Congratulations !

You have purchased the latest in Benchtop pH-mV-Temperature instrumentation. We trust that your new **900-P** will give you many years of reliable service.

The **900-P** is a breeze to operate. This manual has been designed to help you get started, and also contains some handy application tips. If at any stage you require assistance, please contact either your local TPS representative or the TPS factory in Brisbane.

The manual is divided into the following sections:

---

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

2. **Introduction**
   The introduction has a diagram and explanation of the display and controls of the **900-P**. It also contains a full listing of all of the items that you should have received with unit. Please take the time to read this section, as it explains some of items that are mentioned in subsequent sections.

3. **Main Section**
   The main section of the handbook provides complete details of the **900-P**, including operating modes, calibration, troubleshooting, specifications, and warranty terms.

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

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

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

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

E-mail : tps@tpssite.com.au

Web Site : www.tpssite.com.au

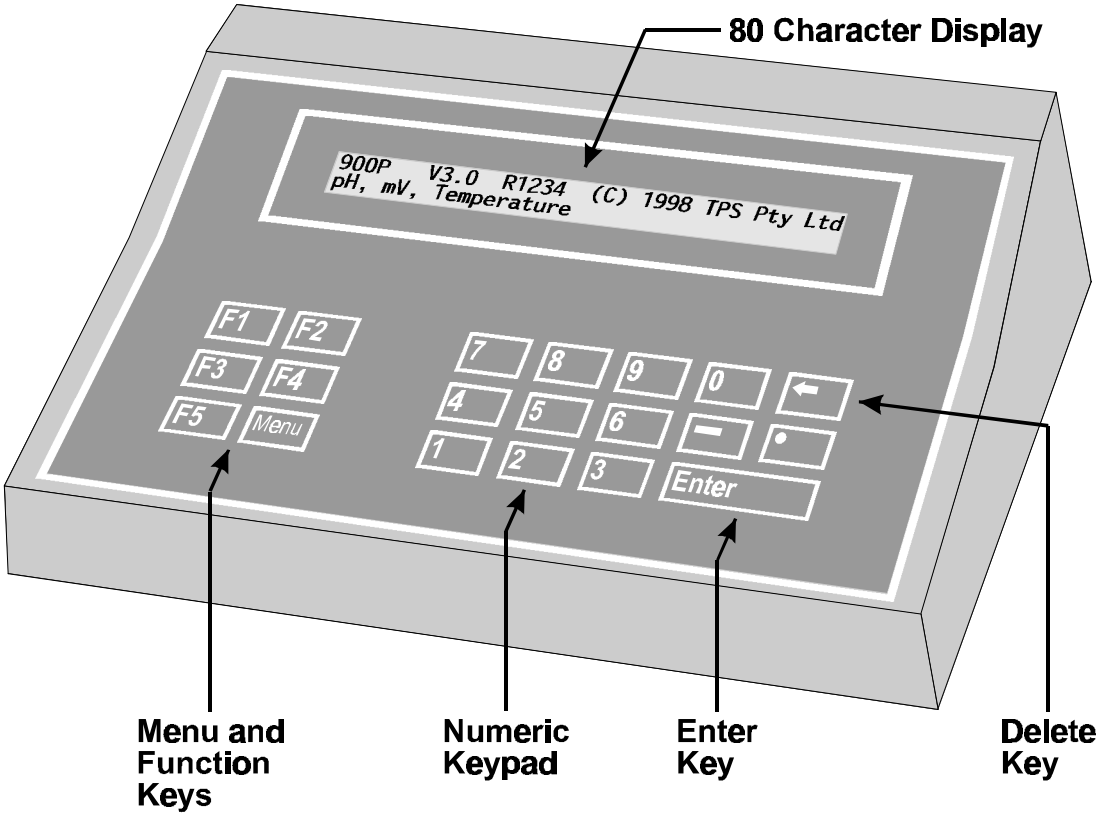
900-P
pH-mV-Temperature
Meter

Date : 21-Jul-98
Author : MS
Version : 3.0

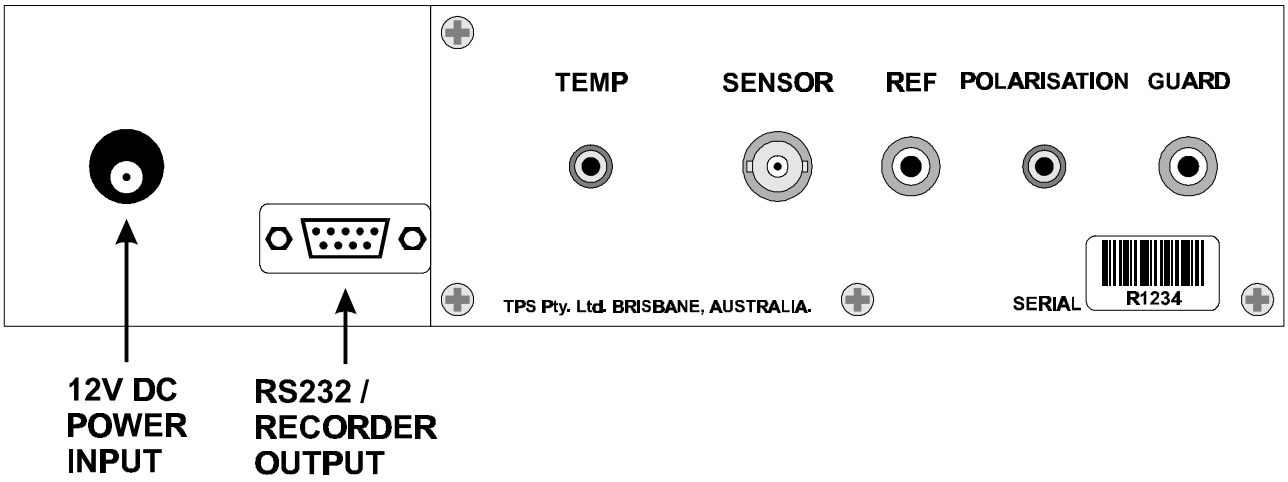
Contents

1. Introduction

1.1 900-P Display and Controls



1.2 900-P Rear Panel Connectors



1.3 Menu and Function Keys

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

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

F1 : Press to record readings into the Notepad. See section 10.
Also used at turn-on to select buffers for auto buffer recognition. See section 14.

F3 : Press to start or stop automatic datalogging. See section 10.
Alternatively, press to transmit current reading plus date and time to the optional RS232 port. See section 11.2.

F4 : Press to Zero Relative mV, when Relative mV is selected. See section 6.

