

# **Palintest®**

## **Macro 900 Water Quality System**

### **Operation Manual**

**[www.palintest.com](http://www.palintest.com)**

## **RECYCLING**



Any product bearing this symbol must be handed over to an applicable collection point for the recycling of electrical and electronic equipment. Palintest Ltd is registered with the United Kingdom Environment Agency under the WEEE regulations. Our unique Producer Reference number is WEE/FD0115XU. We are members of the recovery scheme B2B Compliance.

*Note: For return for recycling, please contact Palintest Ltd for instructions on how to return end-of-life equipment, accessories, and all auxiliary items for proper disposal.*

## **Limitations of Liability**

Palintest Ltd and its affiliates specifically disclaim liability for any and all direct, indirect, special, general, incidental, consequential, punitive or exemplary damages including, but not limited to, loss of profits or revenue or anticipated profits or revenue or expenses incurred arising out of the use or inability to use any Palintest product, miscalibration, loss of data or product failure, even if Palintest Ltd and/or its affiliates has been advised of the possibility of such damages or they are foreseeable or for claims by any third party. Notwithstanding the foregoing, in no event shall Palintest Ltd and/or its affiliates aggregate liability arising under or in connection with Palintest products, regardless of the number of events, occurrences, or claims giving rise to liability, be in excess of the price paid by the purchaser for the Palintest product.

## **TRADEMARKS**

Microsoft®, Windows® and Excel® are trademarks of Microsoft Corporation  
GOOGLE™ is a trademark of Google, Inc. StabICal® is a trademark of the HACH Company

**Palintest Ltd has no affiliation with Microsoft Corporation, Google, Inc. or HACH**

## **Table of Contents**

<b>1. INTRODUCTION.....</b>	<b>8</b>
<b>2. WHAT'S IN THE BOX?.....</b>	<b>8</b>
2.1. THE MACRO 900 AND THE ENVIRONMENT.....	8
2.2. THE MAP 2000/2100 AND THE ENVIRONMENT .....	8
2.3. IMPORTANT INFORMATION ABOUT THE PROBE SLEEVE & SLEEVE END CAP.....	9
2.4. TOP TIPS FOR SUCCESSFUL MEASUREMENTS USING OPTICAL ELECTRODES .....	11
2.5. ABOUT THE LANYARD .....	11
<b>3. BATTERY INSTALLATION AND CARE.....</b>	<b>12</b>
3.1. CHOICE OF BATTERY TYPE.....	12
3.2. BATTERY LIFE.....	12
3.3. BATTERY CHARGING.....	12
3.4. BATTERY CONDITION ICON .....	12
3.5. BATTERY SAVER FUNCTIONS .....	12
<b>4. OVERVIEW OF THE OPERATING SYSTEM .....</b>	<b>13</b>
4.1. INITIAL SWITCH ON, LANGUAGE AND CLOCK SETUP.....	13
<b>5. CONNECTING AN MAP 2000/2100 .....</b>	<b>15</b>
<b>6. TAKING MEASUREMENTS.....</b>	<b>15</b>
6.1. WHAT DOES IT ALL MEAN? .....	16
6.2. TREND INDICATION .....	17
6.3. GLOBAL STABILITY INDICATION.....	18
6.4. TEMPERATURE COMPENSATION .....	18
6.5. GPS RECEPTION.....	19
<b>7. DEPTH MEASUREMENT (MAP 2100 ONLY).....</b>	<b>20</b>
7.1. TAKING DEPTH MEASUREMENTS .....	20
7.2. DIFFERENTIAL DEPTH MEASUREMENT .....	20
<b>8. MEMORY MODE .....</b>	<b>21</b>
8.1. MANUALLY SAVING READINGS .....	21
8.2. RECALLING AND VIEWING SAVED READINGS .....	21
8.3. RECALLING GLP DATA.....	21
8.4. CLEARING THE MEMORY.....	22
8.5. AUTOMATIC DATA LOGGING.....	22
8.6. IMPORTANT INFORMATION ABOUT MEMORY MODE .....	23
<b>9. SETUP &amp; INSTALL.....</b>	<b>24</b>
9.1. SETTING UNITS OF MEASUREMENT.....	24
9.2. AUX SOCKET ASSIGNMENT.....	26
<b>10. MACROCAL CALIBRATION METHOD.....</b>	<b>28</b>
10.1. ABOUT CALIBRATION.....	28
10.2. SPECIAL NOTES CONCERNING ISE ELECTRODES.....	28
10.3. USING MACROCAL.....	29
<i>To Calibrate the 100% Saturation Point in Damp Air.....</i>	31
10.4. CALIBRATION ERROR MESSAGES .....	31
10.5. RESETTING TO FACTORY CALIBRATION DEFAULTS .....	32
10.6. CALIBRATION DATA STORAGE .....	33
10.7. CALIBRATION REPORTS.....	33
<b>11. AFTER USE .....</b>	<b>34</b>
<b>12. GENERAL PROBE MAINTENANCE .....</b>	<b>35</b>

12.1.	IDENTIFYING THE INDIVIDUAL ELECTRODES.....	35
<b>13. PH/ORP ELECTRODE CALIBRATION AND MAINTENANCE.....</b>	<b>36</b>	
13.1.	RECOGNISING THE PH/ORP ELECTRODE.....	36
13.2.	ELECTRODE REMOVAL AND REPLACEMENT .....	36
13.3.	KEEPING THE ELECTRODES MOIST.....	36
13.4.	CALIBRATING pH.....	36
13.5.	SPECIAL NOTES CONCERNING ISE ELECTRODES.....	37
13.5.1.	<i>Calibrating the First Point (pH 7.00).....</i>	37
13.5.2.	<i>Calibrating the Second Point.....</i>	39
13.5.3.	<i>Calibrating the Third Point.....</i>	39
13.6.	ERRORS DURING CALIBRATION.....	39
13.7.	PH ELECTRODE EFFICIENCY .....	39
13.8.	SERVICING THE PH ELECTRODE .....	40
13.9.	CALIBRATING ORP .....	40
13.10.	CONVERTING ORP READINGS TO THE HYDROGEN SCALE.....	43
<b>14. DO/EC ELECTRODE CALIBRATION AND MAINTENANCE.....</b>	<b>44</b>	
14.1.	RECOGNISING THE DO/EC ELECTRODE.....	44
14.2.	DO MEASUREMENT TECHNIQUE .....	44
14.3.	PRECAUTIONS DURING USE.....	44
14.4.	CALIBRATING THE DO/EC ELECTRODE.....	44
14.5.	CALIBRATING THE DO ZERO POINT.....	44
14.6.	CALIBRATING THE DO 100% SATURATION POINT IN MOIST AIR.....	46
14.7.	REPLACING THE OPTICAL DO CAP .....	46
14.8.	CALIBRATING EC .....	48
14.9.	VERIFYING EC CALIBRATION.....	50
14.10.	ERRORS DURING CALIBRATION.....	50
14.11.	CLEANING THE EC CONTACTS.....	51
<b>15. OPTIONAL OPTICAL PROBES CALIBRATION AND MAINTENANCE .....</b>	<b>52</b>	
15.1.	PT 1551 TURBIDITY PROBE.....	54
15.1.1.	<i>About Turbidity.....</i>	54
15.1.2.	<i>Precautions During Use .....</i>	54
15.1.3.	<i>Calibrating the Turbidity Electrodes .....</i>	55
15.1.4.	<i>Turbidity Zero Point Calibration .....</i>	55
15.1.5.	<i>Calibrating the Turbidity 1000 NTU Point .....</i>	57
15.1.6.	<i>Errors During Calibration .....</i>	57
15.1.7.	<i>Lens and Sleeve Maintenance .....</i>	57
15.1.8.	<i>References .....</i>	57
15.2.	PT 1552 FRESHWATER BLUE-GREEN ALGAE (PHYCOCYANIN) PROBE .....	59
15.2.1.	<i>Principle of Operation.....</i>	59
15.2.2.	<i>Limitations of Use .....</i>	59
15.2.3.	<i>Calibrating the BGA-PC Electrode .....</i>	59
15.2.4.	<i>Calibration Solution Preparation .....</i>	60
15.2.5.	<i>Serial Dilution .....</i>	60
15.2.6.	<i>Zero Point Calibration .....</i>	62
15.2.7.	<i>Calibrating Point 2 .....</i>	63
15.2.8.	<i>Errors During Calibration .....</i>	64
15.2.9.	<i>Lens and Sleeve Maintenance .....</i>	65
15.3.	PT 1553 MARINE WATER BLUE-GREEN ALGAE (PHYCOERYTHRIN) PROBE .....	66
15.3.1.	<i>Principle of Operation.....</i>	66
15.3.2.	<i>Limitations of Use .....</i>	66
15.3.3.	<i>Calibrating the BGA-PE Probe .....</i>	66
15.3.4.	<i>Calibration Solution Preparation .....</i>	67
15.3.5.	<i>Serial Dilution .....</i>	67
15.3.6.	<i>Zero Point Calibration .....</i>	69
15.3.7.	<i>Calibrating Point 2 .....</i>	70
15.3.8.	<i>Errors During Calibration .....</i>	71

15.3.9. <i>Lens and Sleeve Maintenance</i> .....	72
15.4. PT 1556 CHLOROPHYLL PROBE.....	73
15.4.1. <i>Principle of Operation</i> .....	73
15.4.2. <i>Limitations of Use</i> .....	73
15.4.3. <i>Calibrating the CPHYLL Probe</i> .....	73
15.4.4. <i>Calibration Solution Preparation</i> .....	74
15.4.5. <i>Serial Dilution</i> .....	74
15.4.6. <i>Zero Point Calibration</i> .....	75
15.4.7. <i>Calibrating Point 2</i> .....	76
15.4.8. <i>Errors During Calibration</i> .....	76
15.4.9. <i>Lens and Sleeve Maintenance</i> .....	78
15.5. PT 1554 RHODAMINE WT PROBE.....	79
15.5.1. <i>Principle of Operation</i> .....	79
15.5.2. <i>Limitations of Use</i> .....	79
15.5.3. <i>Calibrating the RHOD Probe</i> .....	79
15.5.4. <i>Calibration Solution Preparation</i> .....	79
15.5.5. <i>Serial Dilution</i> .....	80
15.5.6. <i>Zero Point Calibration</i> .....	80
15.5.7. <i>Calibrating Point 2</i> .....	82
15.5.8. <i>Errors During Calibration</i> .....	82
15.5.9. <i>Lens and Sleeve Maintenance</i> .....	82
15.6. PT 1555 FLUORESCIN DYE PROBE .....	83
15.6.1. <i>Principle of Operation</i> .....	83
15.6.2. <i>Limitations of Use</i> .....	83
15.6.3. <i>Calibrating the FSCEIN Probe</i> .....	83
15.6.4. <i>Calibration Solution Preparation</i> .....	83
15.6.5. <i>Serial Dilution</i> .....	84
15.6.6. <i>Zero Point Calibration</i> .....	84
15.6.7. <i>Calibrating Point 2</i> .....	86
15.6.8. <i>Errors During Calibration</i> .....	86
15.6.9. <i>Lens and Sleeve Maintenance</i> .....	86
15.7. PT 1557 REFINED OIL (HYDROCARBON) PROBE .....	87
15.7.1. <i>Principle of Operation</i> .....	87
15.7.2. <i>Limitations of Use</i> .....	87
15.7.3. <i>Special Precautions When Using the REFOIL Probe</i> .....	88
15.7.4. <i>Calibrating the REFOIL Probe</i> .....	88
15.7.5. <i>Calibration Solution Preparation</i> .....	88
15.7.6. <i>Serial Dilution</i> .....	89
15.7.7. <i>Zero Point Calibration</i> .....	89
15.7.8. <i>Calibrating Point 2</i> .....	91
15.7.9. <i>Errors During Calibration</i> .....	91
15.7.10. <i>Lens and Sleeve Maintenance</i> .....	91
<b>16. OPTIONAL ISE ELECTRODES CALIBRATION AND MAINTENANCE .....</b>	<b>93</b>
16.1. ISE ELECTRODE LIMITATIONS.....	93
16.2. CALIBRATION POINTS.....	93
16.3. SPECIAL NOTES CONCERNING ISE ELECTRODES DURING PH CALIBRATION.....	93
16.4. PT 1541 AMMONIUM/AMMONIA ELECTRODE.....	94
16.4.1. <i>Ammonium Calibration Solution Preparation</i> .....	94
16.4.2. <i>Three-point Calibration</i> .....	95
POINT 2 .....	96
POINT 3 .....	97
16.4.3. <i>Two-point Calibration</i> .....	97
16.4.4. <i>Single-point Calibration</i> .....	97
16.4.5. <i>Errors During Calibration</i> .....	98
16.5. PT 1542 NITRATE ELECTRODE.....	99
16.5.1. <i>Nitrate Calibration Solution Preparation</i> .....	99
16.5.2. <i>Three-point Calibration</i> .....	100
POINT 2 .....	101

POINT 3 .....	102
16.5.3. <i>Two-point Calibration</i> .....	102
16.5.4. <i>Single-point Calibration</i> .....	102
16.5.5. <i>Errors During Calibration</i> .....	103
16.6. PT 1543 CHLORIDE ELECTRODE .....	104
16.6.1. <i>Chloride Calibration Solution Preparation</i> .....	104
16.6.2. <i>Three-point Calibration</i> .....	105
POINT 2 .....	106
POINT 3 .....	107
16.6.3. <i>Two-point Calibration</i> .....	107
16.6.4. <i>Single-point Calibration</i> .....	107
16.6.5. <i>Errors During Calibration</i> .....	108
16.7. PT 1544 CALCIUM ELECTRODE .....	109
16.7.1. <i>Calcium Calibration Solution Preparation</i> .....	109
16.7.2. <i>Three-point Calibration</i> .....	110
POINT 2 .....	111
POINT 3 .....	112
16.7.3. <i>Two-point Calibration</i> .....	112
16.7.4. <i>Single-point Calibration</i> .....	112
16.7.5. <i>Errors During Calibration</i> .....	113
16.8. PT 1545 FLUORIDE ELECTRODE .....	114
16.8.1. <i>Fluoride Calibration Solution Preparation</i> .....	114
16.8.2. <i>Three-point Calibration</i> .....	115
POINT 2 .....	116
POINT 3 .....	117
16.8.3. <i>Two-point Calibration</i> .....	117
16.8.4. <i>Single-point Calibration</i> .....	117
16.8.5. <i>Errors During Calibration</i> .....	118
<b>17. MACRO 900 LINK PC SOFTWARE.....</b>	<b>119</b>
17.1. SOFTWARE INSTALLATION .....	119
17.2. DRIVER INSTALLATION .....	119
17.3. RUNNING MACRO 900 LINK.....	119
17.4. UPLOADING DATA FROM YOUR MACRO 900 METER.....	120
17.5. DISPLAYING GPS Co-ORDINATES .....	121
17.6. ON SCREEN HELP .....	122
17.7. SAVING LOGGED DATA .....	122
17.8. RETRIEVING LOGGED DATA .....	122
17.9. EXPORTING DATA .....	122
17.10. EXPORTING TEXT REPORTS.....	122
17.11. TYPICAL TEXT REPORT COVER PAGE .....	124
17.12. EXPORTING EXCEL® FILES.....	125
17.13. EXPORTING GOOGLE™ FILES.....	125
17.14. IMPORTING FILES INTO GOOGLE™ MAPS .....	125
17.15. IMPORTING FILES INTO GOOGLE™ EARTH.....	126
17.16. GOOGLE™ EXAMPLES.....	127
<b>18. LIMITED WARRANTY .....</b>	<b>128</b>
18.1. CLEANING PRIOR TO RETURN .....	128
18.2. DECONTAMINATION CERTIFICATE .....	129
<b>19. TROUBLESHOOTING.....</b>	<b>130</b>
<b>20. DECLARATION OF CONFORMITY.....</b>	<b>131</b>
<b>21. APPENDIX 1. THE TECH BEHIND PALINTEST'S OPTICAL DO MEASUREMENT SYSTEM .....</b>	<b>133</b>
21.1. PRINCIPLE OF OPERATION.....	133
21.2. SENSOR CAP LIFE.....	134

