivalent to 2.76mS/cm). If this is satisfactory, go directly to section 6.3.


1. Select the Resistivity Standard entry

( → **F4:Setup** → **F1:Standards** → **F3:Resistivity**).

The following screen is now displayed...

```
Resistivity
Standard: 362.3Ω.cm
Range
5Ω.cm to 50KΩ.cm
```


2. Type in the value of the Resistivity standard that is to be used for calibration, including the decimal point. Use the  key to make any corrections.
3. Press  to save the value of the standard solution.

Alternatively, press  to quit without changing the current setting.

4. The **smartCHEM-C** will now ask you to enter the units for the Resistivity standard...

```
Resistivity
Standard: 362.3
Select Units
F1: Ω.cm   F2: KΩ.cm
```

Press  to set the Resistivity Standard as Ω.cm.

Press  to set the Resistivity Standard as KΩ.cm.

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




6.3 Setting the Reference Temperature

The factory default setting for this item is 25°C. If this is satisfactory, go directly to section 6.4.



1. Select the ATC configuration menu.

( → **F4:Setup** → **F6:Next** → **F3:Reference Temp.**)

2. Press  to reference all readings to 25°C for Automatic Temperature Compensation.
Press  to reference all readings to 20°C for Automatic Temperature Compensation.
Press  to quit without changing the current setting.


6.4 Setting the ATC Slope for unknown samples

The factory default setting for this item is 2.00 %/°C. If this is satisfactory, go directly to section 6.5.

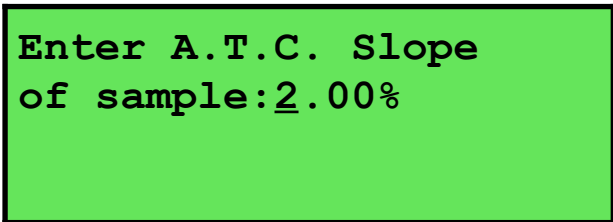
The ATC Slope for the unknown sample solution is the rate at which the Conductivity of the solution changes per degree Celsius. This is important, as Resistivity values are calculated from Conductivity. The ATC Slope must be set correctly on the **smartCHEM-C** to enable the Automatic Temperature Compensation system to work correctly. If the ATC Slope is not known, please refer to section 20.2 for details on how it can be calculated.

To set the ATC Slope for unknown samples...




1. Select ATC Slope entry.

( → **F4:Setup** → **F6:Next** → **F1:ATC Slope** → **F1:Sample**).

The following screen is displayed...



Enter A.T.C. Slope
of sample: 2.00%

2. Type in the ATC Slope of the unknown sample, including the decimal point. Use the  key to make any corrections. Enter 0.00% to obtain absolute readings, without any temperature correction being applied.
3. Press () to save the ATC Slope of the unknown solution.
Alternatively, press () to quit without changing the current setting.


6.5 Setting the ATC Slope for the Calibration Standard

The factory default setting for this item is 2.00 %/°C. If this is satisfactory, go directly to section 6.6.

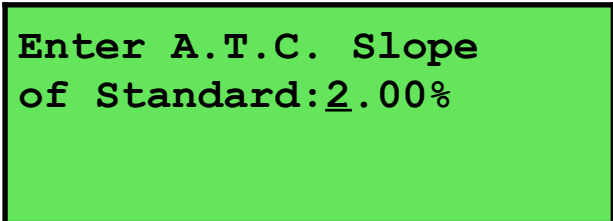
The ATC Slope for the Calibration standard is the rate at which the Conductivity of the solution changes per degree Celsius. This is important, as Resistivity values are calculated from Conductivity. The ATC Slope must be set correctly on the **smartCHEM-C** to enable the Automatic Temperature Compensation system to work correctly. If the ATC Slope is not known, please refer to section 20.2 for details on how it can be calculated.

To set the ATC Slope for the Calibration Standard...


1. Select ATC Slope entry for the Calibration Standard.

( → **F4:Setup** → **F6:Next** → **F1:ATC Slope** → **F2:Standard**).

The following screen is displayed...



Enter A.T.C. Slope
of Standard: 2.00%

2. Type in the ATC Slope of the Calibration Standard, including the decimal point. Use the  key to make any corrections. Enter 0.00% for absolute readings, without any temperature correction being applied.



3. Press **Enter** to save the ATC Slope of the Calibration Standard.
Alternatively, press **Menu** to quit without changing the current setting.



6.6 Resistivity sensor k factor

The **smartCHEM-C** automatically recognises whether a $k=0.1$, $k=1.0$ or $k=10$ Resistivity sensor is being used via links in the connector.

Calibration settings for the various k factors are stored separately. The **smartCHEM-C** does not require re-calibration when a different k factor sensor is connected, provided it has already been calibrated for the different sensor. A “*” is shown in place of the decimal point if the reading is not calibrated or if a past calibration has failed.

6.7 Resistivity Calibration


Before attempting a Resistivity calibration, ensure that the **smartCHEM-C** has been set up correctly according to sections 6.1 to 6.6. The calibration procedure detailed below uses the sample configurations shown in sections 6.1 to 6.6.

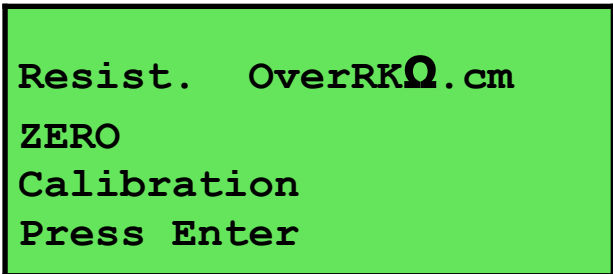
Automatic Temperature Compensation can be done via a temperature sensor inside the Resistivity sensor, or via the separate stainless steel temperature sensor. Using the Resistivity sensor for ATC is more convenient, but the separate temperature sensor has a faster response. If the separate temperature sensor is plugged in, the **smartCHEM-C** always uses this for temperature readout and ATC. To use the Resistivity sensor for Temperature readout and ATC, the separate temperature sensor must be disconnected. Please choose one or the other according to your preference.

Ensure that Temperature has been correctly calibrated (see section 8.1). A “*” in the Temperature readout in place of the decimal point indicates that Temperature is NOT calibrated.



1. Plug the Resistivity sensor into the **Cond / TDS** socket. If required, plug the separate Temperature sensor into the **Temperature** socket.
2. Rinse the sensor(s) in distilled water. Shake off as much water as possible. Blot the outside of the sensor(s) dry. **DO NOT BLOT THE RESISTIVITY SENSOR PLATES.**

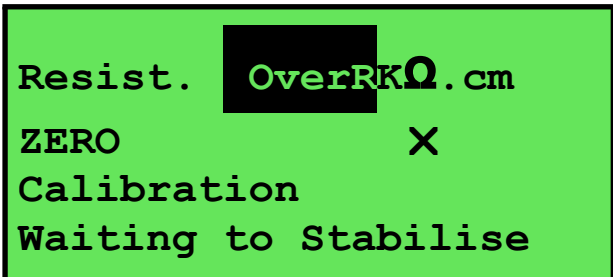
Air Calibration

3. Let the sensor dry in air.
4. Select Resistivity Calibration ( → **F1:Calibrate** → **F1:Resistivity**).
5. The **smartCHEM-C** will recognise the over-range Resistivity signal and attempt an Air calibration. For example...




Resist. OverRKΩ.cm
ZERO
Calibration
Press Enter

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



Resist. OverRKΩ.cm
ZERO X
Calibration
Waiting to Stabilise

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

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

The “*” will not be removed after an Air calibration.



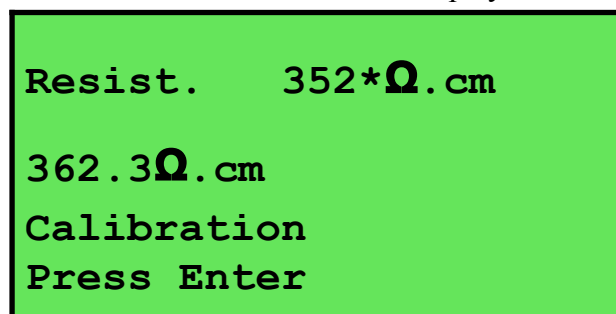
Continued over the page...

Standard Calibration

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

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

Select Resistivity Calibration ( → **F1:Calibrate** → **F1:Resistivity**). The calibration screen will be displayed with the Resistivity standard to be used. For example...