F5 : Press to obtain context-sensitive help messages. This function is disabled within menus.

1.4 Numeric Keypad

Used to enter values during set-up and calibration. A negative sign and decimal point are provided.

1.5 Enter Key

Press the Enter key to accept default values or those entered on the Numeric Keypad.

1.6 Delete Key

Press the ← key to make corrections to values entered on the Numeric Keypad.

Press and hold this key at turn-on to initialise the **900-P**. See section 15.

1.7 80 Character Display

80 character alphanumeric display with user-friendly menu and context-sensitive help system. Shows pH, Temperature, Date and Time simultaneously.

1.8 Unpacking Information

Before using your new **900-P**, please check that the following accessories have been included:

	Part No
Standard Kit:	
1. **900-P** Benchtop pH-mV-Temp Instrument	121101
2. pH Sensor, BNC Plug	121207
3. Temperature/ATC Sensor	121245
4. pH6.88 Buffer, 200mL	121306
5. pH4.00 Buffer, 200mL	121381
6. Plug-Pack Power Supply	130044
7. **900-P** Handbook	130050
Options that may have been ordered with your 900-P:	
1. Flexible arm type electrode holder	130088
2. RS232 Serial Interface Option (includes cable)	130029
3. Recorder Output Option (includes cable)	130028
4. RS232 PLUS Recorder Output Option (includes cable)	130049
5. Communication software for Windows 3.1, 95, and NT	130086
6. Communication software for DOS	130075
7. RS232 Printer	130031
Other spares:	
1. RS232 Interface Cable	130022
2. Recorder Cable	130021
3. RS232 PLUS Recorder Cable	130030

1.9 Specifications

Mode	Range	Resolution	Accuracy
pH	0 to 14.000 pH 0 to 14.00 pH 0 to 14.0 pH	0.001 pH 0.01 pH 0.1 pH	±0.002 pH ±0.01 pH ±0.1 pH
mV	0 to ±500.0 mV 0 to ±1500 mV (auto-ranging)	0.1 mV 1 mV	±0.15 mV ±1 mV
Relative mV	0 to ±500.0 mV 0 to ±1500 mV (auto-ranging)	0.1 mV 1 mV	±0.15 mV ±1 mV
Temperature	-10.0 to 120.0 ^{O}C	0.1 ^{O}C	±0.2 ^{O}C

Additional pH Specifications

Input Impedance : >3 x 10^{12} Ω
Asymmetry Range : -1.00 to 1.00 pH
Slope Range : 85.0 to 105.0 %
Temperature Compensation : Automatic, 0 to 100 ^{O}C

Additional Temperature Specifications

Temp. Sensor Offset Range : -10.0^{o}C to +10.0^{o}C

General Specifications

Memory : 2700 readings including date and time
Automatic Logging : User-set for one reading every 1 to 90 seconds, minutes or hours.
RS232 Port (optional) : 300, 1200 & 9600 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 Value of last pH Asymmetry, pH Slope and Temperature calibration are stored. This information can be recalled or sent to the optional RS232 port at any time.
Power : 12V DC, 50mA. Plug-pack power supply is included in standard kit.
Dimensions : 270 x 210 x 75 mm
Mass : Instrument only : Approx 1.0 kg
Full Kit : Approx 3.0 kg
Environment Temperature : 0 to 45 ^{O}C
Humidity : 0 to 90 % R.H.

2. 900-P Menu Structure

A detailed breakdown of the menu system of the **900-P** is shown below. This diagram provides a quick reference for the menu functions available for the **900-P**.

Press the function keys in normal display mode, to perform the following tasks:

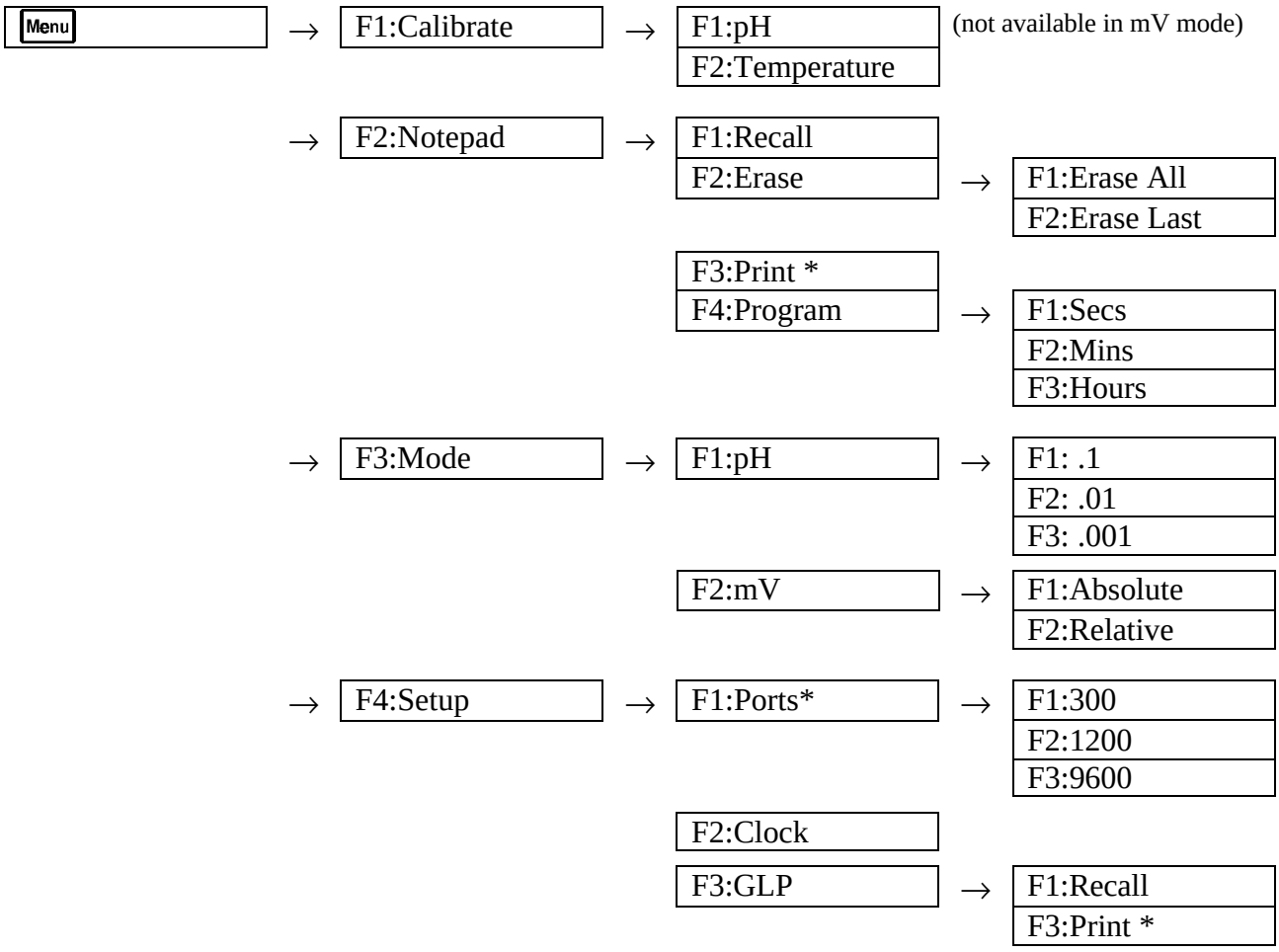
F1 : Press to record readings into the Notepad. See section 9.1.