<b>22. APPENDIX 2. FLOW THROUGH CELL.....</b>	<b>135</b>
22.1. INTRODUCTION .....	135
22.2. SPIGOT INSTALLATION.....	135
22.3. PROBE INSTALLATION.....	135
22.4. OPERATION.....	135
22.5. CAUTION.....	136
22.6. CLEANING.....	136
22.7. FLOWCELL TROUBLESHOOTING.....	136
<b>23. APPENDIX 3. FITTING AUX ELECTRODES .....</b>	<b>137</b>
23.1. INSTALLING AUX ELECTRODES.....	137
23.2. SOCKET ASSIGNMENT AND CALIBRATION .....	138
<b>24. APPENDIX 4. STANDARD ELECTRODES DETAILED SPECIFICATION .....</b>	<b>140</b>
<b>25. APPENDIX 5. OPTICAL PROBES DETAILED SPECIFICATION AND FAQS .....</b>	<b>142</b>
25.1. WHAT ARE THE EXCITATION AND DETECTION WAVELENGTHS?.....	142
25.2. HOW DOES THE REFINED OIL SENSOR WORK?.....	142
25.3. I CAN SEE ALGAE IN THE WATER BUT MY SENSOR IS GIVING LOW READINGS. WHY? .....	143
25.4. WHAT IS THE RANGE AND RESOLUTION OF THE OPTICAL PROBES?.....	143
25.5. WHAT IS THE ACCURACY OF THE OPTICAL PROBES? .....	144
<b>26. APPENDIX 6. ISE ELECTRODES DETAILED SPECIFICATION .....</b>	<b>145</b>
26.1. SPECIAL NOTES CONCERNING ISE ELECTRODES DURING PH CALIBRATION.....	147

## 1. Introduction

This manual covers the setup, operation, calibration and maintenance of the Macro Accessory Probe (MAP) 2000/2100, Macro 900 Meter v2, Macro 900 Link PC software and associated accessories.

## 2. What's in the Box?

The Macro 900 Water Quality System is supplied with the following:

- The Macro 900 Meter.
- Quick release lanyard.
- Set of 5 AA Alkaline batteries.
- USB Cable for downloading logged data to a PC.
- Cross-head screwdriver for fitting the batteries and Probe maintenance.
- Quick start manual.
- CD containing Macro 900 Link software, USB drivers and this Instruction Manual.

The MAP 2000/2100 probe is supplied with the following:

- Protective Sleeve End Cap with End Cap Plug fitted.
- Calibration bottle filled with MacroCal Solution.
- Spare calibration / rinse bottle.
- One mounting nut (pre-fitted).
- 25mL bottle of pH storage solution.
- Pot of silicone grease.

To complete your system you will also need a connection cable, available in various lengths, plus additional optional optical probes and ion selective electrodes.

### 2.1. The Macro 900 and the Environment

The Macro 900 Meter is designed to be used outdoors and is rated to IP67, that is to say it is waterproof but it **is not** designed for submersion. In order to prevent accidental dunking or loss, a lanyard is supplied.

**Please note that the socket on the Macro 900 Meter is only waterproof when the associated plug is fitted. Without the plug fitted, water can enter the socket. Damage caused by water ingress through the socket is not covered by your warranty.**

You may notice a small hole on the rear of the unit near the top. This is a waterproof vent for the internal barometric sensor. **Do not poke anything in this hole!** Doing so will cause major damage to the vent's waterproof membrane and invalidate your warranty.

### 2.2. The MAP 2000/2100 and the Environment

The MAP 2000/2100 is designed to be fully submerged in water and is rated to

IP68, that is to say, it is rated for continual immersion to a depth of 10 meters, and short term immersion to 50 meters.

### **2.3. Important Information about the Probe Sleeve & Sleeve End Cap**

The MAP 2000/2100 is constructed with an aluminium sleeve surrounding the delicate sensing electrodes. The Sleeve can be easily removed by unscrewing to allow cleaning of the individual electrodes, however, **the Probe sleeve forms an integral, working part of the Probe's measurement system, and MUST be fitted for correct operation.**

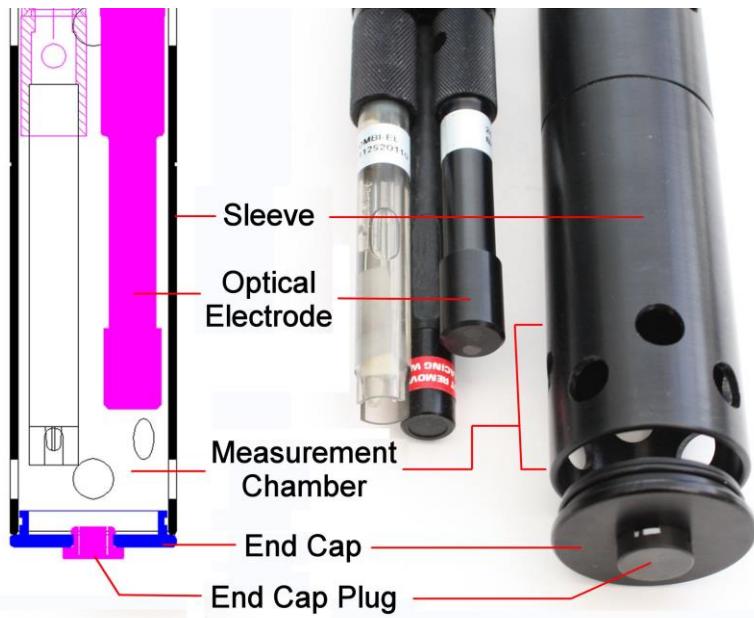
**All Palintest Optical Electrodes are incredibly sensitive. For example, the Turbidity electrode is capable of measuring between 0 and 3000NTU with an internal resolution of greater than 0.1NTU. This means that the electrode is able to detect changes in turbidity that is less than 0.003% of the full range! The other optical electrodes have a similar level of sensitivity.**

It follows, therefore, that in order to provide stable, repeatable readings, the environment in which the measurements are made must be completely stable and repeatable.

For this reason, the MAP 2000/2100 is constructed with a matt black aluminium sleeve and end cap that enclose the sensing electrodes and provide a closed, constant condition, non-reflective measurement chamber.

**This is essential for the correct calibration and operation of all types of optical electrodes.**

A diagram of the MAP 2000/2100's measurement chamber is shown here.



**In order to obtain consistent results, the measurement chamber created must remain physically constant during both calibration and measurement.**

If the optical electrode is calibrated under one set of conditions then used to measure under another set of conditions, the readings will naturally be erroneous, especially at low concentrations.

A perfect example of this is calibrating with the end cap removed then measuring with the end cap fitted (or vice-versa). By changing the physical characteristics of the measurement chamber, you also change the calibration and response of the electrode.

## 2.4. Top Tips for successful measurements using optical electrodes

- Always keep the measurement chamber and electrode lenses clean.
- Always fit the sleeve and end cap during both calibration and measurement.
- Ensure the End Cap Plug is also always fitted.
- Always allow the readings to settle completely during both calibration and measurement.
- Always try to eliminate air bubbles by agitating the Probe after insertion both during calibration and measurement.
- Always calibrate and zero the electrode as close to your sample temperature as possible. This is especially important with the PT 1557 Refined Oil probe.
- Always zero the optical electrodes just prior to use in clean water (bottled still mineral water is ideal) then deploy **without disturbing the measurement chamber**. This is especially important when using the Turbidity and Refined Oil probes.

## 2.5. About the Lanyard

The lanyard supplied with the Macro 900 Meter may, at first, appear to be a little long. This is intentional. In order to keep the Meter out of the way whilst your hands are full, the lanyard has been made long enough to wear round your neck and over your shoulder so the Meter sits on your hip.

The extra length also allows the meter to be held in a comfortable position in front of you during normal use. In order to prevent you being dragged into the water in the event of the Probe cable becoming snagged, the lanyard includes a quick-release clip.

### 3. Battery Installation and Care

The Macro 900 Meter requires five AA size batteries. To install the batteries, loosen the two screws on the centreline of the rear of the meter and remove the battery compartment lid. Following the battery polarity markings inside the battery compartment, insert five AA cells then replace the compartment lid and tighten the screws.

#### 3.1. Choice of Battery Type

Alkaline or rechargeable batteries may be used, but never mix battery types in the meter. If you choose to use rechargeable batteries, we recommend *Energizer* 2500mAh (or greater) Nickel-Metal Hydride cells, which are widely available.

If the Meter is to be out of use for a long period, remove the batteries to prevent damage due to possible leakage.

#### 3.2. Battery Life

A set of fresh alkaline cells will give over 20 hours use in the Macro 900 Meter. A fully charged set of 2500mAh NiMH cells will give up to 40 hours use in the Macro 900 Meter.

#### 3.3. Battery Charging

During the charging process, batteries generate heat and vent gasses, and must never be charged inside a sealed unit. Because the Macro 900 Meter is a sealed unit, we do not allow charging in-situ. Batteries must be removed and charged with a suitable battery charger outside the Meter. We recommend the use of one of the *Energizer* range of NiMH chargers.

#### 3.4. Battery Condition Icon

On all the main Macro 900 Meter screens, a battery condition icon is displayed in the top left corner. The icon shows full when the batteries are fresh, and gradually empties as the batteries are used. When the batteries need replacing, the empty battery icon will flash on and off. If you ignore this, the Meter will automatically switch itself off when the battery voltage becomes too low for reliable operation.

When using rechargeable batteries, the battery icon will not show completely full, even with freshly charged cells. This is due to the fact that rechargeable batteries are only rated at 1.2V per cell compared to 1.5V per cell for alkaline batteries. This indication does not affect battery life. The icon will simply sit at the  $\frac{3}{4}$  full mark for a longer period of time.

#### 3.5. Battery Saver Functions

The Macro 900 Meter is designed to switch off automatically if you do not touch any of the keys for 30 minutes. The only exception to this is if you have activated the [Automatic Data Logging](#) feature. In this case, the Meter will continue to operate until either the memory is full or the batteries go flat.

The display on the Macro 900 Meter incorporates a white backlight to improve

visibility in low-light conditions. As on a mobile phone, the backlight switches on each time a key is pressed, and stays on at full brightness for 15 seconds. After 15 seconds, the backlight will fade to half brightness. After a further 15 seconds the backlight will switch off.

During normal operation, if you want to activate the backlight without changing the Meter function, simply press the **ESC** key.

## 4. Overview of the Operating System

The operating software in the Macro 900 Meter has been designed for simple, intuitive use. Similarly, a great deal of development work has been put into simplifying and automating the calibration procedures in the Macro 900 Meter in order to allow normal field operatives (as opposed to trained lab technicians) to achieve quick and accurate results.

If you are used to operating a mobile phone or programming audio/visual equipment using a remote control, you should feel at home with the familiar up/down left/right arrow shaped navigation keys and central **OK** key.

The tree structure behind the **MENU** key should also be very familiar. Each item on the menu leads to a sub menu and then either onto further menus or final choices. Each branch of the menu system is navigated using the arrow keys. At each point, selections can be made by either pressing the **OK** key or the right arrow key.

To reverse along a branch of the menu system, use the **ESC** (escape) key or left arrow key. After a short time, you should be able to navigate around the entire menu system at speed using just the four arrow keys. If, at any time, you leave the Meter in one of the sub-menu screens, it will automatically back out to the main operating screen after 15 seconds.

### 4.1. Initial Switch On, Language and Clock Setup

To switch the meter on or off, briefly press the red key. **Do not hold it down.** The meter contains a clock and is capable of operating in several different languages. When switching on for the first time, you must select an operating language and set the clock. The first screen you will see is the Language Selection Screen.



→English  
Francais  
Deutsch  
Espanol

To select a language, move the cursor down the list using the down arrow key. To enter your selection, press the **OK** key or the right arrow key.

The next screen to be displayed is the Time & Date Setting Screen.

**Time & Date**  
→**Time:15:46:37**  
**Date:15/Jun/12**

To set the time and date, use the arrow keys to move the cursor around the screen. Use the up and down arrow keys to adjust values. When the time and date are correct, press the **OK** key. Don't worry if you make a mistake first time round. You can easily get back to these screens later through the **MENU** key.

## 5. Connecting an MAP 2000/2100

The MAP 2000/2100 is designed to connect to the Macro 900 Meter using a connecting cable. The cable features high-pressure metal connectors, which incorporate several O-ring seals at the Probe end. Prior to first connection, the seals must be lubricated using the silicone grease supplied.



Apply a generous smear of grease to the O-rings where indicated above. Be careful not to get any grease inside the connector near the gold contacts. A small smear of grease should also be applied to the thread on the Probe to allow easy tightening of the collar.

To connect the cable to the MAP 2000/2100, align the coloured dot on the MAP 2000/2100 with the **◀Palintest** logo on the plug body, then press the plug into the socket and tighten the retaining collar fully. **DO NOT TWIST THE CONNECTOR BODY WITH RESPECT TO THE PROBE.** Once the MAP 2000/2100 has been connected to the cable, the Macro 900 Meter can be connected.

Always ensure the Macro 900 Meter **is switched off** prior to connecting or disconnecting an MAP 2000/2100. Align the **◀Palintest** logo on the plug body with the red on/off switch on the Macro 900 Meter, then press the plug into the socket and tighten the retaining collar.

Once the MAP 2000/2100 is connected to the Macro 900 Meter, switch the Meter on by pressing the red on/off switch. The Macro 900 Meter should detect the Probe and automatically start displaying readings.

## 6. Taking Measurements

The MAP 2000/2100 includes a pH/ORP electrode, which is kept moist by a storage cap. Remove the storage cap by pulling the red lanyard marked 'Remove Before Use / Replace After Use' straight down. **Do not use a twisting motion to remove or replace the cap as this can unscrew the electrode from the Probe body.** Rinse any salty deposits from the pH/ORP electrode with fresh water.