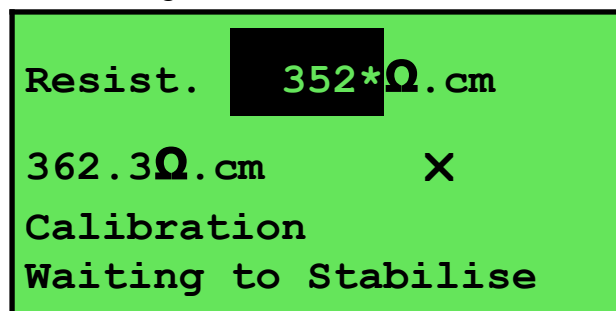
```

Resist.    352*Ω.cm

362.3Ω.cm

Calibration
Press Enter
  
```

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




```

Resist.    352*Ω.cm

362.3Ω.cm    X

Calibration
Waiting to Stabilise
  
```

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

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

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

- The **smartCHEM-C** is now calibrated for Resistivity and is ready for use in this mode.

6.8 Resistivity Calibration Notes

1. An Air calibration should be performed at least monthly. In high Resistivity applications (where a 'zero' error is particularly significant), an air calibration may have to be done weekly.
2. A Standard calibration should be performed at least weekly. Of course, more frequent calibration will result in greater confidence in results.
3. Conductivity, TDS, Resistivity and Ratio calibration data is stored separately in memory. Ensure that the **smartCHEM-C** has been correctly calibrated for the mode in which it will be used. The **smartCHEM-C** does not require re-calibration when alternating between modes, providing the instrument has been correctly calibrated for each mode on the k factor sensor to be used.
4. All calibration information is retained in memory when the **smartCHEM-C** is switched off. This information can be recalled or printed later using the GLP function (see section 11).
5. The **smartCHEM-C** 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 6.2).
6. Calibration settings for $k=0.1$, $k=1.0$ and $k=10$ sensors are stored separately. The meter does not require re-calibration when a different k factor sensor is connected, provided it has already been calibrated for the different sensor.

6.9 Resistivity Calibration Messages

1. If an Air Calibration has been successfully performed, the **smartCHEM-C** will display the following message...

Zero Calibration OK

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

**Calibration OK,
k=0.99**

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

**Calibrate Failure,
Check STD=362.3Ω.cm
k=3.64, Exceeds Limit**



Notes

1. The allowable k factor range is +/-25% of nominal. This range is ample to allow for correctly functioning Resistivity sensors. If calibration fails due to the k factor being outside these limits, please consult the Troubleshooting guide (section 19.2) for possible remedies.

7. Ratio Mode

There are two Ratio modes available on the **smartCHEM-C**...

- **Absolute Ratio** mode provides a readout of the exact ratio between the two Conductivity sensors.
- **Ratio*Standard** mode takes the ratio between the two Conductivity sensors and multiplies it by the nominated standard solution value. This effectively provides an absolute readout of Conductivity and reduces errors due to temperature effects (assuming that the standard and the sample are at the same temperature).

7.1 Selecting Ratio Mode

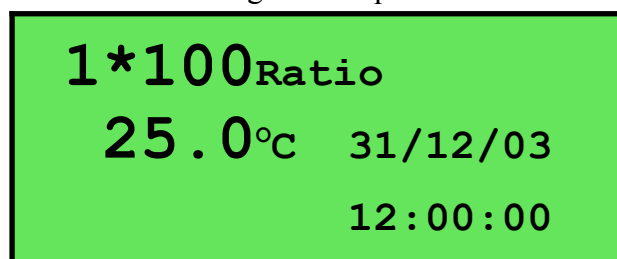
1. Plug a k=0.1, k=1.0 or k=10 Conductivity sensor into the **Cond / TDS** socket.
2. Plug a Conductivity sensor *with the same k factor* into the **Ratio** socket. This input is used as the reference.
3. Select Absolute or Ratio*Standard Mode...

Menu → **F3:Mode** → **F4:Ratio** → **F1:Absolute**

or **Menu** → **F3:Mode** → **F4:Ratio** → **F3:Ratio*Standard**

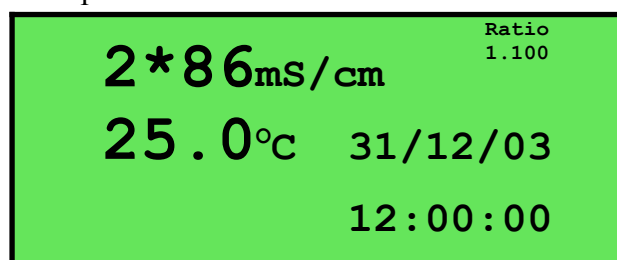
4. When returning to normal measurement, the **smartCHEM-C** will perform a check to ensure that the two sensors have the same k factor. It also checks if the actual Conductivity of the signals from each sensor are within the range of measurement of the k factor being used. If either of these checks fail, the **smartCHEM-C** will not proceed to Ratio mode. If this occurs, press **Menu**, then **F3:Mode**, and change back to Conductivity, TDS or Resistivity modes.
5. Having passed the checks above the **smartCHEM-C** will now proceed to ratio measurement mode. Note that the decimal point will be replaced by a “*” until a successful calibration has been performed (see section 7.3).

The following is a sample of absolute ratio mode readout...



1*100Ratio
25.0°C 31/12/03
12:00:00

The following is a sample of ratio*standard mode readout. Note that the **smartCHEM-C** still provides an absolute ratio readout on the top right of the display.



2*86mS/cm Ratio
1.100
25.0°C 31/12/03
12:00:00



Note that for both Ratio modes, the ratio is expressed as the sensor plugged into the Cond / TDS socket relative to the reference sensor plugged into the Ratio socket.

7.2 Setting the Ratio calibration standard

*This section is only applicable to Ratio*Standard mode. The factory default for this item is 2.76mS/cm. If this is satisfactory, go directly to section 7.3.*

1. Select the Ratio Standard entry

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

The following screen is now displayed...

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

2. Type in the value of the Ratio standard that is to be used for calibration, including the decimal point. Use the **⊖** key to make any corrections.
3. Press (**Enter**) to save the value of the standard solution.

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


4. The **smartCHEM-C** will now ask you to enter the units for the Ratio standard...

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

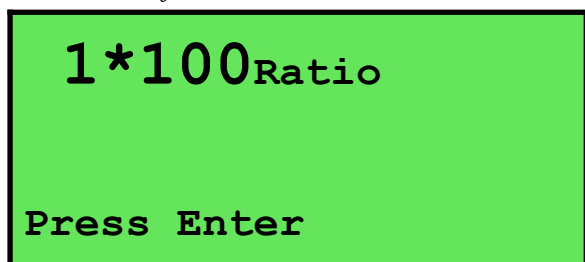
- (a) If the **smartCHEM-C** is set up for S/cm (section 3.2)...
 - Press (**F1**) to set the Conductivity Standard as μ S/cm.
 - Press (**F2**) to set the Conductivity Standard as mS/cm.
 - or (b) If the **smartCHEM-C** is set up for S/m (section 3.2)...
 - Press (**F1**) to set the Conductivity Standard as μ S/m.
 - Press (**F2**) to set the Conductivity Standard as mS/m.
 - Press (**F3**) to set the Conductivity Standard as S/m.
 - or (c) If the **smartCHEM-C** is set up for dS/m (section 3.2), dS/m is set as the unit for the standard.
5. The Ratio standard is now programmed for use at calibration for Ratio*Standard mode.

7.3 Ratio Calibration

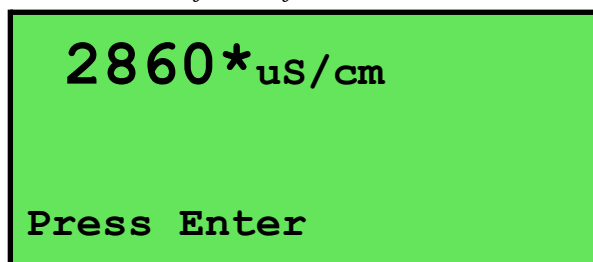
Ratio calibration involves placing both of the Conductivity sensors into the same value solution and setting the ratio reading to 1.000.



1. Ensure that matching k factor sensors have been plugged into the **Cond / TDS** and **Ratio** sockets, and Ratio mode has been selected (see section 7.1). A temperature sensor is not required for Ratio mode, but both solutions must be at the same temperature.
2. Rinse the Conductivity sensors in distilled water. Shake off as much water as possible. Blot the outside of the sensors dry. **DO NOT BLOT THE SENSOR PLATES**. Let the sensors dry in air.
3. Place the two Conductivity sensors into two separate beakers of the same solution. The solution that is to be used as the reference for ratio measurements is generally the most ideal. Ensure that the sensors are immersed correctly at least to the top of the vent hole in the side of the sensor.
4. Select Ratio Calibration ( → **F1:Calibrate** → **F1:Ratio**). The calibration screen will be displayed. For example...

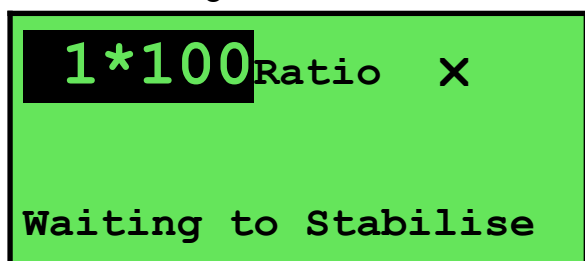
Absolute Ratio mode attempts to calibrate to a ratio of 1.000...