F3 : Press to start or stop automatic datalogging. See section 10.
If logging period is set to zero, press to transmit current reading plus date and time to the optional RS232 port. See section 11.2.

F4 : Press to Zero Relative mV, when Relative mV is selected. See section 6.

F5 : Press to obtain context-sensitive help messages. This function is disabled within menus.

Menu : Press to access the user-friendly menu system, as detailed below.



* These functions available when RS232 option is fitted.

3. Operating Modes

The **900-P** has three operating modes : pH, mV and Relative mV.

3.1 pH Mode

To select pH mode, press Menu → **F3:Mode** → **F1:pH**

Now choose the desired pH resolution…

Press F1 to select 0.1 pH resolution.

Press F2 to select 0.01 pH resolution.

Press F3 to select 0.001 pH resolution.

3.2 Absolute Millivolt Mode

To select absolute mV mode, press Menu → **F3:Mode** → **F2:mV** → **F1:Absolute**

The 900-P will display the actual millivolts produced by the sensor in this mode.

3.3 Relative Millivolt Mode

To select relative mV mode, press Menu → **F3:Mode** → **F2:mV** → **F1:Relative**

The 900-P will display the millivolt data relative to a known, user-selectable zero point.

Absolute millivolt data is also displayed.

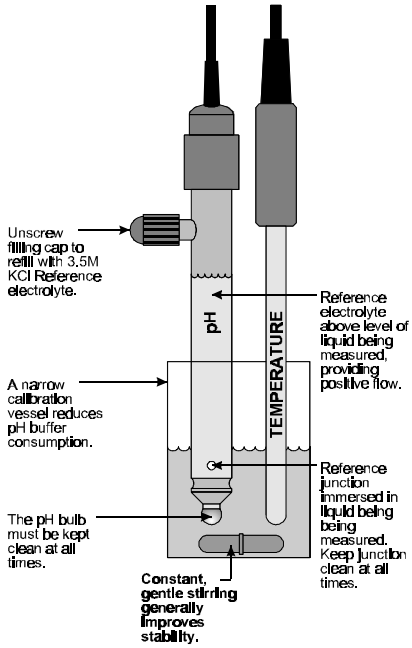
3.4 Notes

1. Temperature compensation does not apply in mV mode.
2. The decimal point is replaced by a * if a pH or Temperature calibration has failed (see sections 4 and 7), if the unit is initialised (section 15), or if the unit has lost its factory calibration (section 17.1).

4. pH Calibration

4.1 Calibration Procedure

1. Plug the pH sensor into the **SENSOR** socket and the temperature sensor into the **TEMP** socket. Switch the meter on.
2. Select pH Mode and the desired pH resolution (see section 3.1).
3. Ensure that temperature has already been calibrated, or manually set (see sections 7.1 and 7.4). NOTE: If the decimal point in the temperature reading is shown by a ∗, then the temperature readout is not calibrated.
4. Remove the wetting cap from the pH sensor. Rinse the pH and Temperature sensors in distilled water and blot them dry.
5. Ensure that the primary and secondary buffers to be used have been correctly selected for automatic buffer recognition. See section 14.
6. Place both electrodes into a small sample of primary buffer (pH6.88 or 7.00), so that the bulb and reference junction are both covered, as per the diagram below.



DO NOT place the electrodes directly into the buffer bottle.

7. Select pH Calibration (Menu → **F1:Calibrate** → **F1:pH**). The display should now look something like this…

```
     6*85pH  Buffer=6.86          25.0°c
Press ENTER to Calibrate, or Edit Buffer.
```

The current pH reading is shown on the left. Note the "*****", indicating that pH is currently not calibrated. Wait for this reading to stabilise before attempting to calibrate the **900-P**.

The buffer that the **900-P** has attempted to recognise is also displayed with the correct value at the current temperature.

Press Enter to calibrate to the displayed buffer.

Otherwise, enter an alternative buffer using the Numeric Keypad, and then press Enter.

If a 1 point calibration has been performed, the ∗ will not be removed until a full 2 point calibration has been performed.

8. Rinse the pH and Temperature sensors in distilled water and blot them dry.
9. Place both sensors into a small sample of secondary buffer (pH4.00, 9.23 or 10.01), so that the bulb and reference junction are both covered, as per the diagram in step 6, above.

   DO NOT place the electrodes directly into the buffer bottle.

   NOTE: pH9.23 and pH10.01 buffers are highly unstable. Avoid using these buffers if possible. Discard immediately after use.
10. Select pH Calibration (Menu → **F1:Calibrate** → **F1:pH**). The display should now look similar to the example shown in step 7. Note that the **900-P** has automatically recognised the second buffer.

    Wait for the displayed reading to stabilise before attempting to calibrate the **900-P**.

    Press Enter to calibrate to the displayed buffer.

    Otherwise, enter an alternative buffer using the Numeric Keypad, and then press Enter.
11. The **900-P** is now calibrated and is ready for use. Discard the used samples of buffer.

4.2 Calibration Notes

1. A 1-point calibration should be performed at least weekly. In applications where the electrode junction can become blocked, such as dairy products, mining slurries etc, a 1-point calibration may have to be done daily.
2. A full 2-point calibration should be performed at least monthly. Of course, more frequent calibration will result in greater confidence in results.
3. All calibration information is retained in memory when the **900-P** is switched off, even when the power supply is removed. This information can be recalled or printed later using the GLP function (see section 8).