Fit the protective Sleeve End Cap into the end of the Probe sleeve. Switch the Macro 900 Meter on and immerse the MAP 2000/2100 in the sample water, making sure that the water level covers the minimum immersion depth groove halfway up the Probe sleeve.

**TIP:** Occasional application of a smear of silicone grease or similar lubricant to the protective Sleeve End Cap O ring and the inside rim of the Probe sleeve will make fitting and removal of the Cap easier.

If the MAP 2000/2100 is connected correctly, the meter will read the Probe's serial number and model number, then will automatically configure itself to display only those readings the current MAP 2000/2100 is capable of taking. Initial Probe readings will be displayed on the meter's screen along with the current GPS status. The initial data screen for the Macro 900 Meter in conjunction with the MAP 2000/2100 is shown below.

<b>TEMP:018.5°C</b>	↔
<b>ORP:0415.2 mV</b>	↔
<b>pH:06.48</b>	↑
<b>← GPS:Acquiring →</b>	

Left/right arrows at the bottom corners of the screen indicate further data screens are available. To access these screens, simply press either the left or right arrow keys. Any value that is out of range or unavailable will be displayed as dashes. The other four screens available with the Macro 900/MAP 2000/2100 combination are shown below.

<b>DO:098.7%</b>	↑
<b>EC:6541µS/cm</b>	↔
<b>TDS:3271mg/L</b>	↔
<b>← GPS:3D Pos →</b>	

<b>SAL:03.57 PSU</b>	↔
<b>SSG:01.3øt</b>	↔
<b>← GPS:3D Pos →</b>	

<b>BARO:1013mb</b>	
<b>DEPTH:01.75m</b>	
<b>Hit [OK] to zero</b>	
<b>← GPS:3D Pos →</b>	

<b>Lat:N51 °21.498</b>	
<b>Long:E001°24.323</b>	
<b>Alt:00050M 1013mb</b>	
<b>← Sats in use:09 →</b>	

## 6.1. What Does It All Mean?

The screens above show the full default range of readings for the Macro 900

Meter and MAP 2000/2100 combination. If you are using a different Meter/Probe combination, you may have fewer screens to choose from and the readings may appear in a different order to facilitate logical screen layouts. If an asterisk (\*) character is flashing just below the battery symbol, this indicates that Auto Data Logging is switched on. See [Automatic Data Logging](#) in section 8.

The table below explains the readings and indicates which to expect with each Meter/Probe combination.

Prefix	Meaning	Units	Available On
TEMP	Probe Temperature	°C or °F*	MAP 2000/ MAP 2100
pH	pH (Acidity/Alkalinity)	pH or pHmV*	MAP 2000/ MAP 2100
ORP	Oxidation Reduction Potential	mV	MAP 2000/ MAP 2100
GPS	GPS Status	See section 6.5	Macro 900 Meter
DO	Dissolved Oxygen	%Sat or mg/L*	MAP 2000/ MAP 2100
EC	Electrical Conductivity	µS/cm or mS/cm <sup>†</sup>	MAP 2000/ MAP 2100
TDS	Total Dissolved Solids	mg/L or g/l <sup>†</sup>	MAP 2000/ MAP 2100
SAL	Salinity	PSU or ppt*	MAP 2000/ MAP 2100
SSG	Sea Water Specific Gravity	σt	MAP 2000/ MAP 2100
BARO	Barometric Pressure	mb or mmHg*	Macro 900 Meter
DEPTH	Depth above / below zero datum	Meters / Feet*	MAP 2100 only
Lat	Latitude	Degrees & Mins	Macro 900 Meter
Long	Longitude	Degrees & Mins	Macro 900 Meter
Alt	Altitude above Sea Level	Meters or Feet*	Macro 900 Meter

Note: the Depth is not displayed with the MAP 2000. In this case, barometric pressure is displayed after the altitude (Alt) at the end of line 3 on the position and altitude screen, with no prefix (as shown [1013mb] on the above screen example).

Items in the Units column marked with an asterisk (\*) can be selected as alternative units of measurement in the Settings Menu (see section 9 [Error! Reference source not found.](#)). Items in the Units column marked with a dagger (†) are auto-ranging, i.e. when the values become too large to display, the units of measurement automatically re-scale.

The EC field can be replaced by its reciprocal value, RES (Resistivity), if selected in the Settings Menu. If selected, readings will be displayed in either Ω·cm or KΩ·cm, depending on the value. See section 9 [Error! Reference source not found.](#) for more details.

## 6.2. Trend Indication

To the right of each reading, (except position, BARO and Depth), a trend indication is given. This consists of either an upwards facing arrow (which indicates the numeric value of the reading is rising), a downwards facing arrow (which indicates the numeric value of the reading is falling) or a two-headed arrow, which indicates a stable reading. Readings are judged to be stable when

the variation over a ten second period drops below 1%.

### 6.3. Global Stability Indication

In addition to the individual trend indications, there is a global stability indication, which is displayed when **all** readings are stable. This takes the form of a flashing double headed arrow which is displayed at the start of the third line of the display.

When taking a set of readings, gently stir the Probe, or raise and lower it in the sample (if there is no natural water flow) until the global stability icon appears. The initial display of the global stability icon will be accompanied by a double beep. When this occurs, all values are stable and ready for reading or saving.

### 6.4. Temperature Compensation

The electrochemical properties of all solutions change with the solution's temperature. In addition, the response of electrochemical measuring electrodes change with temperature. It is a fundamental, practical requirement in the field of water quality monitoring that test measurements taken at different temperatures can be compared.

In order to facilitate this, the MAP 2000/2100 automatically applies corrections for temperature wherever required.

During three point calibration of the ISE electrodes, the variation in response of the electrodes due to temperature is automatically calculated. During measurement, the variation in response of the electrodes due to temperature is automatically compensated for.

During calibration of the EC electrode, the variation in the calibration buffer solution due to temperature is automatically corrected for. During measurement of EC, the readings can be displayed without any temperature correction, corrected to 20°C, or corrected to 25°C. See section 9 **Error! Reference source not found.** for more details.

During calibration of the DO electrode, variations due to temperature and air pressure are automatically compensated for. During the measurement of DO, temperature, air pressure and salinity are automatically compensated for.

During calibration of the ORP electrode, the variation in the calibration buffer solution due to temperature is automatically corrected for. During measurement of ORP however, temperature corrections are not applied as the correction factors are matrix dependent and are not easily determined.

ORP potential measurements are mostly made to follow reactions rather than for their own sake. The completion of an ORP reaction is normally accompanied by a sharp change in the ORP millivolts reading. This change is usually much larger than the errors induced by temperature side effects.

During calibration of the optical electrodes, variations in the calibration solutions due to temperature are automatically compensated for. During the

measurement, temperature is automatically compensated for.

During calibration of the pH electrode, the small variation in the calibration buffer solutions due to temperature is not compensated for due to the differences in thermal coefficient between various buffer manufacturers. For this reason, the three pH points should be calibrated as close to the buffer manufacturer's specified temperature as possible (usually 20°C or 25°C) although a variation of up to +/-10°C makes very little difference in reality.

During pH measurement, temperature variation is automatically compensated for.

## 6.5. GPS Reception

The Macro 900 Meter contains a built-in GPS receiver and antenna. The antenna is situated at the top of the case, just behind the Palintest logo. For optimum signal reception, the antenna must be able to 'see' a reasonably large amount of the sky. **The GPS receiver will not work indoors or when shielded from the sky by any solid structure.**

After switch-on, the GPS receiver will automatically start to search for satellites. During this phase, the message **GPS:Acquiring** will be shown on the bottom line of all the screens. As soon as three satellites are acquired, two dimensional position (no altitude) will be calculated and the message **GPS:2D POS** will be shown on the bottom line of the screens.

Once a fourth satellite is acquired, altitude will be calculated and **GPS:3D POS** will be shown on the bottom line of the screens. With a good view of the sky, position should be calculated within ninety seconds of switch-on. To see your geographic position and the number of satellites in use, use the left or right arrow keys to scroll to the Position page.

If you switch the meter on indoors, then carry it outside after several minutes, there may be a considerable delay in acquiring satellites. In this case, switch the meter off, then back on again to reset the acquisition process.

## 7. Depth Measurement (MAP 2100 only)

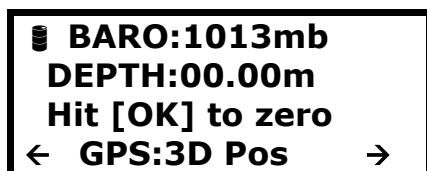
Depth is measured in the MAP 2100 by a pressure sensor mounted inside the body of the probe.

Depth is calculated by subtracting the barometric pressure being measured in the Macro 900 Meter from the water pressure being measured in the MAP 2100. The pressure differential, once corrected for temperature and salinity (water density), is directly proportional to depth.

The depth measurement system uses the EC sensor to detect when the probe has been placed in water. All the time the probe is measuring an EC of zero, the depth will read zero. As soon as an EC value is detected, the meter will start to calculate depth. **For this reason, it is important to ensure the Probe is connected to the Meter and switched on prior to submerging the probe in water.**

### 7.1. Taking Depth Measurements

Connect the Probe to the Meter and switch on prior to submerging the probe in water. Select the Baro/Depth screen as illustrated below. The depth should be reading zero.



If the depth is not reading zero (this is possible if the probe is wet and a low EC reading is registering), press the OK key. You will be asked to confirm by pressing OK again.

Slowly lower the probe into the water. As soon as the depth value starts to register, you can lower the probe more quickly.

### 7.2. Differential Depth Measurement

If you want to measure changes in depth, it may be more convenient to zero the depth measurement once the probe has been submerged.

To do this, press the OK key whilst displaying depth, then confirm. The unit will now read positive or negative changes in depth from the current depth (zero datum).

If the values are positive, the water level has increased from the zero datum. If the values are negative, the water level has decreased.

Using the Automatic Data Logging feature detailed in the following section, it is possible to monitor water levels over a period of time for later recall.

## 8. Memory Mode

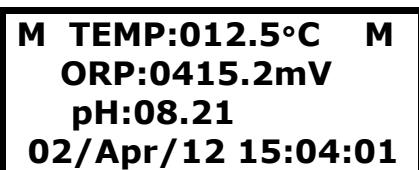
### 8.1. Manually Saving Readings

When you are happy that the readings are stable (see section 6.3: **Error! Reference source not found.**), press the **M+** key to snapshot the readings along with the time, date, GLP (calibration) data and position.

As each reading is saved, a numeric memory location 'Tag' will be briefly displayed which you can note down. This Tag can be used to identify readings at a later date, both on the Macro 900 Meter and when using Macro 900 Link software.

### 8.2. Recalling and Viewing Saved Readings

To recall your readings, press the **MR** key. On entering Memory Recall mode, the most recent Tag and set of readings are displayed first along with the date and time the readings were taken shown on the bottom line of the screen.



M TEMP:012.5°C M  
ORP:0415.2mV  
pH:08.21  
02/Apr/12 15:04:01

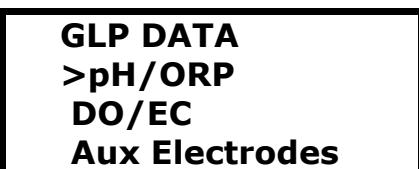
During Memory Recall, an 'M' is flashed in the top left and right corners of the screen alternatively with an up/down arrow and a left/right arrow. This is to indicate that the Meter is in Memory Recall mode and that other screens can be accessed using the arrow keys.

To see earlier readings, press the up arrow key. Just before each set of readings is displayed, the Tag will be briefly displayed. To view all the parameters within one set of readings, use the left/right arrow keys as described earlier. To exit Memory Recall mode, press the **ESC** key. If no key is pressed for 30 seconds, Memory Recall mode will be automatically cancelled.

### 8.3. Recalling GLP Data

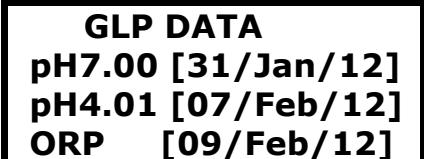
Each time a set of readings is added to memory, the date of the last successful calibration of each electrode is also appended. This is called GLP (Good Laboratory Practice) Data. In addition to the date of the last successful EC calibration, the Calibration Standard value at which the EC was calibrated is also displayed (see section 14: [Calibrating EC](#) for further details).

To view the last successful calibration date for each electrode for any particular stored reading, enter Memory Recall mode, scroll to the reading you are interested in using the up/down keys, then press the  **MENU** key. The screen below will be displayed.



GLP DATA  
>pH/ORP  
DO/EC  
Aux Electrodes

Using the up/down keys, select the electrode you are interested in, then press either the OK key or the right arrow key. If, for instance, you selected pH/ORP, the screen below would be displayed.



**GLP DATA**  
**pH7.00 [31/Jan/12]**  
**pH4.01 [07/Feb/12]**  
**ORP [09/Feb/12]**

This tells you that the last successful calibration, **prior to the recorded reading being taken**, was January 31<sup>st</sup> for the pH 7.00 point, February 7<sup>th</sup> for the pH 4.01 point and February 9<sup>th</sup> for ORP. If the date field is dashed (==/==/==), this means the electrode was either not fitted or had never been calibrated.

To exit this screen press the **ESC** key or the left arrow key.

#### **8.4. Clearing the Memory**

The memory within the Macro 900 Meter is capable of storing 1000 full sets of readings.

To clear the entire memory, switch the Meter off, hold down the **M+** key, then switch the Meter back on. A screen will be displayed asking you to confirm your request. Press OK to clear the memory or ESC to cancel and return to normal operation.

#### **8.5. Automatic Data Logging**

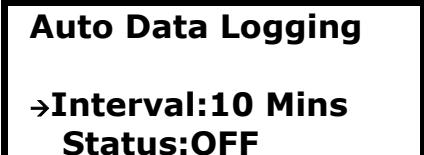
If you want to save readings automatically on a regular basis, in order, say, to check water quality at a certain location over a period of time, you can set the Meter to record readings automatically.

To do this, press the **MENU** key. The Main Menu screen will be displayed. Please note, the first item on the menu, 'Clean Probe', will only be active if a MAP 5000 (which has an automatic cleaning system) is connected.



→ **Clean Probe**  
**Auto Data Logging**  
**Calibration**  
**Setup & Install**

Select **Auto Data Logging** by pressing the down arrow key then the right arrow key or the **OK** key. The Auto Data Logging screen will be displayed.



**Auto Data Logging**  
→ **Interval:10 Mins**  
**Status:OFF**

Using the arrow keys to navigate, set the desired logging interval, then set the **Status** to **ON**.

To leave this screen, reverse back to the Main Menu screen then the normal operation screen by pressing the left arrow key. The Meter will now record a full set of data automatically at the set rate until either the memory is full or the batteries go flat.