*Ratio*Standard mode attempts to calibrate to the value of the reference standard...*



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



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

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

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

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

7.4 Ratio Calibration Notes

1. The two Conductivity sensors **MUST** be calibrated in separate containers, as they interfere with each other.
2. The **smartCHEM-C** checks that the sensors have the same k factor, and that a suitable k factor is being used for the conductivity level of the solutions being measured whenever Ratio mode is selected and before every Ratio calibration. The following table details the acceptable limits of Conductivity for k=0.1, k=1.0 and k=10 sensors. All of these sensors will work to zero Conductivity, but accuracy below the recommended minimum Conductivities listed will be diminished.

Sensor k Factor	Recommended Minimum Conductivity	Maximum Limit of Conductivity
k=0.1	0.1 uS/cm	10 mS/cm
k=1.0	1 uS/cm	100 mS/cm
k=10	10 uS/cm	1000 mS/cm

3. A Ratio calibration should be performed at least weekly. Of course, more frequent calibration will result in greater confidence in results.
7. Conductivity, Resistivity and Ratio calibration data is stored separately in memory. Ensure that the **smartCHEM-C** has been correctly calibrated for the mode in which it will be used. The **smartCHEM-C** does not require re-calibration when alternating between modes, providing the instrument has been correctly calibrated for each mode on the k factor sensor to be used.
8. All calibration information is retained in memory when the **smartCHEM-C** is switched off. This information can be recalled or printed later using the GLP function (see section 11).
9. For Ratio mode, only one calibration setting is stored. If the k factor of the sensors is changed, this mode must be re-calibrated.

7.5 Ratio Calibration Messages

1. If a Ratio Calibration has been successfully performed, the **smartCHEM-C** will display the following message...

```

Calibrate OK
Delta Span = 1.010
  
```

2. If a Ratio Calibration has failed, the **smartCHEM-C** will display the following message and the calculated difference between the outputs of the sensors. For example...

```

Calibrate Failed.
Delta GAIN = 150.0%
Check Cells, Ensure
Identical Standards
  
```

Notes

1. The allowable difference in k factor between the two sensors is 50% to 200%. This range is ample to allow for correctly functioning Conductivity sensors. If calibration fails due to the k



factor being outside these limits, then please consult the Troubleshooting guide (section 19.3) for possible remedies.

8. Temperature Mode

The temperature readout must be calibrated before attempting calibration of any of the other readout modes.


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.

The **smartCHEM-C** is able to take Temperature readings from the Temperature sensor or from the Conductivity sensor. If both the Temperature sensor and a Conductivity sensor are connected at the same time, the Temperature reading is taken from the Temperature sensor.

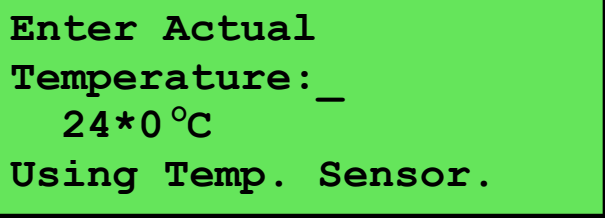
8.1 Temperature Calibration

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

To calibrate the Temperature readout from a Conductivity sensor, plug the Conductivity sensor into the **Cond / TDS** socket and ensure that the separate Temperature is not connected.



2. Switch the meter on.
3. Place the Temperature or Conductivity/TDS 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**).

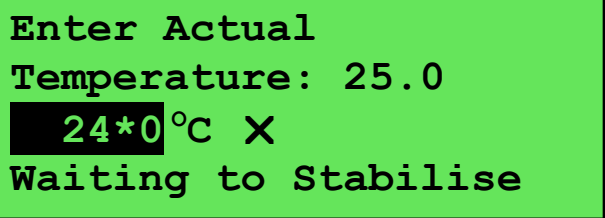
The Temperature Calibration screen is now displayed. The bottom line provides confirmation of which sensor is being calibrated. The following example shows the Temperature sensor being calibrated.



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


The current reading from the Temperature or Conductivity 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...



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

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-C** is now calibrated for Temperature and is ready for use in this mode.

8.2 Temperature Calibration Notes

1. Temperature calibration information is retained in memory when the **smartCHEM-C** is switched off, even when the power supply is removed. This information can be recalled later using the GLP function (see section 11).
2. Temperature does not need to be re-calibrated unless the Temperature or Conductivity sensor is replaced or the meter is initialised.
3. The **smartCHEM-C** keeps the Temperature calibration data for the Temperature and k=0.1, k=1.0 and k=10 Conductivity sensors separately so these can be swapped as required without recalibrating Temperature.

8.3 Calibration Messages

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

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

3. The **smartCHEM-C** has an allowable Offset range of -10.0 to +10.0 °C. If calibration fails due to the Offset being outside these limits, please consult the Troubleshooting guide (section 19.4) for possible remedies.

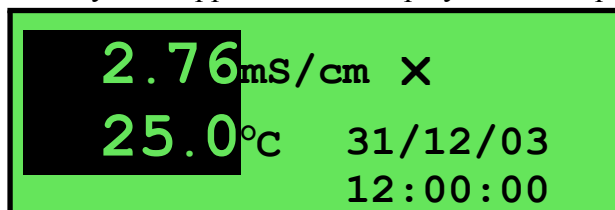
9. Auto Stability Function (ASF)

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

9.1 ASF During Normal Measurement

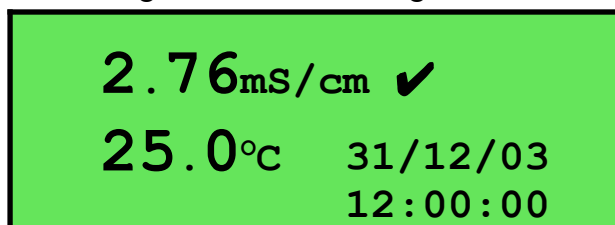
1. Press F5 in normal measurement mode. All active parameters are highlighted and the \boxtimes symbol appears in the display. For example...



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 \checkmark . 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.

9.2 ASF During Calibration

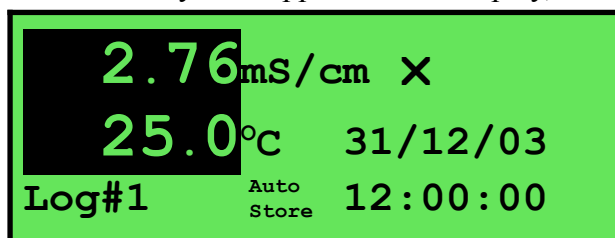
The Automatic Stability Function is automatically invoked during calibration. The stability parameters programmed into the **smartCHEM-C** have a finer tolerance during calibration than during normal measurement. This is done to ensure the most accurate possible calibration results.

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.

9.3 ASF with Manual Data logging

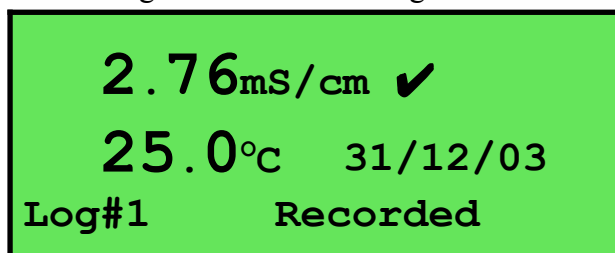
1. Press **F5** then **Store** in normal measurement mode. All active parameters are highlighted and the **✘** symbol appears in the display, along with the message “Auto Store”. For example...



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

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

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



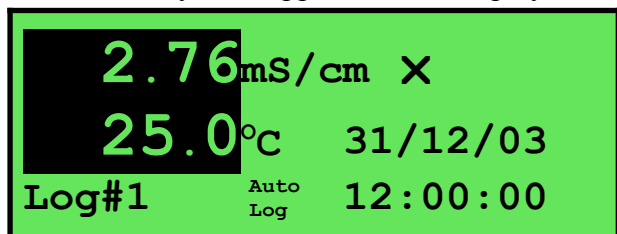
3. To unfreeze the display in order to take the next reading, press **F5** and **Store** again to re-start the ASF Auto-Store process.
4. Press **F5** a second time, while the **✘** symbol is being displayed, to turn ASF off.

9.4 ASF with Automatic Data logging

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

See section 13.2 for details on programming the Automatic Data logging function.