4.3 Calibration Messages

1. If a 1-point calibration has been successfully performed, the **900-P** will display the following message, and the asymmetry of the electrode. Note that the slope value from the last calibration is also shown.

```
Asymmetry Calibration Successful
+0.10pH Asym      100% Slope
```

2. If a 1-point calibration has failed, the **900-P** will display the following message, and the failed asymmetry value of the electrode.

```
Calibrate Failed, +1.2 pH Asymmetry
Repeat Cal. or Initialize Calibration
```

3. If a 2-point calibration has been successfully performed, the **900-P** will display the following message, and the asymmetry and slope of the electrode.

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

4. If a 2-point calibration has failed, the **900-P** will display the following message, and the failed slope value of the electrode.

```
Calibrate Failed, 80% Slope
Repeat Cal. or Initialize Calibration
```

5. The **900-P** has an allowable Asymmetry range of –1.00 to +1.00 pH. The allowable Slope range is 85.0 to 105.0 %. If calibration fails due to either the Asymmetry or the Slope being outside these limits, then please consult the Troubleshooting guide (section 17.2) for possible remedies.

5. mV Calibration

The millivolt section of the 900-P is factory calibrated. There is no user-calibration facility for this mode.

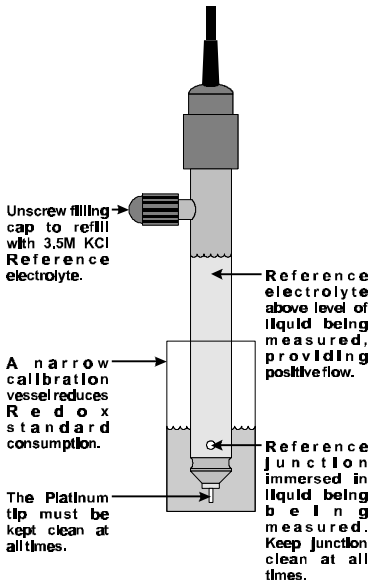
6. Relative mV Calibration

Select Relative mV mode when measurements relative to a known standard are required. Calibration of the Relative mV mode is simply a matter of zeroing the reading when the sensor is in the known standard.

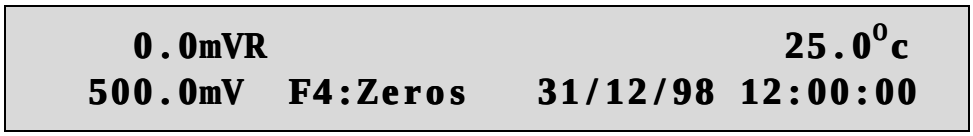
1. Plug the Redox sensor into the **SENSOR** socket. Temperature compensation is not applied in Relative mV mode, so the temperature sensor does not need to be connected.
2. Switch the meter on.
3. Select Relative mV Mode (Menu → **F3:Mode** → **F2:mV** → **F2:Relative**)
4. The display should now be showing Relative mV on the top line with absolute mV on the bottom line. For example…

```
500.0mVR                          25.0°c
500.0mV  F4:Zeros    31/12/98 12:00:00
```

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



7. When the reading has stabilised, press the F4 key to zero the Relative mV reading. The Relative mV reading will now be zero, and the absolute mV reading will remain unchanged. For example…



8. The **900-P** Relative mV mode is now zeroed and is ready for use. The readout can be re-zeroed by pressing the F4 key whenever required.

Notes

1. The Relative mV offset is retained in memory when the **900-P** is switched off, even when the power supply is removed.
2. The Relative mV zero offset is reset when leaving Relative mV mode.

7. Temperature Calibration

The temperature readout must be calibrated or manually set before attempting pH calibration. The decimal point is replaced by a ***** if the reading is not calibrated.

7.1 Calibration Procedure

1. Plug the temperature sensor into the **TEMP** socket.
2. Switch the meter on.
3. Place the temperature sensor into a beaker of room temperature water, alongside a good quality mercury thermometer. Stir the probe and the thermometer gently to ensure an even temperature throughout the beaker.
4. Select Temperature Calibration (Menu → **F1:Calibrate** → **F2:Temperature**).

   The Temperature Calibration screen is now displayed. For example…

   ```
   Enter Actual Temperature : _      24.0°C
   Temperature Calibration        Menu Quits
   ```

   The current reading from the Temperature sensor is displayed on the far right of the top line.

5. When this reading has stabilised, use the Numeric Keypad to enter the same temperature as measured by the mercury thermometer.
6. Press the Enter key to calibrate the temperature readout.

   Alternatively, press the Menu key to abort temperature calibration.

7.2 Calibration Notes

1. Temperature calibration information is retained in memory when the **900-P** is switched off, even when the power supply is removed. This information can be recalled later using the GLP function (see section 8).
2. Temperature does not need to be re-calibrated unless the Temperature sensor is replaced or the meter is initialised.

7.3 Calibration Messages

1. If a temperature calibration has been successfully performed, the **900-P** will display the following message and the offset of the sensor.

   ```
   Temperature Calibration OK
   0.1°C Offset
   ```

2. If a temperature calibration has failed, the **900-P** will display the following message, and the failed offset value of the sensor.

   ```
   Temperature Calibration Failed
   11.0°C Offset
   ```

3. The **900-P** has an allowable Offset range of -10.0 to +10.0 °C. If calibration fails due to the Offset being outside these limits, then please consult the Troubleshooting guide (section 0) for possible remedies.

7.4 Manual Temperature Setting

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

1. Switch the meter on.
2. Measure the temperature of the sample.
3. Select Temperature Calibration (Menu → **F1:Calibrate** → **F2:Temperature**).
4. The current temperature setting is now displayed. For example…

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

   Press Enter to save the new value.

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

6. The **900-P** now returns to normal measurement mode. Note the flashing "**M**" in the temperature readout, indicating that Manual Temperature Compensation is in use. For example…

8. Good Laboratory Practices (GLP)

The **900-P** keeps a record of the date and time of the last pH and Temperature calibrations as part of GLP guidelines.

8.1 To recall GLP information on the display

1. Switch the meter on.
2. Select the GLP menu ([Menu] → **F4:Setup** → **F3:GLP**).
3. Select **F1:Recall** from the menu.
4. The instrument model, firmware version number, and instrument serial number are displayed, along with a prompt describing how to scroll through the GLP information.

```
900P  V3.0 R1234          @ 31/12/98 12:00
                                  F4:Next
```

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

GLP Display sequence…

```
900P  V3.0 R1234          @ 31/12/98 12:00
                                  F4:Next
```

↑[F2] ↓[F4]

```
pH Asymmetry= 0.10pH        31/12/98 11:00
pH Calibrated             F2:Back F4:Next
```

↑[F2] ↓[F4]

```
pH Slope=  99.0%            31/12/98 11:10
pH Calibrated             F2:Back F4:Next
```

↑[F2] ↓[F4]

```
Temperature Offset= 1.0°C 31/12/98 12:00
Temp. Calibrated          F2:Back F4:Ends
```

8.2 Failed Calibration

If calibration has failed, the GLP function will reset the date and time for the failed parameter to zero. The 900-P still shows the results for the last successful calibration, as shown in the following examples.