To remind you that Auto Data Logging is switched on, an asterisk (\*) character will flash on and off just below the battery symbol on all the main reading screens.

You can cancel Auto Data Logging at any time by going back into the screen above and setting the **Status** to **OFF**. Auto Data Logging will also be cancelled if you switch the Meter off.

#### **8.6. Important Information About Memory Mode**

When data is saved in the Meter, it is compressed in raw Probe format. In other words, the same way that it came up from the Probe. When you recall the data in Memory Recall mode, the data is decompressed, then processed for display.

The advantage of this is that the readings will always appear in the current Meter configuration. For example, if you spent a day taking readings with the Meter set to read Dissolved Oxygen in %Saturation, then when you got back you really want to see Dissolved Oxygen displayed in mg/L, you can do this by simply changing the Meter settings (see section 9 **Error! Reference source not found.**).

The stored data can be displayed any way you want on recall. You are not limited to viewing the data in the same way it was logged. This is a major advantage and allows you to actually store and recall far more parameters than can be displayed at any one time.

The same rules apply when data is output to a PC running Macro 900 Link Software via the USB cable. The data that is output is always as per the Meter's current configuration. You can output the data as many times as you like in various Meter configurations.

## 9. Setup & Install

To alter the way the Macro 900 Meter displays readings, press the **MENU** key to get to the Main Menu, then choose **Setup & Install**. The Settings Menu will be displayed. Please note, the 'Socket Assignment' option on this screen is only accessible when a Probe is connected.

→Time & Date  
Units  
Language  
Socket Assignment

### 9.1. Setting Units of Measurement

From this screen choose **Units**. The Units Menu will be displayed. Remember, you can use just the arrow keys to navigate through the branches of the menus. You don't need to press **OK** or **ESC** at each level.

Units Menu  
→ DO/EC/TDS  
TEMP/pH/ORP/SAL  
BARO/Alt & Depth

At the Units Menu, you have a choice of which units you want to adjust. Choose the first line if you want to adjust Dissolved Oxygen, Electrical Conductivity or TDS. Choose line 2 if you want to adjust Temperature, pH, ORP or Salinity. Finally, line 3 will give access to Barometric Pressure, Altitude and Depth settings.

Moving the cursor right onto the first line will display the following screen.

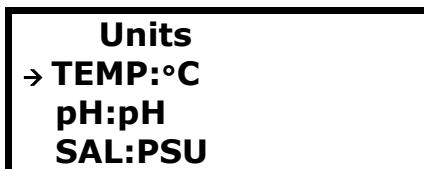
Units  
→ DO:%SAT  
EC:Ref 25°C  
TDS Fact:0.65

On this screen you can adjust the DO: setting between %Sat and mg/L. This will set the Meter to display Dissolved Oxygen as either % Saturation or in milligrams/Litre (which is the same as parts per million). Both readings are automatically corrected for atmospheric pressure, sample temperature and sample salinity.

The second option on this screen allows you to choose how the Meter displays Electrical Conductivity. There are four options. EC can be displayed as 'Absolute EC' without any temperature correction [ABS EC], as 'Specific EC' referenced to 20°C [Ref 20°C], as 'Specific EC' referenced to 25°C [Ref 25°C] or as a reciprocal of Absolute EC, which is Absolute Resistivity [ABS RES].

Finally, this screen allows you to set the factor that the Meter uses to calculate Total Dissolved Solids from Specific EC. This is the TDS Fact: (TDS = EC x TDS Fact) and can be set anywhere between 0.00 and 1.00. Default value is 0.65.

Selecting the second line of the Units Menu will display the following screen.



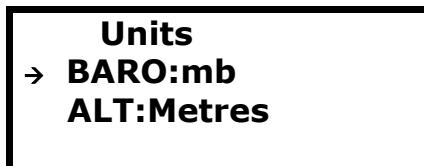
The first option on this screen allows you to change the temperature display between °C and °F.

The second option allows you to change the pH display between plain pH and pHmV. Plain pH displays normal, temperature compensated pH values in the range 0 - 14.

pHmV displays the actual voltage being generated by the pH electrode in +/- millivolts (mV) over a range of +/- 625mV. This is not temperature compensated.

The last option on this screen allows you to choose between displaying salinity in Practical Salinity Units (PSU), or parts per thousand (ppt), which is the same as grams per litre.

Selecting the third line of the Units Menu will display the following screen.



The first line allows you to choose between displaying Barometric pressure in millibars (mb) or in mm of mercury (mmHg).

The second line allows you to choose between displaying altitude and depth in metres (M) or feet (F). Whatever units ALT is set to, DEPTH (MAP 2000/2100-D only) will follow. Altitude is displayed with respect to mean sea level.

Depth is displayed with respect to the depth zero datum, which can be the water surface or any point at which the depth has been zeroed. See section 7: [Differential Depth Measurement](#) for further details.

## 9.2. AUX Socket Assignment

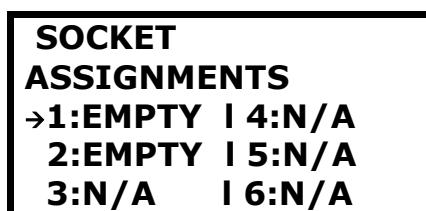
The MAP 2000/2100 features two AUX (axillary) sockets into which additional electrodes may be fitted. AUX socket 1 can be fitted with either MAP 2000/2100 Optical probes or MAP 5000 type ISE (Ion Selective Electrodes). AUX socket 2 can be fitted with MAP 2000/2100 type ISE electrodes only.

When an electrode has been fitted to an AUX socket (see Appendix 3 for fitting instructions), the socket must be assigned to the specific electrode type/parameter.

The Socket Assignment option is only available if the Macro 900 Meter is connected to a Probe. This is because the assignment data is held in the probe, not in the Macro 900 Meter.

When the Socket Assignment option has been selected, the following screen will be displayed.

The numbers 1 – 6 represent the AUX socket numbers. Only sockets 1 and 2 are available on the MAP 2000/2100 so the other four are shown as N/A. The additional sockets are available on larger Probes.



Using the up and down arrow keys, select the AUX socket you wish to assign then move the cursor to the right by pressing the right arrow key. When the cursor has moved to the right of the AUX socket number, use the up and down arrow keys to select the appropriate electrode type.

The tables below show the available electrode options and the selection that should be made on this screen:

MAP 2000/2100 type Optical Probes (AUX1 only)

Electrode Part No.	Function	Macro 900 Meter Selection
PT 1551	Turbidity	TURB
PT 1556	Chlorophyll	Cphl
PT 1552	Phycocyanin (Blue-Green Algae PC)	BGA-PC
PT 1553	Phycoerythrin (Blue-Green Algae PE)	BGA-PE
PT 1554	Rhodamine WT Dye	Rhod
PT 1555	Fluorescein Dye	Fcein
PT 1557	Refined Oil	OIL

## MAP 2000/2100 type ISE Electrodes (AUX2 only)

Electrode No.	Part	Function	Macro 900 Meter Selection
PT 1541		Ammonium/Ammonia	NH4
PT 1543		Chloride	Cl
PT 1545		Fluoride	F
PT 1542		Nitrate	NO3
PT 1544		Calcium	Ca2

When the desired electrode type is showing, move the cursor back to the left of the socket number then press OK to send the selection to the MAP 2000/2100. The socket assignments are stored in the MAP 2000/2100. If you press the ESC key whilst in this screen, any changes you have made will not be transferred to the MAP 2000/2100. **Please note: changing an AUX Socket assignment will clear all the calibration data for that socket.**

If you subsequently remove an electrode, be sure to set the socket assignment back to EMPTY.

## 10. MacroCal Calibration Method

### 10.1. About Calibration

Calibration is a very important part of successful water quality measurement and should be carried out regularly as detailed in each separate section of this manual. A great deal of development work has been put into simplifying and automating the calibration procedures in the Macro 900 Meter in order to allow normal field operatives (as opposed to trained lab technicians) to achieve quick and accurate results.

As a general rule, pH and EC should be calibrated as close to 25°C as possible. Optical electrodes should be calibrated as close to their deployment temperature as possible.

In order to standardise calibration techniques, Palintest provide plastic calibration bottles into which the MAP 2000/2100 can be directly inserted. The MAP 2000/2100 is designed to be calibrated in these calibration bottles **with the Probe Sleeve, Sleeve End Cap and End Cap Plug fitted**.

**The Probe Sleeve, Sleeve End Cap and End Cap Plug form an integral, working part of the Probe's measurement system, and MUST be fitted during calibration and measurement for correct operation. See section Error! Reference source not found. Error! Reference source not found. for further details.**

### 10.2. Special Notes Concerning ISE Electrodes

The high ionic concentration of pH calibration solutions (buffers), including MacroCal, can cause significant offsets in ISE electrodes.

These offsets are temporary, but best avoided because they can cause significant errors during both calibration and normal operation.

For this reason all ISE electrodes are supplied with a red rubber sealing cap.



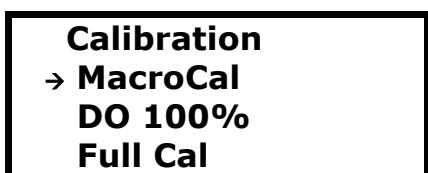
**The caps should be fitted to all ISE Electrode when using MacroCal** in order to protect the ISE electrodes from the effects of the buffer solution.

At all other times, the ISE electrodes should be left uncovered.

### 10.3. Using MacroCal

MacroCal is an easy way to calibrate the MAP 2000/2100 in the field using just one calibration solution. MacroCal calibrates EC at 2570 $\mu$ S/cm, the pH7.00 point and the optional Optical Electrode Zero point simultaneously. Ideally, this procedure should be carried out at the beginning of each day the Probe is to be used. To use MacroCal:

1. Remove the lid from a fresh bottle of MacroCal solution, remove the storage cap from the pH electrode if fitted, wash the Probe in distilled water, then drop the Probe in all the way. Bang the Probe against the bottom of the bottle several times in order to remove any air bubbles that may be clinging to the electrodes.
2. When the Probe is inserted, **ensure the level of the solution is right up to the neck of the bottle**. If the level is low, the EC electrodes will not be covered and EC will not calibrate properly. If the level is low, top up with fresh MacroCal solution.
3. Switch the Macro 900 Meter on and wait until all readings are **completely** stable. The longer you can leave the probe to achieve thermal equilibrium before proceeding, the better.
4. Ensure the temperature of the solution is between 5°C and 40°C (41°F – 104°F). The closer to 25°C the better.
5. Press the **MENU** key then select **Calibration**. The following screen will be displayed.



Calibration  
→ MacroCal  
DO 100%  
Full Cal

6. Select **MacroCal**. The screen will change to:



PLEASE WAIT  
Stabilising  
000%

The Meter will wait until all readings are stable, then it will send the MacroCal command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

**Calibrating  
100%  
Press [OK]**

When calibration is complete, press **OK** then **ESC** to return to normal reading mode.

**Important**

If you have both Optical and ISE electrodes fitted to your Macro Accessory Probe, you must now remove the rubber sealing cap from the ISE electrode then re-calibrate the optical probe's zero point (Pt-1) in fresh, clean water (bottled still mineral water is ideal).

The ISE electrode's sealing cap alters the optical characteristics of the measurement chamber and can therefore render the optical electrode's zero point calibration performed during MacroCal erroneous.

Now the DO 100% saturation point should be calibrated in damp air.

## To Calibrate the 100% Saturation Point in Damp Air

1. After calibrating with MacroCal, remove the Probe from the bottle, wash in fresh water, then shake off ensuring there are no droplets adhering to the DO membrane.
2. Moisten a clean cloth or piece of tissue paper with fresh water and wrap it around the open end of the probe ensuring all the holes are covered. Place the probe on a flat surface. Do not hold the probe, the heat from your hands will warm the probe up and interfere with calibration.
3. Wait until the temperature measurement is **completely stable. This is very important.**
4. Referring back to the screen shown in item 5 above, select **DO 100%**.
5. Wait while the Macro 900 Meter carries out the calibration procedure.
6. When the 'Calibrating 100%' screen (shown above) is displayed, press OK then ESC repeatedly to return to normal reading mode.



### 10.4. Calibration Error Messages

If the Macro 900 Meter detects a problem with either the MAP 2000/2100 or the calibration solution during the calibration procedure, an error will be indicated. The chart below shows the possible errors and how to correct them.

Error Message	Problem	Action
REPLACE DO CAP	Full re-calibration required or Optical DO Cap needs replacing	See note below.
BATTERIES TOO LOW	Battery Voltage is too low for reliable calibration	Replace the batteries
NO PROBE RESPONSE	The Probe is not responding	Check connections/cycle power
READINGS UNSTABLE	Readings did not stabilise within the expected period	Top up/replace the MacroCal Allow longer for stabilisation.
OUT OF CAL RANGE	Readings are outside calibration limits (can be caused by low level / incorrect calibration solution). Or the Probe Sleeve is not fitted	Top up/check calibration solution is correct type. Ensure the Probe Sleeve is fitted
OUT OF TEMP RANGE	Temperature is outside 5°C – 40°C limit	Warm/cool the MacroCal

If the 'REPLACE DO CAP' error occurs during Optical DO Zero calibration, this usually indicates that the DO Cap needs replacing. Perform a full DO calibration first at DO Zero then at 100% DO. If that does not cure the problem, replace the DO Cap (see [Replacing the Optical DO Cap](#) in section 14).

If the corrective actions shown above for 'READINGS UNSTABLE' or 'OUT OF CAL RANGE' errors do not work, thoroughly clean the Probe and try again. If the 'OUT OF CAL RANGE' error persists, reset the calibration values to Factory Defaults then try again.

If the 'OUT OF CAL RANGE' error persists when calibrating EC, check you are using the correct EC Calibration Standard and that the Probe Sleeve is fitted and tight.

If the 'OUT OF CAL RANGE' error persists when calibrating pH, check you are using the correct pH Calibration Standard for the calibration point selected.

If the 'OUT OF TEMP RANGE' error persists when carrying out a three point ISE calibration, check your solution temperatures are within the specified limits with respect to each other.

Remember: **The Probe sleeve forms an integral, working part of the Probe's measurement system, and MUST be fitted during calibration and measurement for correct operation. If you try to calibrate the Probe without the sleeve fitted, you will get an error message.**

#### 10.5. Resetting to Factory Calibration Defaults

In some cases, if there has been a serious calibration error, the easiest way to rectify the situation is to reset the Probe to its factory defaults. To do this, first bring up the Calibration screen:

Calibration  
→ MacroCal  
DO 100%  
Full Cal

Select Full Cal. This will give you a choice of three electrodes:

Calibration  
→ pH/ORP  
DO/EC  
Aux Electrodes

Move the cursor arrow to the electrode you want to reset, then press the **MR** key. If you select Aux Electrodes, you must press OK first to enter the Aux Electrode selection screen. Once in that screen, select the Aux electrode you want to reset then press **MR**.