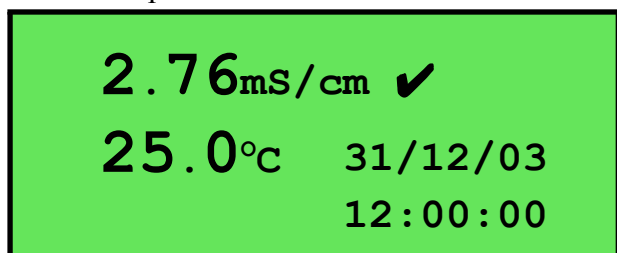
1. Press **F5** then **AutoLog** in normal measurement mode. All active parameters are highlighted and the **✘** symbol appears in the display, along with the message “Auto Log”. For example...



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

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

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



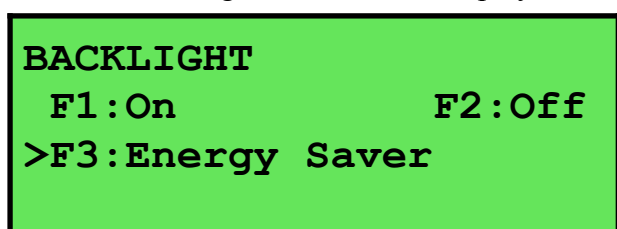
3. To unfreeze the display in order to take the next reading, press **F5** and **AutoLog** again to re-start the ASF automatic data logging process.
4. Press **F5** a second time, while the **✘** symbol is being displayed, to turn ASF off.

10. Display Backlight

The **smartCHEM-C** 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.




11. Good Laboratory Practices (GLP)

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

11.1 To recall GLP information on the display

1. Switch the meter on.
2. Select the GLP menu ( → **F5:GLP**).
3. Select **F1:Recall** from the menu.
4. The instrument model, firmware version number, and instrument serial number are displayed, along with a prompt describing how to scroll through the GLP information. For example...

```
smartCHEM-C V2.0 S1234    31/12/11 16:00
Temp Sensor Offset=1.0oC  31/12/11 11:00
Temp Sensor Calibrated
F4:Next
```

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

GLP Display sequence...

```
smartCHEM-C V2.0 S1234    31/12/11 16:00
Temp Sensor Offset=1.0oC  31/12/11 11:00
Temp Sensor Calibrated
F4:Next
```

↑  ↓ 

```
k=.1 Cell
Cond Zero=0.001uS        31/12/11 12:00
Cond k=0.11 @ 2760.uS/cm 31/12/11 12:10
Cond Calibrated
F2:Back F4:Next
```

↑  ↓ 

```
k=.1 Cell
Res. Zero=0.00 MΩ.cm      31/12/11 12:00
Res. k=0.11 @ 362.3Ω.cm  31/12/11 12:30
Res. Calibrated
Cond. Temp Offset=2.0oC   31/12/11 12:40
Cond. Temp Calibrated
F2:Back F4:Next
```

↑  ↓ 

Continued over the page...

GLP Display sequence, continued...

```
k=1 Cell
Cond Zero=0.00 uS/cm      31/12/11 13:00
Cond k=1.10 @ 2760.uS/cm 31/12/11 13:10
Cond Calibrated
```

F2:Back F4:Next

↑ (F2) ↓ (F4)

```
k=1 Cell
Res. Zero=0. KΩ.cm      31/12/11 13:00
Res. k=1.10 @ 362.3Ω.cm 31/12/11 13:30
Res. Calibrated
```

```
Cond. Temp Offset=3.0oC 31/12/11 13:40
Cond. Temp Calibrated
```

F2:Back F4:Next

↑ (F2) ↓ (F4)

```
k=10 Cell
Cond Zero=0.0 uS/cm      31/12/11 14:00
Cond k=10.1 @ 2760.uS/cm 31/12/11 14:10
Cond Calibrated
```

F2:Back F4:Next

↑ (F2) ↓ (F4)

```
k=10 Cell
Res. Zero=0.0 KΩ.cm      31/12/11 14:00
Res. k=10.1 @ 362.3Ω.cm 31/12/11 14:30
Res. Calibrated
```

```
Cond. Temp Offset=4.0oC 31/12/11 14:40
Cond. Temp Calibrated
```

F2:Back F4:Next

↑ (F2) ↓ (F4)

```
Ratio Delta Span=1.100 31/12/11 15:00
Ratio Calibrated
```

F2:Back F4:Ends

Press (F4) to return to GLP Menu

11.2 Failed Calibration

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

```

k=1 Cell
Cond Zero=0.00 uS/cm      00/00/00 00:00
Cond k=1.10 @ 2760.uS/cm 00/00/00 00:00
Cond UnCalibrated

F2:Back F4:Next
  
```

11.3 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-C**.
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:

 → **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-C V2.0 S1234 @ 31/12/2011 16:00
k=.1 Cond Zero=      0.001uS/cm @ 31/12/2011 12:00
k=.1 Cond k=0.11 @ 2760.uS/cm @ 31/12/2011 12:10
k=.1 Res. Zero=      0.00MOhms @ 31/12/2011 12:00
k=.1 Res. k=0.11 @ 362.3_Ohms @ 31/12/2011 12:30
k=.1 Temp. Offset=   2.0oC @ 31/12/2011 12:40
k=1 Cond Zero=      0.00uS/cm @ 31/12/2011 13:00
k=1 Cond k=1.10 @ 2760.uS/cm @ 31/12/2011 13:10
k=1 Res. Zero=      0.KOhms @ 31/12/2011 13:00
k=1 Res. k=1.10 @ 362.3_Ohms @ 31/12/2011 13:30
k=1 Temp. Offset=   3.0oC @ 31/12/2011 13:40
k=10 Cond Zero=     0.0uS/cm @ 31/12/2011 14:00
k=10 Cond k=10.1 @ 2760.uS/cm @ 31/12/2011 14:10
k=10 Res. Zero=     0.0KOhms @ 31/12/2011 14:00
k=10 Res. k=10.1 @ 362.3_Ohms @ 31/12/2011 14:30
k=10 Temp. Offset=  4.0oC @ 31/12/2011 14:40
Ratio Delta Span=   1.100 @ 31/12/2011 15:00
Temperature Offset= 1.0oC @ 31/12/2011 11:00
Ends
  
```

11.4 GLP Calibration Alarm

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


11.4.1 To set the GLP Calibration Alarm...


1. Select the GLP Calibration Alarm 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  to be reminded that calibration is due every day.





Press  to be reminded that calibration is due every week.

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

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



Press  to switch the GLP Calibration Alarm system off.

Press  to quit and retain the current setting.


3. If , ,  or  was pressed above, the **smartCHEM-C** will now allow the operator to select which parameters will be flagged with a calibration alarm...

```

Select Channels
F1:Conductivity/
    Resistivity/Ratio
F3:Temperature
  
```

Press the relevant  to  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  to exit and save the selection.

11.4.2 How the GLP Alarm Operates

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

```

GLP Alarm, Calibrate
Cond./Resist./Ratio,
Temperature
  
```



Only those parameters that were selected (see section 11.4.1) will be displayed.

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

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

11.4.3 Notes on the GLP Calibration Alarm function

1. Only one of Conductivity, Resistivity or Ratio needs to be calibrated in order to clear the “**Ca1 Now**” message.
2. To remove the “**Ca1 Now**” message and flashing decimal points, each selected parameter must be correctly calibrated.
3. Switching the GLP Calibration Alarm function off will not clear “**Ca1 Now**” message and flashing decimal points. The relevant parameters must be calibrated.
4. 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.

11.5 Instrument Serial Number

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

1. The serial number is displayed at turn-on. The serial number is **S1234** in the following example...