1. Failed pH Asymmetry Calibration…

```
pH Asymmetry= 0.10pH      00/00/00 00:00
pH Un-Calibrated          F2:Back F4:Next
```

2. Failed pH Slope Calibration…

```
pH Slope= 99.0%           00/00/00 00:00
pH Un-Calibrated          F2:Back F4:Next
```

3. Failed Temperature Offset Calibration…

```
Temperature Offset= 1.0°C 00/00/00 00:00
Temp Un-Calibrated        F2:Back F4:Next
```

8.3 Printing GLP Information to the RS232 Port

The GLP information stored in the instrument's memory can be sent to a printer or PC via the RS232 port. This function is available only when the optional RS232 port is fitted.

1. Switch the meter on.
2. Ensure that the **900-P** RS232 cable is connected to the instrument and to the printer or PC.
3. Send the GLP information to the RS232 port:

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

   The message "**Printing GLP Data**" is displayed while sending the data to the RS232 port.
4. The GLP information is sent to the RS232 port in formatted ASCII text. For example…

```
900P  V3.0 R1234 @ 31/12/1998 12:00
pH          Asy=       0.10pH    @ 31/12/1998 11:00
pH          Slope=     99.0%     @ 31/12/1998 11:10
Temperature Offset=     1.0oC     @ 31/12/1998 11:20
```

8.4 Instrument Serial Number

In case the serial number that is fitted to the rear of the **900-P** is removed or becomes illegible, it is also available on the **900-P** display.

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

```
900Ps  V3.0  R1234  (C) 1998 TPS Pty Ltd
pH, mV, Temperature
```

2. The serial number is displayed when recalling the GLP information (section 8.1).
3. The serial number is included on the printout of GLP information (section 8.3).
4. The GLP information can be downloaded to a PC using the optional Windows ® software (part number 130086).

8.5 Additional GLP Features

Another GLP requirement is to record the date and time of every reading. The **900-P** does this for you when readings are recorded either with the Notepad function (section 9) or the Automatic Logging function (section 10).

9. Notepad Function

9.1 Recording Readings into the Notepad

To record readings into the Notepad memory…

1. Press [F1] in normal display mode. The display should now look like this:

```
      7.00pH                          25.0°c
Log#  1, Press F1      31/12/98 12:00:00
```

2. Press [F1], to record pH/mV, Temperature, Date and Time into the notepad. This will be labeled as reading number 1.

   Alternatively, press [Menu] to quit without recording the reading.

3. Repeat steps 1 & 2 as often as required. The maximum number of readings that can be stored in the Notepad is 2700.

9.2 Recalling Readings from the Notepad

To recall records from the Notepad onto the **900-P** display…

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

   Record number 1 is now displayed.

   For example…

```
      7.00pH                          25.0°c
Log#  1,  F2:↑  F4:↓  31/12/98 12:00:00
```

3. Press [F2] to display the next record.

   Press [F4] to display the previous record.

   Press and hold [F2] or [F4] to roll rapidly through the readings.

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

   Press [F3] to send the displayed record to the optional RS232 port.

9.3 Erasing Records from the Notepad

To erase records from the Notepad…

1. Select the Erase Notepad menu (Menu → **F2:Notepad** → **F2:Erase**)
2. The **900-P** now displays the Erase menu, for example…

   ```
   Erase Notepad, ( 100 ) Select Option
   F1:Erase All  F2:Erase Last   Menu Exits
   ```

   The number of readings stored in the Notepad is displayed. See the "**100**" in the example above.

3. Press F1 to erase all of the readings stored in the Notepad.

   Press F2 to erase the last recorded reading only.

   Press Menu to quit without erasing any records.

9.4 Printing Records from the Notepad to the RS232 Port

This function is only available when the optional RS232 port is fitted.

1. Connect one end of the RS232 cable to the **RS232/Recorder** socket of the **900-P**.
2. Connect the other end of the RS232 cable to an RS232 Printer, or to the COM1 or COM2 ports of a PC.
3. Ensure that the baud rate for the printer or PC and the **900-P** are the same. If necessary, alter the baud rate of the **900-P** (see section 11.1).

   The **900-P** uses XON/XOFF protocol. Ensure that the printer is set accordingly.

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

10. Automatic Datalogging

The **900-P** can automatically log records into the Notepad. First the logging period must be programmed, then automatic logging can be started and stopped as required.

1. Select the Notepad menu (Menu → **F2:Notepad**)
2. Select **F4:Program** from the menu.

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

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

3. Use the Numeric Keypad to set the period at which the **900-P** 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 **900-P** will ask you to enter the units. The Logging/Printing Period you have set is also displayed. For example…

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

   Press F1 to save the Logging/Printing Period as hours.

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

   Press F3 to save the Logging/Printing Period as seconds.

5. If the optional RS232 port is fitted, the **900-P** will ask if the records are to be logged into the Notepad, or sent directly to the RS232 port. The display will look like this…

   Press F1 to log records into the Notepad (maximum of 2700 readings).

   Press F2 to send records directly to the RS232 port.

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

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

   When the **900-P** is logging into the Notepad, the display will look like this…

   ```
         7.00pH                    25.0°c
   Log#  1,              31/12/98 12:00:00
   ```

   The log number will increment and the **900-P** will beep each time a reading is recorded.

   If the **900-P** is sending records directly to the RS232 port, the display will look like this…

   ```
         7.00pH                    25.0°c
   Sending               31/12/98 12:00:00
   ```

   The **900-P** will beep each time a record is sent to the RS232 port.

8. Press F3 to stop automatic logging.

9. **Note:** The clock must be set before the **900-P** will allow automatic logging to start. The message "**Clock Not Set**" is displayed if the clock is not set. See section 13 for details on setting the clock.

11. RS232 Port

This section is applicable if the optional RS232 port is fitted.

11.1 Setting the Baud Rate

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

```
Baud Rate:   F1:300   F2:1200  →F3:9600
8 bits, No Parity, 1 Stop bit, XON/XOFF
```

   The arrow indicates the current selection.

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

11.2 Sending Readings to the RS232 Port

Press F3 to instantly send readings to the RS232 port whenever the **900-P** is in normal measurement mode. This function is disabled if the automatic logging period is set to greater than zero (see section 10).