A confirmation screen will be displayed.

**Are you sure you  
want to restore the  
factory calibration  
values? [ESC]=NO**

If you are sure, press the **OK** key. If you want to change your mind, press the **ESC** key. If you press OK, you will see a message that says CAL RESTORED. Once factory calibration defaults have been restored, you **must** carry out a **full calibration** of the electrode in question.

#### **10.6. Calibration Data Storage**

The MAP 2000/2100 contains its own microprocessor and memory. All calibration data, including the GLP data, is stored within the Probe's memory. When a Probe is connected to a Meter, this data is transferred for display and logging.

This is a major advantage and allows you to use a variety of different Probes with a single Meter, without the need for re-calibration.

#### **10.7. Calibration Reports**

At the conclusion of each successful individual electrode calibration, a single line Calibration Report is displayed. This report contains the raw output of the electrode under calibration, uncorrected for temperature.

These values can be recorded and used to track the performance and ageing of the individual electrodes. Please note however, in order to maximise the value of this feature, all calibrations must be performed at the same temperature otherwise the recorded values will not be comparable over time.

No calibration report is generated when using MacroCal.

## 11. After Use

The MAP 2000/2100 should always be cleaned after every use.

**It is advisable to clean the Probe after use with the cable attached. This will prevent any water entering the Probe's socket and will allow any deposits to be removed from the connector collar and shell.**

The Sleeve on the MAP 2000/2100 can be removed by unscrewing to allow cleaning of the individual electrodes. After every use, remove the protective Sleeve End Cap then unscrew the sleeve. With the Sleeve removed, the individual electrodes are very vulnerable, so please handle the Probe with extreme care. If you drop it, it's going to break!

Rinse the exposed electrodes, the inside of the Sleeve and the Sleeve End Cap with fresh, clean water. Shake the water from inside the Sleeve, then reattach. Dry the outside of the Probe using a soft cloth.

**Remember to replace the pH/ORP storage cap after use.** Failure to do so will damage the electrode. For more details, see [Keeping the Electrodes Moist](#) in section 13.

**Never clean the Probe with solvents, alcohol or concentrated acid/alkaline based cleaning products such as Decon 90. These products can strip the anodised finish from the Probe and damage the plastic and rubber components. Damage caused by the use of aggressive cleaning agents or solvents is not covered by your warranty.**

Store the Probe without the protective Sleeve End Cap fitted in order to allow free air circulation around the individual electrodes.

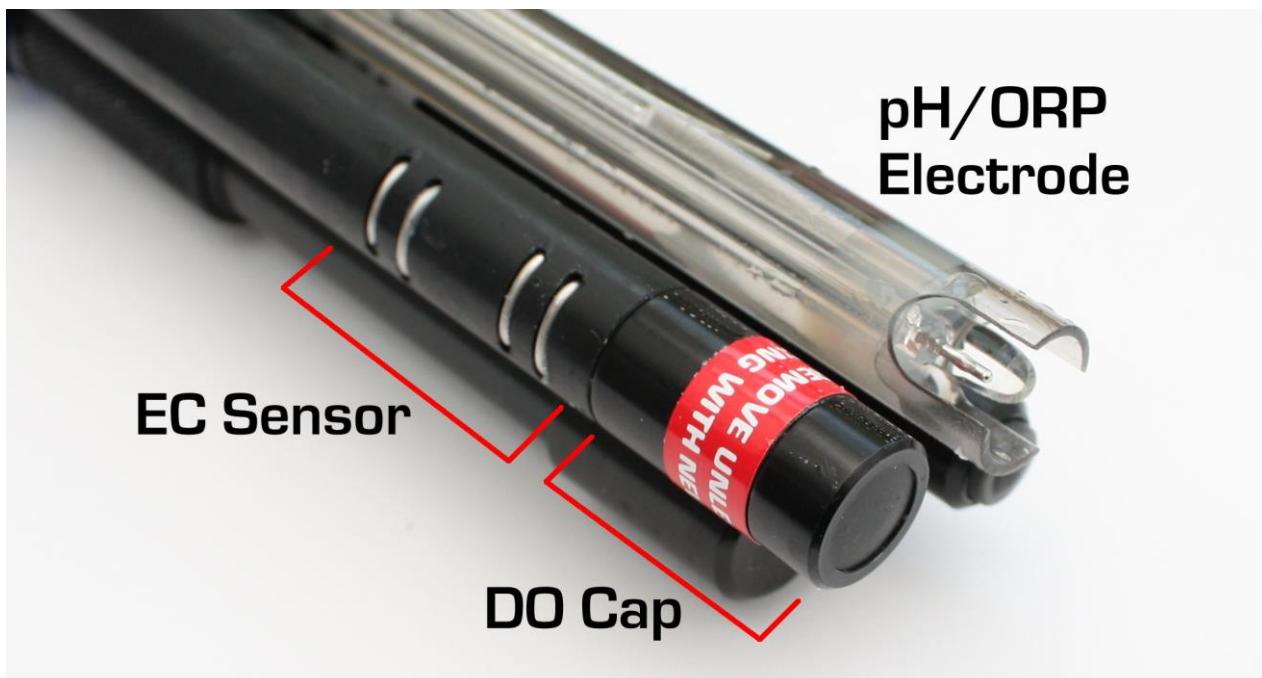
**TIP:** Occasional application of a smear of silicone grease or similar lubricant to the connector O-rings and thread, Sleeve thread, the protective Sleeve End Cap O-ring and the inside rim of the lower Probe Sleeve will make fitting and removal of these parts easier.

## 12. General Probe Maintenance

Other than regular cleaning and calibration, very little in the way of maintenance is needed.

### 12.1. Identifying The Individual Electrodes

The photograph below shows the two standard electrodes. The DO/EC electrode includes the Optical DO sensor and the EC sensor. These electrodes will be referred to in the next two sections.



## 13. pH/ORP Electrode Calibration and Maintenance

### 13.1. Recognising the pH/ORP Electrode

The combined pH/ORP electrode is easy to recognise because it is the only electrode that is not black. This electrode has a clear, gel filled body.

### 13.2. Electrode Removal and Replacement

The pH/ORP electrode can be unscrewed from the Probe body by rotating it anti-clockwise. When replacing an electrode, apply a little silicone grease or similar lubricant to the thread and O ring, then screw fully in.

Gripping the black collar at the top of the electrode, tighten until the O ring is fully compressed. **Do not twist the clear section of the electrode whilst tightening.**

**Useful Tip:** The quick release lanyard that is attached to the pH/ORP storage cap makes a very useful belt wrench for tightening and loosening the pH/ORP and AUX electrodes.

Slide the lanyard over the electrode and use it to grip the knurled body.

Never immerse an MAP 2000/2100 with the pH/ORP electrode removed. This will cause serious damage to the electrode socket. **This is not covered by your warranty.**

### 13.3. Keeping the Electrodes Moist

It is very important that the pH/ORP electrode is kept moist when not in use. This is achieved by always fitting the storage cap, which incorporates a sponge that should be soaked in a special storage solution.

**The sponge within the storage cap should be moistened with a few drops of pH Electrode Storage Solution each time it is removed and replaced.** If a pH/ORP electrode is inadvertently allowed to dry out, it must be re-hydrated by soaking in storage solution for at least one hour prior to use.

### 13.4. Calibrating pH

pH electrodes should be calibrated fully at least once a week to ensure optimum accuracy. Full calibration involves calibrating at pH 7.00 first, then at pH 4.01 and/or pH 10.00. The MAP 2000/2100 allows for both two and three point pH calibration. Should you decide to carry out just a two point calibration, the probe will automatically calculate and save a calibration value for the uncalibrated third point in order to maintain the electrode's linearity over the full range of 0 – 14.

For best results, calibrate all three points as close to 25°C as possible.

### 13.5. Special Notes Concerning ISE Electrodes

The high ionic concentration of pH calibration solutions (buffers), including MacroCal, can cause significant offsets in ISE electrodes.

These offsets are temporary, but best avoided because they can cause significant errors during both calibration and normal operation.

For this reason all ISE electrodes are supplied with a red rubber sealing cap.



**The caps should be fitted to all ISE Electrode during pH calibration** in order to protect the ISE electrodes from the effects of the buffer solution.

At all other times, the ISE electrodes should be left uncovered.

#### 13.5.1. Calibrating the First Point (pH 7.00)

Due to the way in which pH calibration works, **the Probe must be calibrated at pH7.00 before calibrating at pH 4.01 or pH 10.00. Never calibrate at pH 4.01 or pH 10.00 before first calibrating at pH7.00.**

To calibrate the pH electrode follow these steps:

1. Fill a calibration bottle with fresh pH 7.00 solution or MacroCal, remove the storage cap from the pH electrode, wash the Probe in distilled water, then drop the Probe in all the way.
2. Switch the Macro 900 Meter on and wait until the temperature and pH measurements are completely stable.
3. Ensure the temperature of the solution is between 5°C and 40°C (41°F - 104°F).
4. Press the **MENU** key then select **Calibration**. The following screen will be displayed.

**Calibration**  
→MacroCal  
DO 100%  
Full Cal

5. Select **Full Cal**. The screen will change to:

**Calibration**  
→pH/ORP  
DO/EC  
Aux Electrodes

6. Select **pH/ORP**. The screen will change to:

→pH7.00?[01/Jan/12]  
pH4.01?[01/Jan/12]  
pH10.0?[01/Jan/12]  
ORP? [01/Jan/12]

The dates shown to the right of the screen are the dates of the last successful calibration.

7. Select pH7.00. The screen will change to:

**PLEASE WAIT**  
**Stabilising**  
**000%**

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

**Offset: -1.2mV**  
**Calibrating**  
**100%**  
**Press [OK]**

The top line displays the voltage offset from zero for the pH electrode in +/- millivolts (mV). If this offset goes beyond +/-25mV at 25°C, the pH electrode should be serviced.

This value is not stored in memory so should be noted down in a calibration

record book for the Probe. When the offset voltage details have been noted down, press **OK** then **ESC** repeatedly to return to normal reading mode.

Remove the Probe from the calibration bottle, rinse thoroughly in de-ionised water, shake off any excess and dry the outer sleeve with a soft cloth.

### 13.5.2. Calibrating the Second Point

The pH electrode can now be calibrated at either pH 4.01 or pH 10.00. **If you intend to calibrate at both pH 4.01 and pH 10.00, both points must be calibrated in the same session, i.e. without turning the power off.**

If the power is removed after calibrating just one additional point (pH 4.00 for example), the probe will automatically calculate and save a calibration value for the uncalibrated third point in order to maintain the electrode's linearity.

To calibrate the second point, fill a calibration bottle with fresh pH 4.01 or pH 10.00 solution and drop the Probe in all the way. Follow the procedure detailed above, but at step 6, select either pH4.01 or pH10.0, dependent upon the solution you are using. Wait while the Meter stabilises and calibrates. When the 'Calibrating 100%' screen is displayed, the calibration report will display the slope for the pH electrode in millivolts (mV) per pH unit. If this slope goes below 45mV/pH at 25°C, the pH electrode should be serviced. Press **OK** then press the **ESC** key repeatedly to get back to the main display.

Remove the Probe from the calibration bottle, rinse thoroughly in fresh water, shake off any excess and dry the outer sleeve with a soft cloth.

### 13.5.3. Calibrating the Third Point

Without switching the Macro 900 Meter off or disconnecting the Probe, fill a calibration bottle with fresh pH 4.01 or pH 10.00 solution and drop the Probe in all the way. Follow the procedure detailed above, but at step 6, select either pH4.01 or pH10.0 dependent upon the solution you are using. Wait while the Meter stabilises and calibrates. When the 'Calibrating 100%' screen is displayed, the calibration report will display the slope for the pH electrode in millivolts (mV) per pH unit. If this slope goes below 45mV/pH at 25°C, the pH electrode should be serviced. Press **OK** then press the **ESC** key repeatedly to get back to the main display.

Remove the Probe from the calibration bottle, rinse thoroughly in fresh water, shake off any excess and dry the outer sleeve with a soft cloth. Dampen the sponge in the storage cap with storage solution and fit it to the pH/ORP electrode. pH calibration is now complete.

## 13.6. Errors During Calibration

If a problem occurs during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.

## 13.7. pH Electrode Efficiency

If the pH electrode becomes worn or clogged, its efficiency and response time

can be reduced. The efficiency of the pH electrode is constantly monitored and in the event of the efficiency dropping below 85%, 'ERROR 01' will be flashed on the bottom line of the display. If this occurs, or if the pH reading response becomes slow, recondition the electrode as described below.

### 13.8. Servicing the pH Electrode

1. Remove the pH or combined pH/ORP electrode from the Probe body (see [Electrode Removal and Replacement](#)).
2. Rinse with methyl alcohol.
3. Replace the electrode.
4. Re-calibrate.

**Never place the entire MAP 2000/2100 in methyl alcohol, as this will cause irreparable damage to the DO/EC electrode. Damaged caused in this way is not covered by the warranty.**

If the methyl alcohol rinse does not restore the electrode, perform the following actions:

1. Remove the electrode from the body again.
2. Soak in 0.1M HCl for 5 minutes.
3. Rinse in de-ionised water.
4. Soak in 0.1M NaOH for 5 minutes.
5. Rinse in de-ionised water.
6. Soak in pH4.01 buffer for 10 minutes.

If the above procedure still does not restore performance, replace the electrode.

### 13.9. Calibrating ORP

ORP electrodes should be calibrated at least once a month to ensure optimum accuracy. Full calibration involves calibrating at a single point, (255mV at 25°C) using a 255mV ORP calibration standard such as PT 1252 ORP Calibration Solution or similar.

For best results, calibrate as close to 25°C as possible. The probe will automatically compensate for temperature variation in the calibration solution during calibration.

To calibrate the ORP electrode follow these steps:

1. Fill a calibration bottle with fresh calibration solution, remove the storage cap from the pH/ORP electrode, wash the Probe in distilled water, then drop the Probe in all the way.
2. Switch the Macro 900 Meter on and wait until the temperature and ORP measurements are completely stable.
3. Ensure the temperature of the solution is between 5°C and 40°C (41°F - 104°F).

4. Press the **MENU** key then select **Calibration**. The following screen will be displayed.



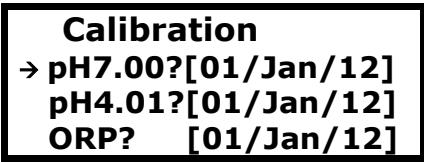
**Calibration**  
→MacroCal  
**DO 100%**  
**Full Cal**

5. Select **Full Cal**. The screen will change to:



**Calibration**  
→ pH/ORP  
DO/EC  
**Aux Electrodes**

6. Select **pH/ORP**. The screen will change to:



**Calibration**  
→ pH7.00?[01/Jan/12]  
pH4.01?[01/Jan/12]  
ORP? [01/Jan/12]

7. Select ORP. The screen will change to:



**PLEASE WAIT**  
**Stabilising**  
**000%**

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.