```
smartCHEM-C V2.0r  
S1234 © 2002 TPS P/L  
Conductivity/TDS  
Resist./Ratio/Temp.
```

The “**r**” after **v2.0** is shown when the Recorder Port option is fitted.

2. The serial number is displayed when recalling the GLP information (section 11.1).
3. The serial number is included on the print-out of GLP information (section 11.3).
4. The GLP information can be downloaded to a PC using the optional **WinTPS** communication software (part number 130086).

11.6 Additional GLP Features

Another GLP requirement is to record the date and time of every reading. The **smartCHEM-C** does this for you whenever readings are recorded either with the Manual Data logging function (section 13.1) or the Automatic Logging function (section 13.2).

12. 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 (**F5**) are still available without the Access Code. This means that others are still able to carry out day-to-day work.

12.1 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-C** now prompts you to enter a new access code...



New Access code: _

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

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

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

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

4. The **smartCHEM-C** now prompts you to re-enter the access code for verification...



New Access code: _
Re-Enter to Verify

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

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

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

12.2 Using the Access Code System

When the Access Code system is enabled (as per section 12.1), the **smartCHEM-C** 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-C** 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.


12.3 Changing the Access Code


1. Select the Access Code menu ( → **F6:Access**).
(Of course, you will need to enter the current access code after pressing  .)
2. Select **F1:Change Code** from the menu.
3. The **smartCHEM-C** now prompts you to enter a new access code...




New Access code: _

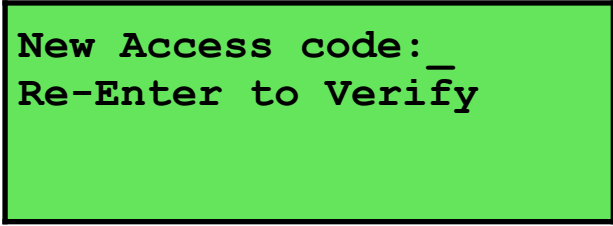
Enter a new code of up to 4 digits using the numeric keypad.

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

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


Press  to quit without changing the Access Code.

4. The **smartCHEM-C** 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  to quit without changing the Access Code.

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

12.4 Disabling the Access Code System

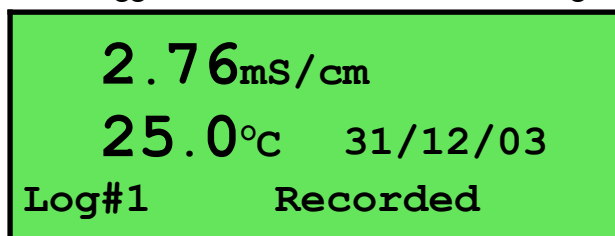
1. Select the Access Code menu ( → **F6:Access**).
(Of course, you will need to enter the current access code after pressing  .)
2. Select **F3:Disable Security** from the menu.
3. The **smartCHEM-C** now confirms that Access Code system has been disabled before returning to the Access Code menu.

13. Data logging

13.1 Manual Data logging

To manually record readings into the Logger memory...

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



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

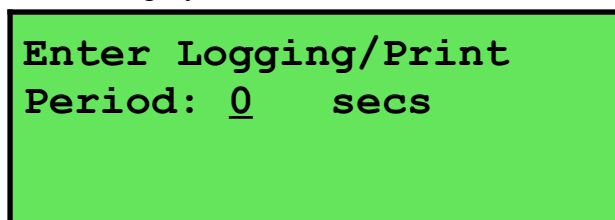
Hint : Press **(F5)** before **(Store)** to make the **smartCHEM-C** store the reading only when all the readings have stabilised. See section 9 for more details on the Auto Stability Function.

13.2 Automatic Data logging

The **smartCHEM-C** can automatically record readings 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.

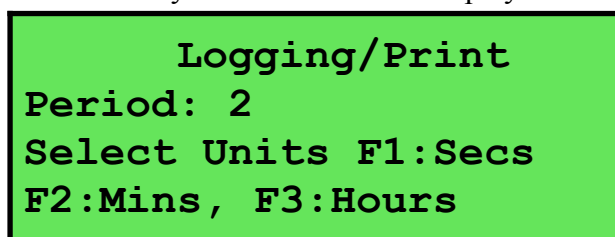


3. Use the Numeric Keypad to set the period at which the **smartCHEM-C** will automatically log records into memory or to the RS232 port.

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

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

4. After pressing **(Enter)**, the **smartCHEM-C** 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-C** 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
F3:Send to RS232

Press **F1** to log records into the Logger (maximum of 2730 readings).

Press **F3** to send records directly to the RS232 port.

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

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

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

2.76mS/cm
25.0°C **31/12/03**
Log#1 **12:00:00**

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

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

2.76mS/cm
25.0°C **31/12/03**
Sending **12:00:00**

The **smartCHEM-C** 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-C** stop logging as soon as all the readings have become stable. See section 9 for more details on the Auto Stability Function.

Notes on Automatic Data logging

1. The clock must be set before the **smartCHEM-C** will allow automatic data logging to start. The message "**Clock Not Set**" is displayed if the clock is not set. See section 16 for details on setting the clock.
2. Pressing **Menu** during automatic data logging halts logging. Press **AutoLog** after returning to normal display mode to re-start automatic data logging.

13.3 Recalling Readings from the Logger

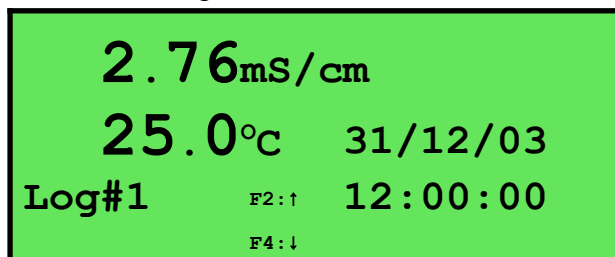
To recall records from the Logger onto the **smartCHEM-C** display...

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



2. Select **F1:Recall** from the menu.


Record number 1 is now displayed.

For example...



3. Press  and  to move forwards and backwards through the records.

Press and hold  or  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 .

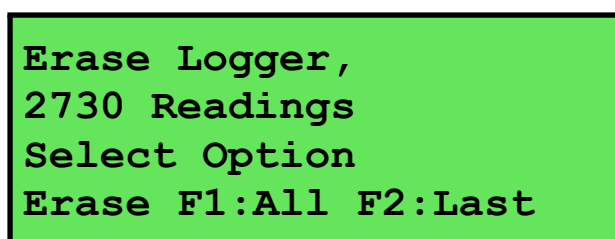
Press  to send the displayed record to the RS232 port.

13.4 Erasing Records from the Logger


To erase records from the Logger...

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

2. The **smartCHEM-C** 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  to erase all of the readings stored in the Logger.

Press  to erase the last recorded reading only.

Press  to quit without erasing any records.

13.5 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-C**.

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-C** are the same. If necessary, alter the baud rate of the **smartCHEM-C** (see section 14.1).


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

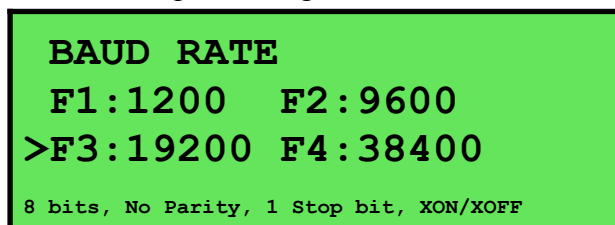


4. Select the Logger menu. ( → **F2:Logger**).
5. Select **F3:Print** from the menu.
6. Printing starts as soon as  is pressed. The display shows the word "**Printing**" until printing is completed.






14. RS232 Port

14.1 Setting the Baud Rate


1. Select the Ports Set-up 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  to select 1200 baud.
 Press  to select 9600 baud.
 Press  to select 19200 baud.
 Press  to select 38400 baud.
 Press  to quit and retain the current setting.

14.2 Sending Readings to the RS232 Port

Press  to instantly send readings to the RS232 port whenever the **smartCHEM-C** is in normal display mode.

Records can be sent directly to the RS232 port rather than stored in memory during automatic data logging. See section 13.2 for details.

Press  while recalling data on the display (see section 13.3) to send that record to the RS232 port.

14.3 RS232 Configuration

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

This information is displayed when setting the baud rate (see section 14.1)

14.4 Communication and Statistical Software

Communication between the **smartCHEM-C** and a PC can be handled with any RS232 communication software. The **WinTPS** 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-C** 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 14.8 and the “excel.txt” file in the folder where you installed the **WinTPS** program.



14.5 Commands

The following commands can be sent from a PC to the **smartCHEM-C**. 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-C . The log number returned is set to Zero.
Request logged data	?R<cr>	Returns all logged records from the smartCHEM-C memory. A <cr> needs to be sent back to the meter after each line of data is received. The data ends with the message ENDS<cr>
Erase logged data	?E<cr>	Erases all logged records from the smartCHEM-C 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-C•V2.0•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 14.7 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... 5,1,10,12,8,21,4,26,10,42,5 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.



14.6 Data Format

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

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

dd/mm/yyyy•hh:mm:ss•LLLL•CCCCCCCCCuuuuu•TTTTTuu

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-C** sends a Zero for instant readings (see section 14.2).

CCCCCCCCC is Conductivity or TDS or Salinity or Resistivity or Ratio data. 10 characters, right justified. Scientific notation in a format which is compatible with most spreadsheet programs is used to keep data to a reasonable length for all possible values.

uuuuu is the Conductivity/TDS/Salinity/Resistivity/Ratio units description, which can be any of the following...

uS/cm	for $\mu\text{S/cm}$ Conductivity readout. (All readings obtained in mS/cm units are converted to $\mu\text{S/cm}$ to preserve the scaling of the data.)
uS/m•	for $\mu\text{S/m}$ Conductivity readout. (All readings obtained in mS/m units are converted to $\mu\text{S/m}$ to preserve the scaling of the data.)
dS/m•	for dS/cm Conductivity readout.
ppM••	for parts per Million TDS readout. (All readings obtained in ppK units are converted to ppM to preserve the scaling of the data.)
%••••	for % Salinity readout.
PSU••	for PSU Salinity readout.
_Ohms	for $\Omega.\text{cm}$ Resistivity readout. (All readings obtained in $\text{K}\Omega.\text{cm}$ and $\text{M}\Omega.\text{cm}$ units are converted to $\Omega.\text{cm}$ to preserve the scaling of the data.)
Ratio	for Ratio readout

TTTTT is Temperature data, 5 characters, right justified.

uu is the Temperature unit description, which is sent as “**oC**”.

When requested by a PC with the ?D or ?R commands (section 14.5), the data is terminated with a carriage return.

When the data is sent by the **smartCHEM-C** using the Print function (section 13.5) or the Instant Send function (section 14.2), the data ends with a carriage return and a line feed.



14.7 GLP Data Format

GLP information is returned as 25 lines terminated by a carriage return. When using the “?G” command (section 14.5), the computer must respond with a character after receiving each line.

For example...