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

Press F3 while recalling data on the display (see section 9.2) to send that record to the RS232 port.

11.3 RS232 Configuration

The **900-P** RS232 configuration is 8 Bits, No Parity, 1 Stop Bit, XON/XOFF Protocol.

This information is displayed when setting the baud rate (see section 11.1)

11.4 Communication and Statistical Software

Communication between the **900-P** and a PC can be handled with any RS232 communication software. The diskette supplied by TPS contains a BASIC program for this purpose. A Windows version is also 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 **900-P** is formatted in columns that can be imported by programs such as Microsoft® Excel® and Lotus 123®.

Information on how to use the software is provided in the README files on the diskette.

11.5 Commands

The following commands can be sent from a PC to the **900-P**. Note that <cr> denotes carriage return and <lf> denotes a line feed.

Action	Command	Notes
Request current data	?D<cr>	Returns the current pH/mV, Temperature, date and time from the **900-P**. The log number returned is set to Zero.
Request logged data	?R<cr>	Returns all logged records from the **900-P** memory. The data ends with the message **ENDS**<cr>
Erase logged data	?E<cr>	Erases all logged records from the **900-P** 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… **900P♦♦V3.0♦R1234♦2700**<cr>, where ♦ are spaces. Note that the number of logged readings is right-justified.
Request GLP information	?G<cr>	Returns all calibration GLP information, plus the instrument model, serial number and current date (see section 11.7 for data format and handshaking).

11.6 Data Format

Data is returned to the RS232 Port by the **900-P** in the following format…

LLLL•PPPPPPPPUUU•TTTTTuuu•dd/mm/yyyy•hh:mm:ss

where….

LLLL is the Log Number, 4 characters, right justified. The **900-P** sends a Zero for instant readings (see section 11.2).

• is one space

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

UUU is the unit description, either "**pH•**", "**mV•**" or "**mVR**" (where • is one space).

• is one space.

TTTTT is Temperature data, 5 characters, right justified.

uuu is the unit description. The **900-P** sends "**oC•**" for real temperature data (where • is one space), or "**oCm**" for manual temperature compensation values.

• is one space.

dd/mm/yyyy is the date, month and year data. The year is sent as 4 digits for Year 2000 compliance.

• is one space

hh:mm:ss is the hours, minutes and seconds data.

When requested by a PC with the ?D or ?R commands (section 11.5), the data is terminated with a carriage return.

When the data is sent by the **900-P** using the Print function (section 9.4) or the Instant Send function (section 11.2), the data ends with a carriage return and a line feed.

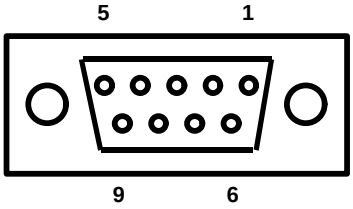
11.7 GLP Format

GLP information is returned as up to 5 lines terminated by a carriage return. When using the "?G" command (section 11.5), the computer must respond with a character after receiving each line.

For example…

```
900P  V3.0 R1234 @ 31/12/97 12:00
pH          Asy=       0.10pH    @ 31/12/1998 11:00
pH          Slope=     99.0%     @ 31/12/1998 11:10
Temperature Offset=     1.0oC     @ 31/12/1998 11:20
ENDS
```

11.8 RS232 Port Connections



Pin No	Connection
2	Receive RS232 Data
3	Transmit RS232 Data
5	Ground

12. Recorder Port

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

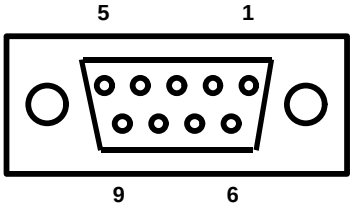
The optional Recorder Port can be used to send pH, mV or Relative mV data to a chart recorder or other analogue logging device.

12.1 Recorder Port Specifications

Mode	Display Range	Output for Display Range	Examples (Reading = mV Out)
pH	0 to 14.000 pH 0 to 14.00 pH 0 to 14.0 pH	0 to 2000 mV (for all resolutions)	7.00 pH = 1000 mV
mV	-1500 to +1500 mV	0 to 2000 mV	0.0 mV = 1000 mV +750 mV = 1500 mV -600 mV = 600 mV
Relative mV	-1500 to +1500 mVR	0 to 2000 mV	0.0 mVR = 1000 mV +750 mVR = 1500 mV -600 mVR = 600 mV

Output Impedance : Approximately 1000 Ohms

12.2 Recorder Port Connections



Pin No	Connection
6	Recorder Output Signal
7	Recorder Output Common

13. Setting the Clock

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

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

3. Use the Numeric Keypad to enter the current time, then press Enter.
4. Alternatively, press menu to quit and retain the current setting.
5. If you pressed Enter above, the display will now show the current date, for example…

```
Date is now    31/12/1998
Enter new date 31/12/1998   dd/mm/yyyy
```

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

Notes

1. The **900-P** tests that a valid day of the month is entered. If an invalid date is entered (eg 31/02/1998), the **900-P** 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 **900-P** also tests for leap years.

14. Selecting the pH Buffer Set

The 900-P can be programmed to automatically recognise any of the following buffer sets during calibration. All pH values listed below are at 20 ^{O}C.

1. pH4.00, pH6.88, pH9.22
2. pH4.00, pH6.88, pH10.06
3. pH4.00, pH7.00, pH9.22
4. pH4.00, pH7.00, pH10.06.

To select the pH buffer set for automatic recognition…

1. Switch the **900-P** OFF.
2. Press and **HOLD** the F1 key while turning the **900-P** back on.
3. The primary buffer selection menu is now displayed…

   Select Primary Buffer
   →F1:6.88pH F2:7.00pH

   The arrow indicates the current selection.

   Press F1 to select pH6.88 as the Primary Buffer.

   Press F2 to select pH7.00 as the Primary Buffer.

   Press Menu to quit without changing the current setting.

4. The secondary buffers selection menu is now displayed…

   Select Secondary Buffers
   →F1:4.00/9.22pH F2:4.00/10.06pH

   The arrow indicates the current selection.

   Press F1 to select pH4.00 and pH9.22 as the Secondary Buffers.

   Press F2 to select pH4.00 and pH10.06 as the Secondary Buffers.

   Press Menu to quit without changing the current setting.