**Offset: 5.5mV**  
**Calibrating**  
**100%**  
**Press [OK]**

The Calibration Report on the top line displays the voltage offset between the ORP electrode output and the value of the calibration solution at the calibration

temperature in +/- millivolts (mV). During normal operation this offset will be subtracted from the ORP electrode output to give a corrected ORP display.

This value is not stored in memory so should be noted down in a calibration record book for the probe. When calibration is complete, press the **OK** key then the **ESC** key repeatedly to return to normal operating mode.

Remove the Probe from the calibration bottle, rinse thoroughly in fresh water, shake off any excess and dry the outer sleeve with a soft cloth. Dampen the sponge in the storage cap with storage solution and fit it to the pH/ORP electrode. ORP calibration is now complete.

**13.10. Converting ORP Readings to the Hydrogen Scale**

Electrochemical measurements are ultimately referred to the so-called hydrogen scale, the convention for which is that the electrochemical potential of a hydrogen electrode in contact with hydrogen gas at one atmosphere partial pressure and a solution containing hydrogen ions at unit activity is zero at all temperatures.

The ORP reference electrode used in Palintest combination electrodes is a 3MPK1 silver chloride type, and exhibits potentials on the hydrogen scale of:

Temperature	Potential
5°C	221 mV
10°C	217 mV
15°C	214 mV
20°C	210 mV
25°C	207 mV
30°C	203 mV
35°C	200 mV
40°C	196 mV

Thus, to refer an ORP potential value measured with the MAP 2000/2100 to the hydrogen scale, the appropriate value above should be added to the measured value.

## 14. DO/EC Electrode Calibration and Maintenance

### 14.1. Recognising the DO/EC Electrode

The DO/EC electrode is easy to recognise because it has a screw-on cap and four stainless-steel EC sensor contacts on the side (see photograph in section 12). Dissolved Oxygen (DO) is measured at the end of the electrode by the components behind the removable cap. Electrical Conductivity (EC) is measured on the side of the electrode by the four stainless steel contacts.

### 14.2. DO Measurement Technique

The MAP 2000/2100 features an optical DO sensor. This sensor does not use a liquid electrolyte and has a black rubber gas-permeable membrane. See [Appendix 1. The Tech Behind Palintest's Optical DO Measurement System](#) for further details.

### 14.3. Precautions During Use

**EC measurement is not possible with the Probe sleeve removed as the sleeve forms an integral part of the measurement system.**

**Never immerse the Probe without the DO Cap fitted. If the components at the end of the DO/EC electrode come into contact with the liquid being tested, serious damage can occur to the DO/EC electrode circuitry.**

### 14.4. Calibrating the DO/EC Electrode

Calibration of the EC section of the electrode is normally carried out during MacroCal (see [MacroCal Calibration Method](#)). EC can be calibrated separately using different EC Calibration Standards, this is covered after the DO calibration section ([Calibrating EC](#)).

The DO section of the electrode should be calibrated at the Zero saturation point at least once a month. Before each day's use, the 100% saturation point should be checked in moist air and re-calibrated if necessary. For optimum accuracy, calibrate the DO100% point as near to your sample temperature as possible (within the calibration temperature limits of 5°C - 40°C).

If you are going to calibrate both the Zero and 100% points at the same time, **ALWAYS calibrate the Zero point first**, then the 100% point.

### 14.5. Calibrating the DO Zero Point

1. Remove the lid from a 150mL bottle of DO Zero calibration solution, remove the storage cap from the pH electrode if fitted, wash the Probe in distilled water, then drop the Probe in all the way.
2. Switch the Macro 900 Meter on and wait until the DO reading is completely stable.
3. Ensure the temperature of the solution is between 5°C and 40°C (41°F - 104°F).
4. Press the **MENU** key then select **Calibration**. The following screen will

be displayed.

**Calibration**  
→MacroCal  
**DO 100%**  
**Full Cal**

5. Select **Full Cal**. The screen will change to:

**Calibration**  
→pH/ORP  
DO/EC  
**Aux Electrodes**

6. Select **DO/EC**. The screen will change to:

**Calibration**  
→DOZero?[01/Jan/12]  
DO100%?[01/Jan/12]  
EC2570?[01/Jan/12]

The dates shown to the right of the screen are the dates of the last successful calibration.

7. Select DOZero. The screen will change to:

**PLEASE WAIT**  
**Stabilising**  
**000%**

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

**Output:4.4**  
**Calibrating**  
**100%**  
**Press [OK]**

The top line will display a value which represents the health of the luminophore. This value should be between 3.5 and 4.5 (at 25°C). If the value returned is less than 3.5, the Optical DO Cap should be replaced.

This value is not stored in memory so should be noted down in a calibration record book for the probe. When the Cell offset voltage details have been noted down, press **OK** then **ESC** repeatedly to return to normal reading mode.

If a problem occurs during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.

Remove the Probe from the calibration bottle, rinse thoroughly in fresh water, shake off any excess and dry the outer sleeve with a soft cloth.

#### 14.6. Calibrating the DO 100% Saturation Point in Moist Air

1. Wash the probe thoroughly in fresh water, then shake off ensuring there are no droplets adhering to the DO membrane.
2. Moisten a clean cloth or piece of tissue paper with fresh water and wrap it around the open end of the probe ensuring all the holes are covered. Place the probe on a flat surface. Do not hold the probe, the heat from your hands will warm the probe up and interfere with calibration.
3. Switch the Macro 900 Meter on and wait until the temperature measurement is completely stable. **This is very important.**
4. Referring back to the screens shown in items 4 or 6 above (dependent on software version), select **DO100%**
5. Wait while the Macro 900 Meter carries out the calibration procedure.
6. When calibration is complete, the Calibration Report will be displayed.

The top line will display a value which represents the health of the luminophore. This value should be between 0.8 and 1.5 (at 25°C). If the value returned is less than 0.8, the Optical DO Cap should be replaced. These values are not stored in memory so should be noted down in a calibration record book for the probe.

If a problem occurs during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.

#### 14.7. Replacing the Optical DO Cap

The Optical DO Cap contains a lens, which is coated with an oxygen sensitive luminophore, which is in turn coated with a black rubber compound that provides optical isolation but is permeable to oxygen. Oxygen molecules pass through the rubber into the luminophore. **Never touch the black rubber end of the DO electrode as the oils in your skin can block the pores in the rubber coating and stop it from working correctly.**

The luminophore within the DO Cap will need replacing every few years, as it is a consumable item. Since the luminophore is an integral part of the DO Cap, the entire DO Cap is replaced. An Optical DO Cap can last up to ten years dependent upon the amount of use it gets. See [Sensor Cap Life](#) in Appendix 1 for further details.

Caution: The inside of the Optical DO Cap is very sensitive to light and can be ruined (bleached) if it is exposed to bright light for any length of time. **Never remove the Optical DO Cap from the Probe unless you intend to replace it with a new one.** When replacing an Optical DO Cap, do so under subdued light.

To replace the Optical DO Cap, follow these simple steps.

1. Remove the Probe sleeve.
2. Unscrew the Optical DO Cap from the end of the DO/EC electrode by rotating it anti-clockwise. **Do not touch the exposed optical components.**
3. Apply a light smear of silicone grease to the thread and O ring.
4. Remove the new Optical DO Cap from its light-proof bag and quickly screw it onto the end of the DO/EC electrode. Ensure that the cap is screwed fully onto the electrode and that it is done up tight.
5. Carry out both Zero point and 100% point DO calibration as described earlier.

**Please Note: It is essential when replacing the Optical DO Cap to calibrate the Zero point BEFORE calibrating the 100% point.**

#### 14.8. Calibrating EC

EC calibration is always carried out at a single point. There is a choice of three single points. These are: 1413µS/cm, 2570µS/cm (using Palintest MacroCal solution) and 12,880µS/cm. These values have been chosen to allow accurate readings to be taken in a variety of water types.

For taking measurements in fresh surface or ground water, use Palintest MacroCal solution. If this is not available, use a third party 1413µS/cm EC Calibration Standard or PT 142/3 Mid Range Conductivity Solution. For taking readings in brackish or salt water, use a third party 12,880µS/cm (12.88mS/cm) EC Calibration Standard or PT 142/2 High Range Conductivity Solution.

**The Probe sleeve forms an integral, working part of the Probe's EC measurement system, and MUST be fitted during calibration and measurement for correct operation. If you try to calibrate the Probe without the sleeve fitted, you will get the 'OUT OF CAL RANGE' error message.**

For best results, calibrate as close to 25°C as possible. The probe will compensate for temperature variation in the Calibration Standard during calibration.

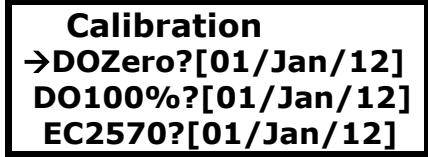
1. Remove the storage cap from the pH electrode if fitted, wash the Probe in distilled water, then drop the Probe into a calibration bottle filled with your chosen EC Calibration Standard.
2. **Ensure the liquid level is all the way up to the neck of the bottle.**  
**Low liquid level will result in erroneous EC calibration.**
3. Switch the Macro 900 Meter on and wait until the temperature and EC measurements are completely stable.
4. Ensure the temperature of the solution is between 5°C and 40°C (41°F - 104°F).
5. Press the  **MENU** key then select **Calibration**. The following screen will be displayed.

Calibration  
→MacroCal  
DO 100%  
Full Cal

6. Select **Full Cal**. The screen will change to:

Calibration  
→pH/ORP  
DO/EC  
Aux Electrodes

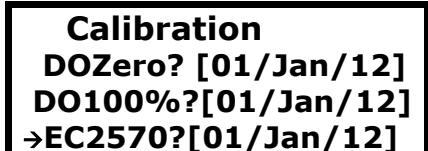
7. Select **DO/EC**. The screen will change to:



**Calibration**  
→DOZero?[01/Jan/12]  
DO100%?[01/Jan/12]  
EC2570?[01/Jan/12]

The dates shown to the right of the screen are the dates of the last successful calibration. The value shown on the bottom line next to 'EC' is the value the EC electrode was last calibrated to.

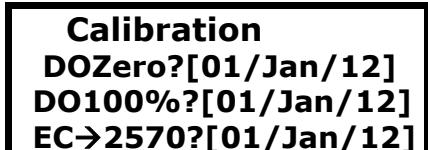
8. Move the pointer down to the bottom line using the down arrow key.



**Calibration**  
DOZero? [01/Jan/12]  
DO100%?[01/Jan/12]  
→EC2570?[01/Jan/12]

If the Calibration Standard value you are using is already displayed, press the **OK** key to start calibrating. Remember, if you are using MacroCal solution, the EC value on this line should be 2570.

If the value of the EC Calibration Standard you are using is not displayed, press the right arrow key. The bottom line will change to:



**Calibration**  
DOZero?[01/Jan/12]  
DO100%?[01/Jan/12]  
EC→2570?[01/Jan/12]

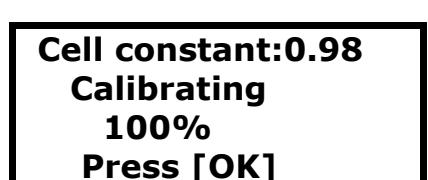
You can now use the up and down arrow keys to select one of three EC Calibration Standard values (1413, 2570 or 12880).

9. Once the correct Calibration Standard value is being displayed, press the **OK** key. The screen will change to:



**PLEASE WAIT**  
**Stabilising**  
**000%**

10. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.



**Cell constant:0.98**  
**Calibrating**  
**100%**  
**Press [OK]**

The Calibration Report on the top line displays the EC Cell Constant. This value is not stored in memory so should be noted down in a calibration record book for the probe.

When the cell constant details have been noted down, press **OK** then **ESC** repeatedly to return to normal reading mode.

### **Special Notes:**

- If you have selected a Calibration Standard value other than 2570 (MacroCal), then you subsequently use the MacroCal calibration technique described in section 10, the Calibration Standard value will automatically be reset to 2570.
- The Calibration Standard value is stored in the Probe, **not** the Meter. If you use one Meter with several different Probes, you will have to set the Calibration Standard value for each probe individually during calibration.
- If you select a Calibration Standard value but do not press **OK**, the information will not be sent to the Probe and the change will not be registered.

### **14.9. Verifying EC Calibration**

Due to the fact that debris and air bubbles can adversely affect EC calibration, it is advisable to verify calibration has been properly achieved. To do this, follow item nine above with this procedure.

1. Remove the probe from the calibration bottle, shake it off, then reinsert.
2. Press the **ESC** key repeatedly to get back to the Main Menu.
3. Go into settings and make sure EC is set to read with reference to 25°C. If it's not, set it that way. See section 9 **Error! Reference source not found.**
4. Go back to the main screen, wait until the temperature and EC readings are stable, then check that the EC is reading +/- 1% of the Calibration Standard value.
5. If the EC reading is outside the 1% limit, recalibrate, this time leaving more time for stabilisation.

If you cannot successfully verify the EC calibration after several attempts, replace the Calibration Standard. If the problem persists, strip the probe down as described below and thoroughly clean the EC contacts.

### **14.10. Errors During Calibration**

At the beginning of the calibration routine, a sanity check is done. If the probe detects that the Calibration Standard value set and the Calibration Standard being used differ, the 'OUT OF CAL RANGE' error will be reported. If any other problems occur during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.

**14.11. Cleaning the EC Contacts**

On a regular basis, thoroughly clean the four stainless steel EC contacts situated on the side of the DO/EC electrode with a soft cloth or toothbrush and non-abrasive detergent. **Never use solvent or alcohol based products to clean the DO/EC electrode.** After cleaning, replace the Probe sleeve and re-calibrate.

## 15. Optional Optical Probes Calibration and Maintenance

The MAP 2000/2100 is constructed with an aluminium sleeve surrounding the delicate sensing probes. The Sleeve can be easily removed by unscrewing to allow cleaning of the individual electrodes, however, **the Probe sleeve forms an integral, working part of the Probe's measurement system, and MUST be fitted for correct operation.**

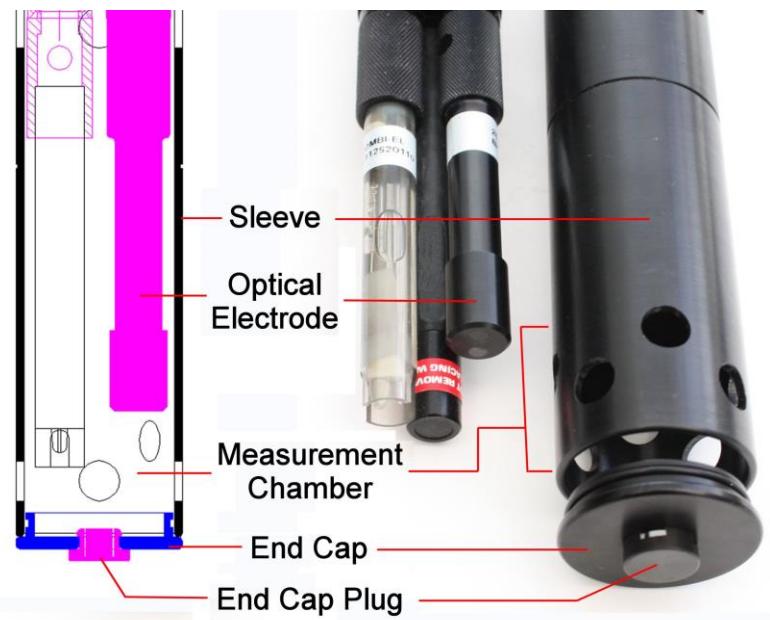
All Palintest Optical Probes are incredibly sensitive. For example, the Turbidity electrode is capable of measuring between 0 and 3000NTU with an internal resolution of greater than 0.1NTU. This means that the electrode is able to detect changes in turbidity that are less than 0.003% of the full range! The other Optical Probes have a similar level of sensitivity.