```
smartCHEM-C V2.0 S1234 @ 31/12/2011 16:00
k=.1 Cond Zero=      0.001uS/cm @ 31/12/2011 12:00
k=.1 Cond k=0.11 @ 2760.uS/cm @ 31/12/2011 12:10
k=.1 Res. Zero=      0.00MOhms @ 31/12/2011 12:00
k=.1 Res. k=0.11 @ 362.3_Ohms @ 31/12/2011 12:30
k=.1 Temp. Offset=   2.0oC @ 31/12/2011 12:40
k=1 Cond Zero=      0.00uS/cm @ 31/12/2011 13:00
k=1 Cond k=1.10 @ 2760.uS/cm @ 31/12/2011 13:10
k=1 Res. Zero=      0.KOhms @ 31/12/2011 13:00
k=1 Res. k=1.10 @ 362.3_Ohms @ 31/12/2011 13:30
k=1 Temp. Offset=   3.0oC @ 31/12/2011 13:40
k=10 Cond Zero=     0.0uS/cm @ 31/12/2011 14:00
k=10 Cond k=10.1 @ 2760.uS/cm @ 31/12/2011 14:10
k=10 Res. Zero=     0.0KOhms @ 31/12/2011 14:00
k=10 Res. k=10.1 @ 362.3_Ohms @ 31/12/2011 14:30
k=10 Temp. Offset=  4.0oC @ 31/12/2011 14:40
Ratio Delta Span=   1.100 @ 31/12/2011 15:00
Temperature Offset= 1.0oC @ 31/12/2011 11:00
Ends
```

14.8 Importing Data into Microsoft Excel

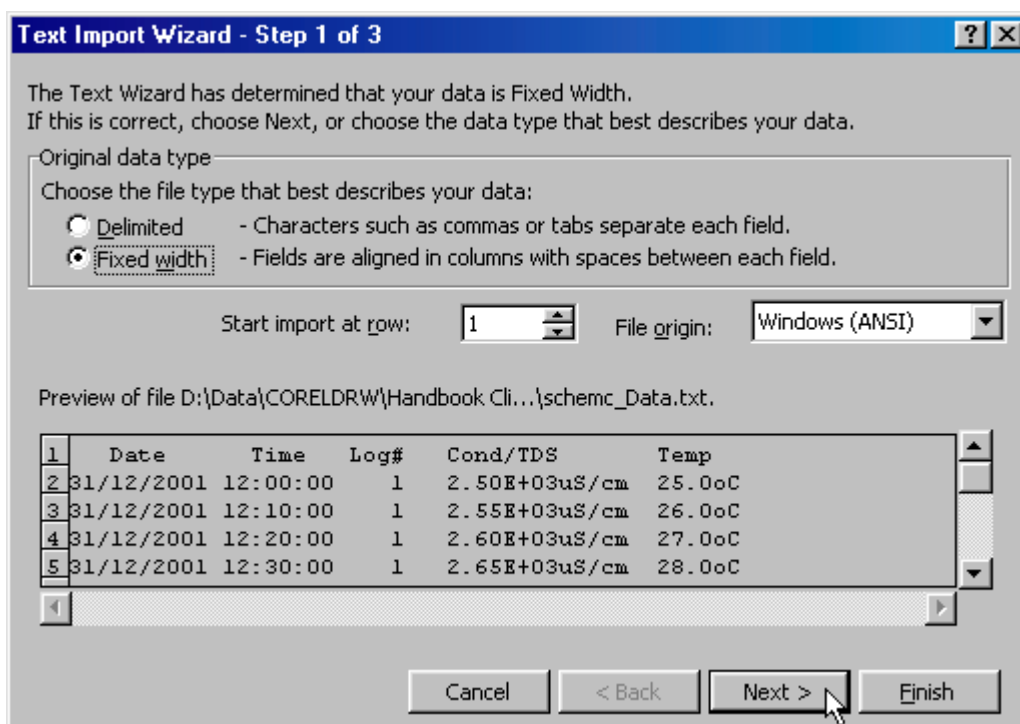
The following procedure details the method for importing a **smartCHEM-C** text data file into Microsoft® Excel®.

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.

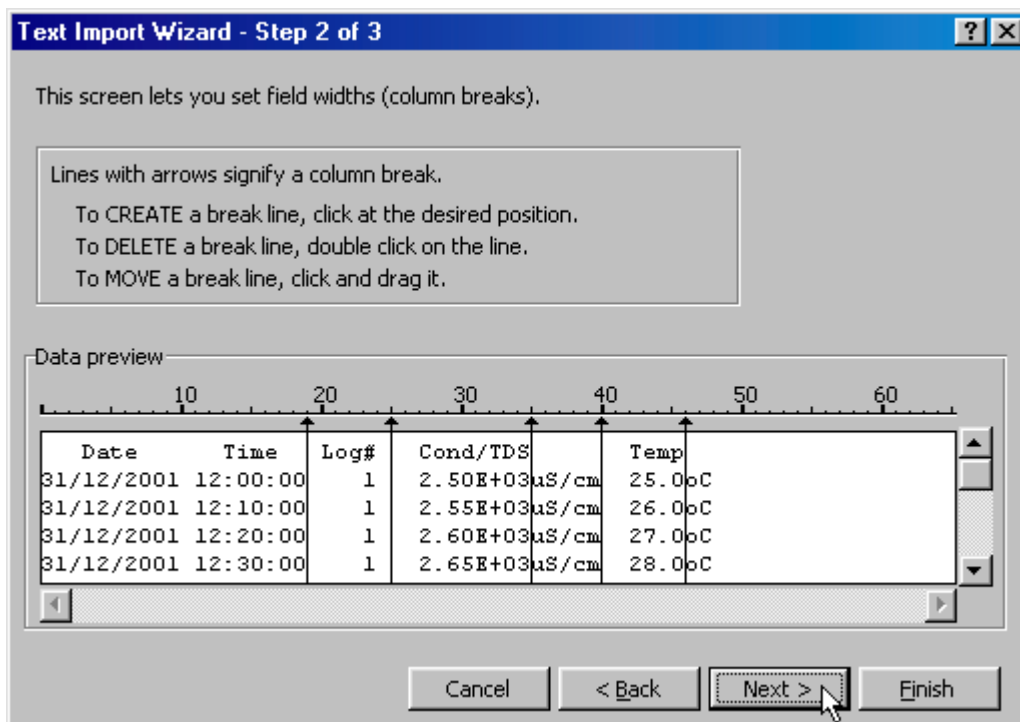


Continued over the page...

- 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.

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.



- 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.


15. Recorder Port

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

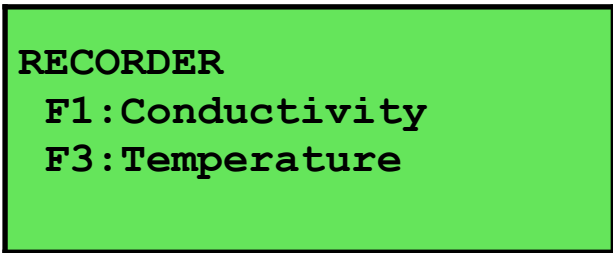
The optional Recorder Port can be used to send the data from any one parameter to a chart recorder or other analogue logging device.

15.1 Recorder Port Configuration

1. Select the Recorder set-up menu




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

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



RECORDER
F1:Conductivity
F3:Temperature

The arrow indicates the current selection.

2. Press  to set the Recorder output to Conductivity/TDS/Salinity/Resistivity/Ratio data.
Press  to set the Recorder output to Temperature data.
Press  to quit and retain the current setting.

15.2 Recorder Port Specifications

Mode	Range	Output Range	Examples (Reading = mV Out)
Conductivity	0 to 3.000 $\mu\text{S}/\text{cm}$ 0 to 30.00 $\mu\text{S}/\text{cm}$ 0 to 300.0 $\mu\text{S}/\text{cm}$ 0 to 3000 $\mu\text{S}/\text{cm}$ 0 to 30.00 mS/cm 0 to 300.0 mS/cm Manual range selection recommended for recorder output See section 20.1.	0 to 2000 mV for full scale of selected range.	0.000 $\mu\text{S}/\text{cm}$ = 0 mV 2760 $\mu\text{S}/\text{cm}$ = 1840 mV
TDS	0 to 2.000 ppm 0 to 20.00 ppm 0 to 200.0 ppm 0 to 2000 ppm 0 to 20.00 ppK 0 to 200.0 ppK Manual range selection recommended for recorder output See section 20.1.	0 to 2000 mV for full scale of selected range.	0.00 ppm = 0 mV 1000 ppm = 1000 mV 36.0 ppK = 360 mV
Salinity	0 to 8.00 % 0 to 80.0 PSU Manual range selection recommended for recorder output See section 20.1	0 to 2000 mV 0 to 2000 mV	0.00 % = 0 mV 3.60 % = 900 mV 0.0 PSU = 0 mV 36.0 PSU = 900 mV
Resistivity	0 to 500 counts per range.	0 to 2000 mV	250 $\Omega.\text{cm}$ = 1000 mV 500 $\text{k}\Omega.\text{cm}$ = 2000 mV
Ratio	0.000 to 1.500 1.50 to 15.00	0 to 1500 mV 150 to 1500 mV	1.000 = 1000 mV 5.00 = 500 mV
Temperature	-10 to 120.0 $^{\circ}\text{C}$	0 to 2000 mV	-10 $^{\circ}\text{C}$ = 0 mV 0 $^{\circ}\text{C}$ = 154 mV 100 $^{\circ}\text{C}$ = 1692 mV

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

Output Impedance : Approximately 1000 Ohms

Resolution : Approximately 2 mV

16. 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 31/12/03
Enter Date  31/12/03
           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-C** tests that a valid day of the month is entered. If an invalid date is entered (eg. 31/02/2001), the **smartCHEM-C** 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-C** also tests for leap years.

17. Initialising the smartCHEM-C

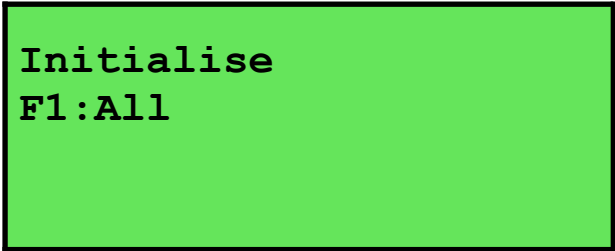
If the calibration settings of the **smartCHEM-C** exceed the allowable limits, the unit may need to be initialised to factory default values. This action may be required if a sensor is replaced.

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-C**...

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

2. The **smartCHEM-C** now asks if you are sure that you wish to initialise ALL parameters...



Initialise
F1:All

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

Press  to quit without resetting any data or user settings.

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.

18. Instrument firmware version number

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



19. Troubleshooting

19.1 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.

19.2 Conductivity, TDS, Salinity & Resistivity Troubleshooting

Symptom	Possible Causes	Remedy
Unit fails to calibrate, even with new sensor.	Calibration settings outside of allowable limits due to previous failed calibration.	Initialise the unit. See section 17.
Unit attempts Span calibration instead of Zero calibration.	Sensor has Zero error.	Thoroughly rinse sensor in distilled water and allow to completely dry in air before attempting zero calibration. Clean the glass around the platinum plate area. DO NOT rub the black platinised surfaces.
Standard calibration fails, and k factor is greater than 25% <i>above</i> the nominal value.	<ol style="list-style-type: none"> 1. Sensor is not immersed correctly. 2. Sensor may have a build-up of dirt or oily material on sensor plates. 3. Platinum-black coating has worn off. 4. Standard solution is inaccurate. 5. Sensor is faulty. 6. Faulty instrument. 	<p>Immerse sensor at least to the vent hole in the side of the sensor.</p> <p>Clean sensor as per the instructions detailed in section 20.3.</p> <p>Sensor requires replatinisation as per section 20.3. Alternatively, return to the factory for replatinisation.</p> <p>Replace standard solution.</p> <p>Return sensor to factory for repair or replacement.</p> <p>Return to factory for repair.</p>
Standard calibration fails, and k factor is greater than 25% <i>below</i> the nominal value.	<ol style="list-style-type: none"> 1. Standard solution is inaccurate. 2. Sensor may have a build-up of conductive material, such as salt. 3. Sensor is faulty. 4. Faulty instrument. 	<p>Replace standard solution.</p> <p>Clean sensor as per the instructions detailed in section 20.3.</p> <p>Return sensor to factory for repair or replacement.</p> <p>Return to factory for repair.</p>
Inaccurate readings, even when calibration is successful.	<ol style="list-style-type: none"> 1. Sensor may have a build-up of dirt or oily material on sensor plates. 2. Platinum-black coating has worn off. 	<p>Clean sensor as per the instructions detailed in section 20.3.</p> <p>Sensor requires replatinisation as per section 20.3. Alternatively, return to the factory for replatinisation.</p>
Readings drift.	Sensor may have a build-up of dirt or oily material on sensor plates.	Clean sensor as per the instructions detailed in section 20.3.
Readings are low or near zero.	<ol style="list-style-type: none"> 1. Sensor may have a build-up of dirt or oily material on sensor plates. 2. Sensor is not immersed correctly. 3. Sensor is faulty. 4. Faulty instrument. 	<p>Clean sensor as per the instructions detailed in section 20.3.</p> <p>Immerse sensor at least to the vent hole in the side of the sensor.</p> <p>Return sensor to factory for repair or replacement.</p> <p>Return to factory for repair.</p>
Meter displays “ Sensor ” instead of Conductivity/TDS/Salinity/Resistivity data.	Meter was calibrated on a different k factor sensor than that which is connected.	Re-calibrate on the new k factor sensor.
Meter displays “ No Sensor ” when sensor is connected.	<ol style="list-style-type: none"> 1. Sensor is faulty. 2. Faulty instrument. 	<p>Return sensor to factory for repair or replacement.</p> <p>Return to factory for repair.</p>

Reading does not change in any sample being measured	Auto Stability Function has frozen display (notice the <input checked="" type="checkbox"/>).	Turn Auto Stability Function OFF or re-start sampling (see section 9).
--	---	--

19.3 Ratio Troubleshooting

Any possible causes related to the sensor in this section could be due to the sensor plugged into **Cond/TDS** or **Ratio** socket or both. If in doubt, always check both sensors.

Symptom	Possible Causes	Remedy
Unit will not proceed to Ratio mode, even with matching k factor sensors connected to Cond / TDS and Ratio sockets	1. Sensor connectors are not correctly coded.	Ensure that you are using genuine TPS Conductivity sensors. If not, contact TPS for details on k factor coding.
Cell / Solution match check fails, even with new sensor.	1. Calibration settings outside of allowable limits due to previous failed calibration.	Initialise the unit. See section 17.