Notes

1. The selected buffer set is kept in memory when the meter is switched off.
2. The buffers are re-set to pH4.00, pH6.88 and pH9.23 during initialisation.
3. pH6.88 buffer is a DIN 19266 and NBS Primary-standard pH solution. Its use as the primary buffer is highly recommended for the most accurate possible results. If pH7.00 buffer is used, ensure that it is manufactured to at least 0.01pH accuracy. pH7.00 buffer has a buffer capacity less than half that of pH6.88 buffer and is therefore much less stable.
4. pH9.23 and pH10.01 buffers are highly unstable. Avoid using these buffers if possible. Discard immediately after use.
5. If you wish to use a pH buffer other than one of those listed above, its value can be keyed in during calibration. Make sure that you have pH versus Temperature data for the buffer.

15. Initialising the 900-P

If the calibration settings of the **900-P** exceed the allowable limits, the unit may need to be initialised to factory default values. This action may be required if the electrode is replaced.

To initialise the **900-P**…

1. Switch the **900-P** off.
2. Press and hold the ← key while switching the **900-P** back on.
3. The following messages should be displayed…

```
Initializing
```

then…

```
      System Initialized
Unit should be Re-calibrated before use
```

then…

```
900Ps  V3.0  R1234  (C) 1998 TPS Pty Ltd
pH, mV, Temperature
```

(The "s" after **900P** is only shown when the RS232 serial port option is fitted)

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

16. Instrument firmware version number

If you need to phone or fax TPS for any further technical assistance, the version number of your **900-P** firmware may of benefit to us. The version number is displayed by the **900-P** at turn-on.

17. Troubleshooting

17.1 General Errors

Error Message	Possible Causes	Remedy
Factory Calibration Data Failure. **mV and Temperature Readings Inaccurate**	The EEPROM chip which contains the factory calibration information has failed.	The unit must be returned to TPS for service. • mV & Temperature readings may be up to 10% incorrect. • Specific Ion and pH readings will be accurate after a 2-point calibration (use manual temperature compensation).
EEPROM Write Failure **Return to Factory for Service**	User calibration settings have been lost or corrupted.	Switch the meter OFF and switch back ON. If the problem persists, return the unit to TPS for service.

17.2 pH and mV Troubleshooting

Symptom	Possible Causes	Remedy
Unit fails to calibrate, even with new probe.	Calibration settings outside of allowable limits due to previous failed calibration.	Initialize the unit. See section 15.
1 Point calibration fails (Asymmetry is greater than +/-1.00 pH).	1. Reference junction blocked.	Clean reference junction, as per instructions supplied with the electrode.
	2. Reference electrolyte contaminated.	Flush with distilled water and replace electrolyte.
2 Point calibration fails (Slope is less than 85.0%).	1. Buffer set incorrectly	For automatic buffer recognition, ensure that you are using buffers that match the selected buffer set (section 14). Otherwise, ensure that the buffer value is entered correctly at calibration.
	2. Glass bulb not clean.	Clean glass bulb as per instructions supplied with the electrode.
	3. Electrode is aged.	Attempt rejuvenation, as per instructions supplied with the electrode. If not successful, replace electrode.
	4. Connector is damp.	Dry in a warm place.
	5. Buffers are inaccurate.	Replace buffers.
Unstable readings.	1. Electrolyte chamber needs to be refilled.	Refill with saturated KCl filling solution.
	2. Reference junction blocked.	Clean reference junction, as per instructions supplied with the electrode.
	3. Glass bulb not clean.	Clean glass bulb as per instructions supplied with the electrode.
	4. Bubble in glass bulb.	Flick the electrode to remove bubble.
	5. Faulty connection to meter.	Check connectors. Replace if necessary.
	6. Reference junction not immersed.	Ensure that the bulb AND the reference junction are fully immersed.
	7. KCl crystals around reference junction, inside the electrolyte chamber.	Rinse electrolyte chamber with warm distilled water until dissolved. Replace electrolyte.
Inaccurate readings, even when calibration is successful.	Reference junction blocked.	Clean reference junction, as per instructions supplied with the electrode.
Displays 7.00 for all solutions.	Electrical short in connector.	1. Check connector. Replace if necessary. 2. Replace electrode.
Displays 4-5 pH for all solutions.	Glass bulb or internal stem cracked.	Replace electrode.

17.3 Temperature Troubleshooting

Symptom	Possible Causes	Remedy
Temperature inaccurate and cannot be calibrated.	1. Faulty connector.	Check the connector and replace if necessary.
	2. Faulty temperature probe.	Fit new temperature probe, part number 121245.
Displays flashing "**M**" when temperature probe plugged in.	1. Faulty **TEMP** socket.	Return the instrument to the TPS factory for service.
	2. Faulty temperature probe.	Fit a new temperature probe, part number 121245.

18. Appendices

18.1 pH Electrode Fundamentals

A combination pH Electrode is two electrodes in one. The sensing membrane is the round or spear shaped bulb at the tip of the electrode. This produces a voltage that changes with the pH of the Solution. This voltage is measured with respect to the second part of the electrode, the reference section. The reference section makes contact with the sample solution using a salt bridge, which is referred to as the reference junction. A saturated solution of KCl is used to make contact with the sample. It is vital that the KCl solution has an adequate flow rate in order to obtain stable, accurate pH measurements.

18.1.1 Asymmetry of a pH Electrode

An "ideal" pH electrode produces 0 mV output at 7.00 pH. In practice, pH electrodes, generally produce 0 mV output at slightly above or below 7.00 pH. The amount of variance from 7.00 pH is called the asymmetry. Figure 18-1 illustrates how asymmetry is expressed.

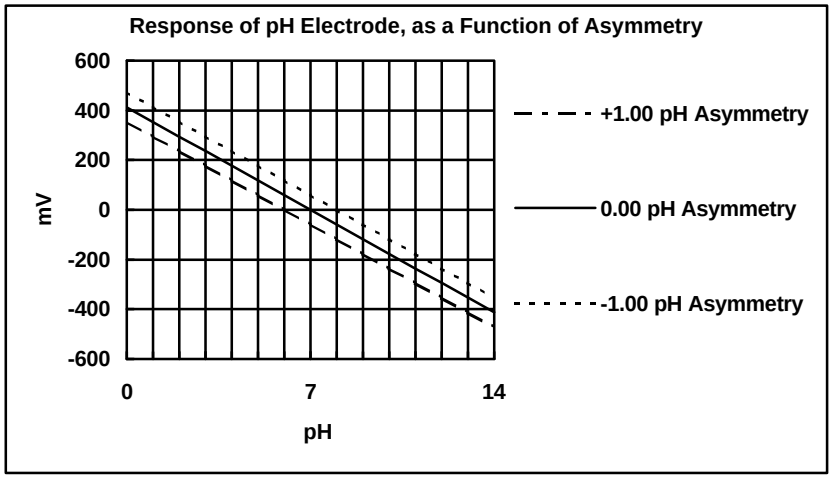


Figure 18-1

18.1.2 Slope of a pH Electrode

As mentioned above, a pH electrode produces 0 mV output at around 7.00 pH. As the pH goes up, an "ideal" pH electrode produces -59mV/pH unit at 25 ^{O}C As the pH goes down, an ideal pH electrode produces +59mV/pH unit. In practice, pH electrodes usually produce slightly less than this. The output of a pH electrode is expressed as a percentage of an ideal electrode. For example, an ideal electrode that produces 59mV/pH unit has "100% Slope". An electrode that produces 50.15mV/pH unit has "85% Slope" (see Figure 18-2).