It follows, therefore, that in order to provide stable, repeatable readings, the environment in which the measurements are made must be completely stable and repeatable.

For this reason, the MAP 2000/2100 is constructed with a matt black aluminium sleeve and end cap that enclose the sensing electrodes and provide a closed, constant condition, non-reflective measurement chamber.

**This is essential for the correct calibration and operation of all types of Optical Probes.**

A diagram of the MAP 2000/2100's measurement chamber is shown here.



**In order to obtain consistent results, the measurement chamber created within the Macro Accessory Probe must remain physically constant during both calibration and measurement.**

If the optical electrode is calibrated under one set of conditions then used to measure under another set of conditions, the readings will naturally be erroneous, especially at low concentrations.

A perfect example of this is calibrating with the end cap removed then measuring with the end cap fitted (or vice-versa). By changing the physical characteristics of the measurement chamber, you also change the calibration and response of the electrode.

Always zero the Optical Probes just prior to use in clean water (bottled still mineral water is ideal) then deploy **without disturbing the measurement chamber**. This is especially important when using the Turbidity and Ref-Oil electrodes.

## 15.1. PT 1551 Turbidity Probe

Turbidity can be measured by the MAP 2000/2100 using the optional PT 1551 Turbidity optical probe.

This electrode employs a Nephelometric technique in accordance with ISO 7027, which uses Formazin as a reference standard. The Macro 900 Meter displays turbidity in Nephelometric Turbidity Units (NTU) which is nominally equivalent to Formazin Turbidity Units (FTU).

Turbidity can be calibrated with either Formazin Turbidity Standards prepared freshly from PT 121 Formazin Stock Solution or SDVB Turbidity Standards, depending upon your preferred turbidity reference. **Be aware, these two standards will give very different results.** Factory calibration is carried out with a 1000 NTU Formazin Turbidity Standard in accordance with ISO 7027.

### 15.1.1. About Turbidity

Turbidity is a measurement of the light scattering properties of solids suspended within a liquid and is therefore an **indirect** measurement of clarity. Turbidity is not a direct measurement of suspended solids, clarity or colour.

Particle size relative to the wavelength of the transmitted light, particle shape and refractive index modify the distribution of scattered light. Sample colour, (particularly dark colours) can also reduce a certain portion of the scattered light by varying degrees.

Combined, these effects result in wide variability in the distribution and intensity of light scattering from a turbid water sample. As a result, different combinations of particle shape, size, colour and refractive index can produce similar turbidity effects.

By contrast, changing only the incident light wavelength and detector distance can dramatically change the measured turbidity of a given sample. As a result, different model sensors from different manufacturers can measure different turbidity values for the same sample. This highlights the qualitative nature of turbidity measurements.

Integrated monitoring programs, where turbidity measurements from different locations are to be compared, **must** use a single model of sensor and maintain a strict QA and calibration program to accurately characterise, compare, and interpret observed turbidity values.

### 15.1.2. Precautions During Use

In common with all other submersion type Turbidity Probes, air bubbles and stray reflections can be a problem when trying to measure low turbidity values. In order to avoid air bubbles, keep the Turbidity probe clean, and agitate the Probe after submersion to dislodge any air bubbles which may be clinging to the lenses. In order to maintain a common reflective pattern between calibration and use, **always calibrate and measure turbidity with the protective Sleeve End Cap and End Cap Plug fitted.**

The lens system in the Turbidity Electrodes is designed to focus correctly in water. When the Probe is not submerged, the system will be out of focus and random readings will occur. This is normal.

### 15.1.3. Calibrating the Turbidity Electrodes

**The Probe Sleeve, Sleeve End Cap and End Cap Plug form an integral, working part of the Probe's turbidity measurement system, and MUST be fitted during calibration and measurement for correct operation.**

Calibration of the Turbidity electrode Zero NTU point is normally carried out during MacroCal (see [MacroCal Calibration Method](#)).

The Turbidity electrode should be calibrated at the Zero NTU point before each day's use, and at least once a month at 1000 NTU to ensure optimum accuracy. To avoid air bubbles in the calibration solutions, **never shake the bottles**.

### 15.1.4. Turbidity Zero Point Calibration

To calibrate the Turbidity zero point, follow these steps:

1. Fill a calibration bottle with de-ionised water or fresh MacroCal solution, remove the storage cap from the pH electrode if fitted, wash the Probe in distilled water, then drop the MAP in all the way. **The Sleeve End Cap and Plug must be fitted.** Bang the MAP against the bottom of the bottle several times in order to remove any air bubbles that may be clinging to the Turbidity probe.
2. Switch the Macro 900 Meter on and wait until the temperature and turbidity readings are stable. If the turbidity reading is very high, there are probably air bubbles adhering to the lenses. Bang the MAP against the bottom of the bottle to remove.
3. Ensure the temperature of the solution is between 5°C and 40°C (41°F - 104°F).
4. Press the  **MENU** key then select **Calibration**. The following screen will be displayed.

Calibration  
→MacroCal  
DO 100%  
Full Cal

5. Select **Full Cal**. The screen will change to:

Calibration  
→pH/ORP  
DO/EC  
Aux Electrodes

6. Select **Aux Electrodes**. The screen will change to:



**SELECT ELECTRODE**  
→1:TURB | 4:N/A  
2:EMPTY | 5:N/A  
3:N/A | 6:N/A

The TURB electrode should have been assigned to AUX socket 1 when it was fitted. Press the OK or right arrow key to select TURB. The screen will change to:



**CALIBRATE TURB**  
→Pt-1? [01/Jan/12]  
Pt-2? [01/Jan/12]

Calibration point 1 (Pt-1) is the Zero NTU point. Calibration point 2 (Pt-2) is the 1000 NTU point.

The dates shown to the right of each point are the dates of the last successful calibration.

7. Select Pt-1. The screen will change to:



**PLEASE WAIT**  
**Stabilising**  
**000%**

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.



**Offset:1138mV**  
**Calibrating**  
**100%**  
**Press [OK]**

The Calibration Report on the top line displays the voltage output from the Turbidity Receiver Electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

### 15.1.5. Calibrating the Turbidity 1000 NTU Point

Remove the Probe from the calibration bottle, rinse thoroughly in fresh water (if using MacroCal solution), shake off any excess and dry the outer sleeve with a soft cloth.

Gently invert, **do not shake**, freshly prepared 1000 NTU Formazin solution or a bottle of **StabCal® Standard 1000 NTU Stabilised Formazin Turbidity Standard** solution (manufactured by the **HACH Company** and available from most lab supply companies) several times to thoroughly mix.

**Formazin Turbidity Standard is hazardous to your health. Be sure to handle with care and to read and comply with all health and safety advice.**

Fill a calibration bottle with the solution and drop the Probe in all the way. Again, bang the Probe against the bottom of the bottle several times in order to remove any air bubbles that may be clinging to the Turbidity electrode.

Follow the procedure detailed above for Zero point calibration as far as step 6, then select Pt-2. Wait while the Meter stabilises and calibrates.

After successful calibration, the 'Calibrating 100%' screen will be displayed along with the Calibration Report, which will show the voltage output from the Turbidity Receiver Electrode in millivolts (mV). Press the **OK** key to continue.

Turbidity calibration is now complete.

### 15.1.6. Errors During Calibration

If a problem occurs during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.

### 15.1.7. Lens and Sleeve Maintenance

On a daily basis, the lenses on the electrode should be wiped over with a soft damp cloth.

Similarly, the inside of the Probe Sleeve and Sleeve Cap should be kept clean and free from any deposits that may cause stray reflections.

**Never use an abrasive cleaner on the inside of the Probe sleeve or cap as they have been treated with a non-reflective coating which can be easily damaged.** The inside of the sleeve should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Always re-calibrate the zero point after cleaning the sleeve or lenses.

### 15.1.8. References

The summary on turbidity at the beginning of this section is based on

information from the following sources.

- National Field Manual For the Collection of Water-Quality Data, Turbidity section 6.7, Revised by Chauncey w. Anderson, USGS, 2004.
- Environmental Instrumentation and Analysis Handbook, Randy D. Down and Jay H. Lehr, Chapter 24 Turbidity Monitoring, John Downing, John Wiley & Sons, Inc. 2005
- Turbidity Science, Michael J. Sadar, Hach Company 1998.
- Guidelines and Standard Procedures for continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation and Reporting, Richard J. Wagner et al., USGS Reston VA Meeting, 2000.

## 15.2. PT 1552 Freshwater Blue-Green Algae (phycocyanin) Probe

Freshwater Blue-Green Algae can be measured by the MAP 2000/2100 using the optional PT 1552 optical probe.

### 15.2.1. Principle of Operation

The PT 1552 Blue Green Algae optical probe is a submersible, fixed response fluorometer, which provides excitation at 590nm and detects any resultant fluorescence above 655nm.

The electrode induces the phycocyanin to fluoresce, then measures the longer wavelength light which is emitted as a result of the fluorescence process.

### 15.2.2. Limitations of Use

Determination of BGA-PC in the field using fluorescence measurement techniques will never be as accurate as measurements made in a lab using either cell counting or analysis of molecular phycocyanin after its extraction from cells.

Factors adversely affecting accuracy include:

- Interference from other microbiological species and compounds, which fluoresce at similar wavelengths.
- Differences in the fluorescent response between various species of BGA.
- Differences in the fluorescent response caused by temperature.
- Differences in the fluorescent response caused by ambient light.
- Interference caused by turbidity.

Fluorescence measurement techniques are ideal for researchers who are interested in detecting the presence or absence of a specific substance and measuring relative fluorescence changes that can be used as an indication of increasing or decreasing concentrations.

Fluorescence measurement techniques are not ideal for quantitative measurement. **In order to obtain more accurate results, data obtained with the fluorometer in the field should be post-calibrated with data from standard laboratory analysis of grab samples acquired during the study.**

### 15.2.3. Calibrating the BGA-PC Electrode

The BGA-PC probe has two calibration points. Careful calibration is essential in order to ensure consistent and reliable results.

When a BGA-PC probe is first installed, **it MUST be calibrated at both points** in order to set the probe's relative sensitivity and establish its slope.

Subsequently, a single point (Zero) calibration should be carried out daily. Calibration of the BGA-PC probe Zero point is normally carried out during

MacroCal (see [MacroCal Calibration Method](#)).

Full two-point calibration should be carried out every few months.

#### **15.2.4. Calibration Solution Preparation**

In order to 'calibrate' (actually, set the relative sensitivity) of the BGA-PC probe, a 100µg/L calibration solution of fluorescent dye known as Rhodamine WT should be used. This is exactly the same calibration solution that is recommended for calibration of the RHOD probe.

Please note: there is no direct correlation between Rhodamine concentration and the number of BGA-PC cells/L. Rhodamine is used as a convenient dye for setting the sensitivity of the sensor. The subsequent display of BGA-PC in terms of cells/L is a generalisation based on research and experience. The only way to obtain a true value in terms of cells/L is to correlate the values from the Probe to quantitative data that has been obtained by laboratory analysis of grab samples. See previous 'Limitations of Use' section.

The 100µg/L calibration solution should be freshly prepared by serial dilution from 200g/L standard using deionised water. The following Rhodamine WT standard is recommended:

Part number: 70301027  
Description: Rhodamine WT Liquid  
Supplier: Keystone Europe Ltd.  
Contact: <http://www.dyes.com>

**Be sure to handle chemicals with care and to read and comply with all health and safety advice.**

#### **15.2.5. Serial Dilution**

The recommended Rhodamine solution is supplied as a 20% or 200g/L solution, dilution of the stock solution should be carried out as follows.

200g/L stock → 100µg/L is recommended to be done as a two-step dilution procedure.

**Step 1:** weigh out 0.5g of 200g/L stock solution in a weigh boat and add this to 1L of deionized water in a volumetric flask, use some of the water from the 1L flask to rinse the weigh boat so no stock Rhodamine remains on the boat. Put a lid on the 1L flask and invert 10 times.

This step results in a 1 in 2000 dilution of the stock. At this point the 1L flask will contain a 100mg/L solution.

**Step 2:** Transfer 1ml of the 100mg/L solution to a 1L volumetric flask and top up to 1L with deionized water. Put a lid on the 1L flask and invert 10 times.

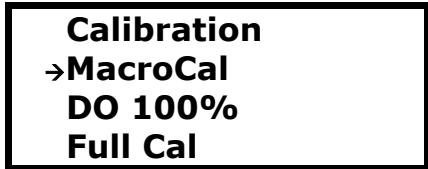
This step results in a 1 in 1000 dilution of the solution from step 1. The concentration of this solution is 100 $\mu$ g/L. This solution can now be used as Pt-2 calibration of the BGA-PC sensor.

The dilute solution can be stored in a dark bottle in a refrigerator for up to five days. After that time it must be discarded.

### 15.2.6. Zero Point Calibration

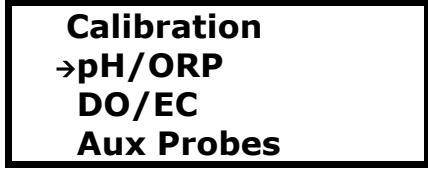
To calibrate the zero point, follow these steps:

1. Fill a calibration bottle with distilled water, remove the storage cap from the pH probe if fitted, wash the Probe in distilled water, then drop the Probe in all the way. **The Sleeve End Cap and Plug must be fitted.** Bang the Probe against the bottom of the bottle several times in order to remove any air bubbles that may be clinging to the probe.
2. Switch the Macro 900 Meter on and wait until the temperature and BGA-PC readings are stable. If the BGA-PC reading is very high, there are probably air bubbles adhering to the lenses. Bang the Probe against the bottom of the bottle to remove.
3. Ensure the temperature of the solution is between 5°C and 40°C (41°F - 104°F).
4. Press the **MENU** key then select **Calibration**. The following screen will be displayed.