Calibration fails. Span difference between the two sensors is >200% or < 50%.	<ol style="list-style-type: none"> 1. Sensor is not immersed correctly. 2. Sensor may have a build-up of dirt or oily material on sensor plates. 3. Platinum-black coating has worn off. 4. Standard solution is inaccurate. 5. Sensor is faulty. 6. Faulty instrument. 	<p>Immerse sensor at least to the vent hole in the side of the sensor.</p> <p>Clean sensor, as per the instructions detailed in section 20.3.</p> <p>Sensor requires replatinisation, as per section 20.4. Alternatively, return to the factory for replatinisation.</p> <p>Replace standard solution.</p> <p>Return sensor to factory for repair or replacement.</p> <p>Return to factory for repair.</p>
Inaccurate readings, even when calibration is successful.	<ol style="list-style-type: none"> 1. Sensor may have a build-up of dirt or oily material on sensor plates. 3. Platinum-black coating has worn off. 	<p>Clean sensor, as per the instructions detailed in section 20.3.</p> <p>Sensor requires replatinisation, as per section 20.4. Alternatively, return to the factory for replatinisation.</p>
Readings drift.	1. Sensor may have a build-up of dirt or oily material on sensor plates.	Clean sensor, as per the instructions detailed in section 20.3.
Readings are low or near zero.	<ol style="list-style-type: none"> 1. Sensor may have a build-up of dirt or oily material on sensor plates. 2. Sensor is not immersed correctly. 3. Sensor is faulty. 4. Faulty instrument. 	<p>Clean sensor, as per the instructions detailed in section 20.3.</p> <p>Immerse sensor at least to the vent hole in the side of the sensor.</p> <p>Return sensor to factory for repair or replacement.</p> <p>Return to factory for repair.</p>

19.4 Temperature Troubleshooting

Symptom	Possible Causes	Remedy
Temperature inaccurate and cannot be calibrated.	<ol style="list-style-type: none"> 1. Faulty connector. 2. Faulty Conductivity/TDS or Temperature sensor, whichever is being calibrated. 	<p>Check the connector and replace if necessary.</p> <p>Return Conductivity/TDS or Temperature sensor for repair, or replace sensor.</p>
Displays 'OverRnge' when Temperature and/or Conductivity/TDS sensor plugged in.	<ol style="list-style-type: none"> 1. Faulty instrument socket. 2. Faulty Conductivity/TDS or Temperature sensor, whichever is being calibrated. 	<p>Return the instrument to the TPS factory for service.</p> <p>Return Conductivity/TDS or 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 <input checked="" type="checkbox"/>).	Turn Auto Stability Function OFF or re-start sampling (see section 9).

20. Appendices

20.1 Selecting Automatic or Manual Range Switching

The Automatic Range switching function of the **smartCHEM-C** is ideal for most applications. When used in the mode, the **smartCHEM-C** will always provide the user with optimum resolution and accuracy for the measurement being taken.

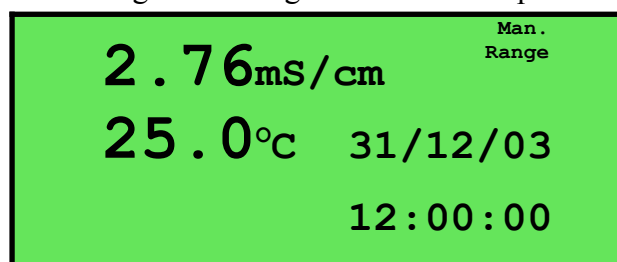
If readings are being sent to the optional recorder port, it may be better to switch ranges manually. This will avoid unusual spikes or troughs in the data being output.

20.1.1 Conductivity, TDS or Salinity modes

To select Manual range switching...

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


2 . Select **F6:Man R** to change to Manual Range Switching, if the **smartCHEM-C** is currently in Automatic Range Switching mode. The **smartCHEM-C** now provides information on how to manually change ranges up and down when taking measurements. The main display will now appear with the “**Man. Range**” prompt to remind the user that the unit is in Manual Range Switching mode. For example...




3. Press  to switch **UP** one range at a time.

Press  to switch **DOWN** one range at time.

Notes

1. If a range is selected which is too low for the current reading, the message “**Change Range**” is displayed. Press  to switch **UP** one range at a time until the **smartCHEM-C** displays a reading.
2. If a range is selected which is too high for the k factor of the sensor, the message “**Range Limit**” is displayed and the **smartCHEM-C** returns to the previous range.

To select Automatic range switching...

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

2. Select **F6:AutoR** to change to Automatic Range Switching, if the **smartCHEM-C** is currently in Manual Range Switching mode.

3. The main display does not show a prompt to indicate that Automatic range switching has been selected to avoid cluttering the display for most applications.

20.1.2 Resistivity Mode

Manual range switching is not available in Resistivity Mode.



20.1.3 Ratio Mode

Manual range switching is not available in Ratio Mode.

20.2 Calculating the ATC Slope of Solutions

The conductivity of all solutions changes as the temperature of the solution changes. The ATC Slope of a solution is the amount that this Conductivity changes per degree Celsius. The ATC Slope is dependant upon the chemicals dissolved in the solution, the concentration of those chemicals, and the actual temperature of the solution. Consider the following examples...

- A 0.02 Molar solution of KCl has a different ATC Slope to a 0.02 Molar solution of NaCl.
- A 0.02 Molar solution of KCl has a different ATC Slope to a 0.01 Molar solution of the same salt.
- A 0.02 Molar solution of KCl at 25 °C has a different ATC Slope to a 0.02 Molar solution of KCl at 15 °C.

To calculate the ATC Slope of a solution...

1. Set the ATC Slope for sample measurements to zero, with the following key sequence...

Menu → **F4: Setup** → **F6: Next** → **F1: ATC Slope** → **F1: Sample** → **0.00** → **Enter**

2. Ensure that the temperature function has been calibrated (see section 8.1). The conductivity function does not need to be calibrated at this point.
3. Warm or cool the solution to approximately 5 °C below the temperature at which you expect to take sample measurements. Record the Conductivity and Temperature readings, once both have become stable.
4. Warm the solution to approximately 5 °C above the temperature at which you expect to take sample measurements. Record the Conductivity and Temperature readings, once both have become stable.
5. Apply the following formula, where C1 and T1 are the first readings taken, and C2 and T2 are the second readings taken...

$$\text{ATC Slope} = 100 \times \left[10^{\left(\frac{\log \left(\frac{C2}{C1} \right)}{T2 - T1} \right)} - 1 \right]$$

6. Enter the result that is obtained as the ATC Slope of the solution.
 - (a) If this is the ATC Slope of the sample solution to be measured...

Menu → **F4: Setup** → **F6: Next** → **F1: ATC Slope** → **F1: Sample** → **[result]** → **Enter**

- (b) If this is the ATC Slope of the standard solution to be used for calibration...

Menu → **F4: Setup** → **F6: Next** → **F1: ATC Slope** → **F2: Standard** → **[result]** → **Enter**

Note

To assist in calculating the ATC Slope the following information can be entered into a spreadsheet. This example has been specifically written for Microsoft® Excel®, although the syntax should be similar for other spreadsheet software.

	A	B
1	Conductivity 1	<Enter first Conductivity reading>
2	Temperature 1	<Enter first Temperature reading>
3	Conductivity 2	<Enter second Conductivity reading>
4	Temperature 2	<Enter second Temperature reading>

5	ATC Slope	$=100*((10^{((\text{LOG}10(\text{B}3/\text{B}1))/(\text{B}4-\text{B}2)))-1}$
---	-----------	--

Alternatively a ready-made file can be downloaded from the Downloads page of the TPS Web Site. Enter <http://www.tps.com.au/downloads/> into your browser to go there directly.

20.3 Care, Cleaning and Maintenance of Conductivity Sensors

Care of Conductivity sensors

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

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

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

Cleaning Conductivity Sensors.

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

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


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

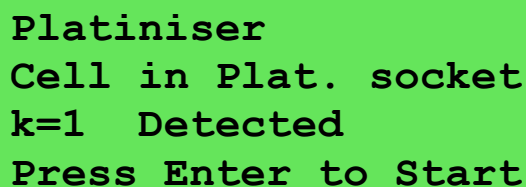
20.4 Replatinising Conductivity Sensors

The **smartCHEM-C** is fitted with an automatic sensor platinising function to restore Conductivity sensors to correct performance. To replatinise Conductivity sensors...


1. Soak the sensor in a solution of 1 part Concentrated HCl and 10 parts distilled water for approximately 5 minutes.
2. Rinse the sensor well in distilled water.
3. Plug the Conductivity sensor into the **Platiniser** socket.
4. Immerse the sensor in platinising solution, so that both of the platinum plates are well covered.

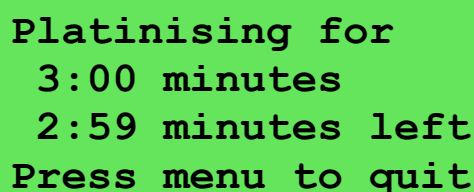
Platinising solution is available from TPS (part no 122300). Alternatively, platinising solution can be prepared by dissolving 1g of Hydrogen Chloroplatinate (H_2PtCl_6) in 30mL of distilled water, and including about 0.01g of Lead Acetate ($(CH_3COO)_2Pb$) and a drop or two of concentrated HCl.

5. Select Platiniser mode ( → **F3:Mode** → **F5:Re-Plat.**). The Platiniser screen is now displayed...