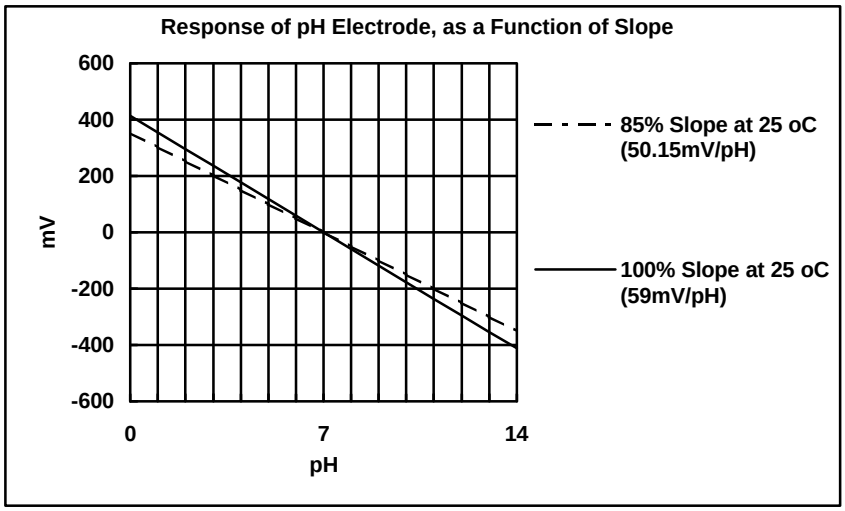


Figure 18-2

18.1.3 Temperature Compensation

The slope of a pH electrode is affected by temperature. This effect is compensated for either by using an Automatic Temperature Compensation (ATC) probe or by entering the sample temperature manually. Figure 18-3 shows the slope of a pH electrode at various temperatures.

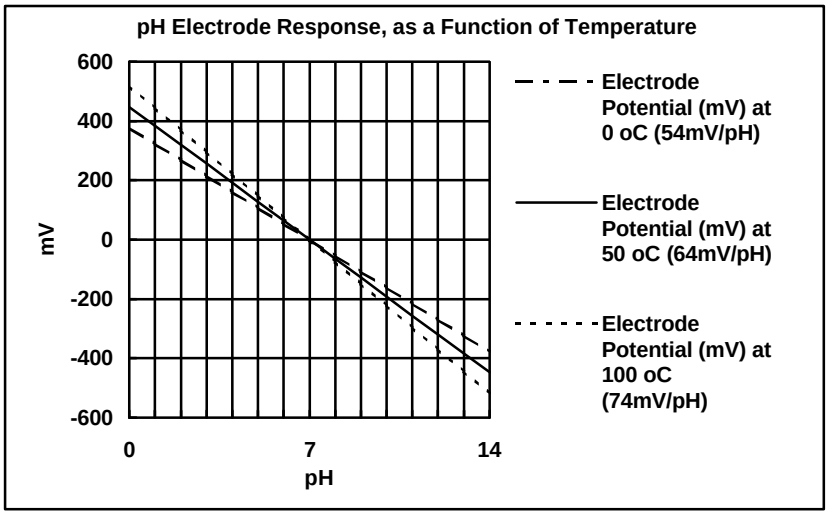


Figure 18-3

18.2 Guard Connector

In some circumstances, the pH or mV readings may become unstable. This may be due to static charge in the sample vessel, or electrical noise from nearby electrical equipment. In these cases, a solution guard may eliminate the problem.

A solution earth rod is available from TPS (part no 121360). This connects directly to the **Guard** socket. Alternatively, run a wire from the **Guard** socket to a stainless steel fitting in contact with the sample.

18.3 Polarisation Connector

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

The TPS Double Platinum electrode (part no 122207) has two connectors. The larger BNC connector fits to the **Sensor** socket and the smaller 3.5mm phono plug fits to the **Polarisation** socket.

DO NOT PLUG THE DOUBLE PLATINUM ELECTRODE INTO THE TEMPERATURE SOCKET.

When performing Karl Fischer titrations, ensure that the **900-P** is in mV mode.

18.4 Checking the reference junction of a pH electrode

If pH readings are inaccurate or unstable, the reference junction of the electrode may be blocked. The following test can be performed to determine if the reference junction of a pH electrode is making adequate contact with the sample solution.

1. Calibrate the **900-P**, as per section 4.
2. Dilute 1 part of pH6.88 buffer with 9 parts of distilled water.
3. Measure the pH of the diluted buffer. The result should be 7.06 +/-0.02 pH.
4. If the value obtained is outside of these limits, then clean the reference junction, as per the instructions supplied with the pH electrode.
5. Re-calibrate the **900-P** and repeat the test.
6. If the value obtained is still outside 7.06 +/-0.02 pH, then the electrode should be replaced.

18.5 Determining if an instrument or electrode is faulty

The following test can be performed to help determine if the **900-P** or the pH electrode is faulty.

1. Initialise the 900-P (see section 15).
2. Disconnect the pH electrode.
3. Connect the centre pin of the **SENSOR** connector with the outside frame of the connector, using a short piece of wire or a paper clip etc.
4. The meter should display approximately pH7.00, depending on the current calibration settings.
5. If the **900-P** is operating correctly, the reading should be totally stable with the wire firmly in place. If not, the meter requires servicing.
6. Now carefully disconnect the wire from the centre pin only (make sure the other end of the wire remains connected to the outside frame of the connector).
7. The reading should steadily drift away from 7.00 (either up or down) at a rate of approximately 1 pH or less every 3 seconds. If the drift rate is faster than this, then input circuitry of the **900-P** is faulty and requires servicing.

19. Warranty

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

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

Shipping damage is not covered by this warranty.

PLEASE NOTE:

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

PROCEDURE FOR SERVICE

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

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

To obtain this service, please follow this procedure:

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

Please check that the following is enclosed with your equipment:

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

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

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