```
Platiniser
Cell in Plat. socket
k=1 Detected
Press Enter to Start
```

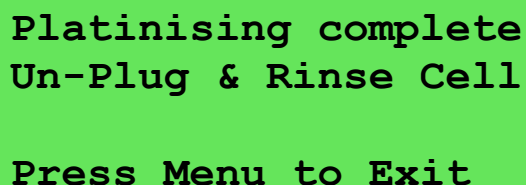
6. Press  to start platinising the sensor. The **smartCHEM-C** confirms how long it will platinise the sensor for, and count down how much time is remaining. The following example is for a k=1 sensor...



```
Platinising for
3:00 minutes
2:59 minutes left
Press menu to quit
```

Press  to quit platinising at any time. Remove the sensor and rinse well in distilled water. If the sensor has not been fully platinised, start the process again from step 1.

7. When the platinising cycle is complete, the following screen is displayed and the **smartCHEM-C** will beep...



```
Platinising complete
Un-Plug & Rinse Cell
Press Menu to Exit
```

Press  and remove the sensor from the platinising solution. Rinse well in distilled water.

8. The sensor is now replatinised, with its surface restored to “as new” condition. The sensor must be recalibrated before use, as its span will have changed.



21. Warranty

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

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

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

Procedure for Service

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

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

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

Please check that the following is enclosed with your equipment:

- 3. A TPS 'Service / Return Goods Form' – from our website**
- 4. Your full name**
- 5. Your company name**
- 6. Your email address**
- 7. Your return street address**
- 8. A description of the fault. (Please be specific - "Please Repair" does not describe a fault.)**

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

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