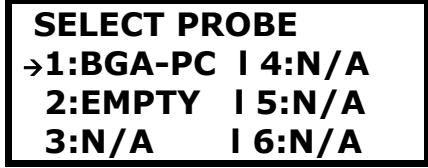
Calibration  
→MacroCal  
DO 100%  
Full Cal

5. Select **Full Cal**. The screen will change to:



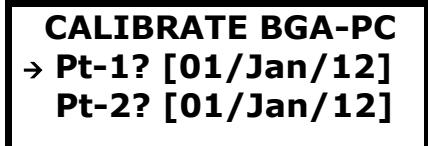
Calibration  
→pH/ORP  
DO/EC  
Aux Probes

6. Select **Aux Probes**. The screen will change to:



SELECT PROBE  
→1:BGA-PC | 4:N/A  
2:EMPTY | 5:N/A  
3:N/A | 6:N/A

The BGA-PC probe should have been assigned to AUX socket 1 when it was fitted. Press the OK or right arrow key to select BGA-PC. The screen will change to:



CALIBRATE BGA-PC  
→ Pt-1? [01/Jan/12]  
Pt-2? [01/Jan/12]

Calibration point 1 (Pt-1) is the Zero point. Calibration point 2 (Pt-2) is the upper calibration point.

The dates shown to the right of each point are the dates of the last successful calibration.

7. Select Pt-1. The screen will change to:



The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.



The Calibration Report on the top line displays the voltage output from the probe in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

### 15.2.7. Calibrating Point 2

Remove the Probe from the calibration bottle, shake off any excess water then dry the outer sleeve with a soft cloth.

Fill a calibration bottle with freshly mixed Rhodamine calibration solution and drop the Probe in all the way. Again, bang the Probe against the bottom of the bottle several times in order to remove any air bubbles that may be clinging to the probe.

Follow the procedure detailed above for Zero point calibration as far as step 6, then select Pt-2. Wait while the Meter stabilises and calibrates.

After successful calibration, the 'Calibrating 100%' screen will be displayed along with the Calibration Report, which will show the voltage output from the probe in millivolts (mV). Press the **OK** key to continue. The reading on the Macro 900 Meter directly after calibration should be approximately 70,000 cells/L at 20°C (this value will vary with temperature).

Calibration is now complete.

### **15.2.8. Errors During Calibration**

If a problem occurs during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.

### **15.2.9. Lens and Sleeve Maintenance**

On a daily basis, the lenses on the probe should be wiped over with a soft damp cloth.

Similarly, the inside of the Probe Sleeve and Sleeve Cap should be kept clean and free from any deposits that may cause stray fluorescence.

**Never use an abrasive cleaner on the inside of the Probe sleeve or cap as they have been treated with a non-reflective coating which can be easily damaged.** The inside of the sleeve should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Always re-calibrate the zero point after cleaning the sleeve or lenses.

### **15.3. PT 1553 Marine Water Blue-Green Algae (phycoerythrin) Probe**

Marine water Blue-Green Algae (BGA-PE) can be measured by the MAP 2000/2100 using the optional PT 1553 Blue Green Algae optical probe.

#### **15.3.1. Principle of Operation**

The PT 1553 Blue Green Algae optical probe is a submersible, fixed response fluorometer, which provides excitation at 520nm and detects any resultant fluorescence above 575nm.

The probe induces the phycoerythrin to fluoresce, then measures the longer wavelength light which is emitted as a result of the fluorescence process.

#### **15.3.2. Limitations of Use**

Determination of BGA-PE in the field using fluorescence measurement techniques will never be as accurate as measurements made in a lab using either cell counting or analysis of molecular phycoerythrin after its extraction from cells.

Factors adversely affecting accuracy include:

- Interference from other microbiological species and compounds, which fluoresce at similar wavelengths.
- Differences in the fluorescent response between various species of BGA.
- Differences in the fluorescent response caused by temperature.
- Differences in the fluorescent response caused by ambient light.
- Interference caused by turbidity.

Fluorescence measurement techniques are ideal for researchers who are interested in detecting the presence or absence of a specific substance and measuring relative fluorescence changes that can be used as an indication of increasing or decreasing concentrations.

Fluorescence measurement techniques are not ideal for quantitative measurement. **In order to obtain more accurate results, data obtained with the fluorometer in the field should be post-calibrated with data from standard laboratory analysis of grab samples acquired during the study.**

#### **15.3.3. Calibrating the BGA-PE Probe**

The BGA-PE probe has two calibration points. Careful calibration is essential in order to ensure consistent and reliable results.

When a BGA-PE probe is first installed, **it MUST be calibrated at both points** in order to set the probe's relative sensitivity and establish its slope.

Subsequently, a single point (Zero) calibration should be carried out daily.

Calibration of the BGA-PE probe Zero point is normally carried out during MacroCal (see [MacroCal Calibration Method](#)).

Full two-point calibration should be carried out every few months.

#### **15.3.4. Calibration Solution Preparation**

In order to 'calibrate' (actually, set the relative sensitivity) of the BGA-PE probe, an 8 $\mu$ g/L calibration solution of fluorescent dye known as Rhodamine WT should be used.

Please note: there is no direct correlation between Rhodamine concentration and the number of BGA-PE cells/L. Rhodamine is used as a convenient dye for setting the sensitivity of the sensor. The subsequent display of BGA-PE in terms of cells/L is a generalisation based on research and experience. The only way to obtain a true value in terms of cells/L is to correlate the values from the Probe to quantitative data that has been obtained by laboratory analysis of grab samples. See previous 'Limitations of Use' section.

The 8 $\mu$ g/L calibration solution should be freshly prepared by serial dilution from 200g/L standard using deionised water. The following Rhodamine WT standard is recommended:

Part number: 70301027  
Description: Rhodamine WT Liquid  
Supplier: Keystone Europe Ltd.  
Contact: <http://www.dyes.com>

**Be sure to handle chemicals with care and to read and comply with all health and safety advice.**

#### **15.3.5. Serial Dilution**

The recommended Rhodamine solution is supplied as a 20% or 200g/L solution, dilution of the stock solution should be carried out as follows.

200g/L stock  $\rightarrow$  8 $\mu$ g/L is recommended to be done as a two-step dilution procedure.

**Step 1:** weigh out 0.5g of 200g/L stock solution in a weigh boat and add this to 1L of deionized water in a volumetric flask, use some of the water from the 1L flask to rinse the weigh boat so no stock Rhodamine remains on the boat. Put a lid on the 1L flask and invert 10 times.

This step results in a 1 in 2000 dilution of the stock, at this point the 1L flask will contain a 100mg/L solution.

**Step 2:** Transfer 80 $\mu$ l of the 100mg/L solution to a 1L volumetric flask and top up to 1L with deionized water. Put a lid on the 1L flask and invert 10 times.

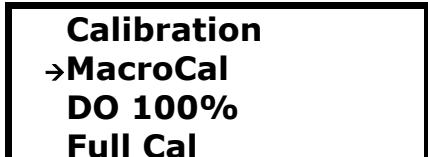
This step results in a 1 in 12500 dilution of the solution from step 1. The concentration of this solution is 8 $\mu$ g/L. This solution can now be used as Pt-2 calibration of the BGA-PE sensor.

The dilute solution can be stored in a dark bottle in a refrigerator for up to five days. After that time it must be discarded.

### 15.3.6. Zero Point Calibration

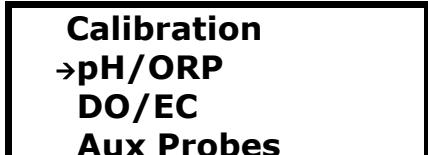
To calibrate the zero point, follow these steps:

1. Fill a calibration bottle with distilled water, remove the storage cap from the pH probe if fitted, wash the Probe in distilled water, then drop the Probe in all the way. **The Sleeve End Cap and Plug must be fitted.** Bang the Probe against the bottom of the bottle several times in order to remove any air bubbles that may be clinging to the probe.
2. Switch the Macro 900 Meter on and wait until the temperature and BGA-PE readings are stable. If the BGA-PE reading is very high, there are probably air bubbles adhering to the lenses. Bang the Probe against the bottom of the bottle to remove.
3. Ensure the temperature of the solution is between 5°C and 40°C (41°F - 104°F).
4. Press the **MENU** key then select **Calibration**. The following screen will be displayed.



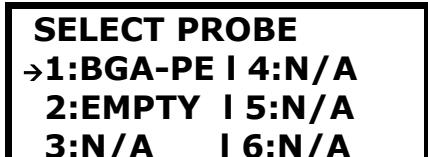
Calibration  
→MacroCal  
DO 100%  
Full Cal

5. Select **Full Cal**. The screen will change to:



Calibration  
→pH/ORP  
DO/EC  
Aux Probes

6. Select **Aux Probes**. The screen will change to:



SELECT PROBE  
→1:BGA-PE | 4:N/A  
2:EMPTY | 5:N/A  
3:N/A | 6:N/A

The BGA-PE probe should have been assigned to AUX socket 1 when it was fitted. Press the OK or right arrow key to select BGA-PE. The screen will change to:

**CALIBRATE BGA-PE**  
→Pt-1? [01/Jan/12]  
Pt-2? [01/Jan/12]

Calibration point 1 (Pt-1) is the Zero point. Calibration point 2 (Pt-2) is the upper calibration point.

The dates shown to the right of each point are the dates of the last successful calibration.

7. Select Pt-1. The screen will change to:

**PLEASE WAIT**  
**Stabilising**  
**000%**

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

**Offset:2500mV**  
**Calibrating**  
**100%**  
**Press [OK]**

The Calibration Report on the top line displays the voltage output from the probe in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

### **15.3.7. Calibrating Point 2**

Remove the Probe from the calibration bottle, shake off any excess water then dry the outer sleeve with a soft cloth.

Fill a calibration bottle with freshly mixed Rhodamine calibration solution and drop the Probe in all the way. Again, bang the Probe against the bottom of the bottle several times in order to remove any air bubbles that may be clinging to the probe.

Follow the procedure detailed above for Zero point calibration as far as step 6, then select Pt-2. Wait while the Meter stabilises and calibrates.

After successful calibration, the 'Calibrating 100%' screen will be displayed along with the Calibration Report, which will show the voltage output from the probe in millivolts (mV). Press the **OK** key to continue. The reading on the Macro 900 Meter directly after calibration should be approximately 200,000 cells/L at 20°C (this value will vary with temperature).

Calibration is now complete.

#### **15.3.8. Errors During Calibration**

If a problem occurs during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.

### **15.3.9. Lens and Sleeve Maintenance**

On a daily basis, the lenses on the probe should be wiped over with a soft damp cloth.

Similarly, the inside of the Probe Sleeve and Sleeve Cap should be kept clean and free from any deposits that may cause stray fluorescence.

**Never use an abrasive cleaner on the inside of the Probe sleeve or cap as they have been treated with a non-reflective coating which can be easily damaged.** The inside of the sleeve should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Always re-calibrate the zero point after cleaning the sleeve or lenses.

#### **15.4. PT 1556 Chlorophyll Probe**

Chlorophyll can be measured by the MAP 2000/2100 using the optional PT 1556 Chlorophyll optical probe.

##### **15.4.1. Principle of Operation**

The PT 1556 Chlorophyll optical probe is a submersible, fixed response fluorometer, which provides excitation at 470nm and detects any resultant fluorescence above 630nm.

The probe induces the chlorophyll to fluoresce, then measures the longer wavelength light which is emitted as a result of the fluorescence process.

##### **15.4.2. Limitations of Use**

Determination of chlorophyll in the field using fluorescence measurement techniques will never be as accurate as measurements made in a lab using either cell counting or analysis of molecular chlorophyll after its extraction from cells.

Factors adversely affecting accuracy include:

- Interference from other microbiological species and compounds, which fluoresce at similar wavelengths.
- Differences in the fluorescent response between various species of phytoplankton.
- Differences in the fluorescent response caused by temperature.
- Differences in the fluorescent response caused by ambient light.
- Interference caused by turbidity.

Fluorescence measurement techniques are ideal for researchers who are interested in detecting the presence or absence of a specific substance and measuring relative fluorescence changes that can be used as an indication of increasing or decreasing concentrations.

Fluorescence measurement techniques are not ideal for quantitative measurement. **In order to obtain more accurate results, data obtained with the fluorometer in the field should be post-calibrated with data from standard laboratory analysis of grab samples acquired during the study.**

##### **15.4.3. Calibrating the CPHYLL Probe**

The CPHYLL probe has two calibration points. Careful calibration is essential in order to ensure consistent and reliable results.

When a CPHYLL probe is first installed, **it MUST be calibrated at both points** in order to set the probe's relative sensitivity and establish its slope.

Subsequently, a single point (Zero) calibration should be carried out daily. Calibration of the CPHYLL probe Zero point is normally carried out during MacroCal (see [MacroCal Calibration Method](#)).

Full two-point calibration should be carried out every few months.

#### 15.4.4. Calibration Solution Preparation

In order to 'calibrate' (actually, set the relative sensitivity) of the CPHYLL probe, a 500µg/L calibration solution of fluorescent dye known as Rhodamine WT should be used.

Please note: there is no direct correlation between Rhodamine concentration and the concentration of chlorophyll. Rhodamine is used as a convenient dye for setting the sensitivity of the sensor. The subsequent display of chlorophyll in terms of mg/L is a generalisation based on research and experience. The only way to obtain a true value in terms of cells/L is to correlate the values from the Probe to quantitative data that has been obtained by laboratory analysis of grab samples. See previous 'Limitations of Use' section.

The 500µg/L calibration solution should be freshly prepared by serial dilution from 200g/L standard using deionised water. The following Rhodamine WT standard is recommended:

Part number: 70301027  
Description: Rhodamine WT Liquid  
Supplier: Keystone Europe Ltd.  
Contact: <http://www.dyes.com>

**Be sure to handle chemicals with care and to read and comply with all health and safety advice.**

#### 15.4.5. Serial Dilution

The recommended Rhodamine solution is supplied as a 20% or 200g/L solution, dilution of the stock solution should be carried out as follows.

200g/L stock → 500µg/L is recommended to be done as a two-step dilution procedure.

**Step 1:** weigh out 0.5g of 200g/L stock solution in a weigh boat and add this to 1L of deionized water in a volumetric flask, use some of the water from the 1L flask to rinse the weigh boat so no stock Rhodamine remains on the boat. Put a lid on the 1L flask and invert 10 times.

This step results in a 1 in 2000 dilution of the stock, at this point the 1L flask will contain a 100mg/L solution.

**Step 2:** Transfer 5ml of the 100mg/L solution to a 1L volumetric flask and top up to 1L with deionized water. Put a lid on the 1L flask and invert 10 times.

This step results in a 1 in 200 dilution of the solution from step 1. The concentration of this solution is 500µg/L. This solution can now be used as Pt-2 calibration of the CPHYLL sensor.

The dilute solution can be stored in a dark bottle in a refrigerator for up to five days. After that time it must be discarded.

#### 15.4.6. Zero Point Calibration

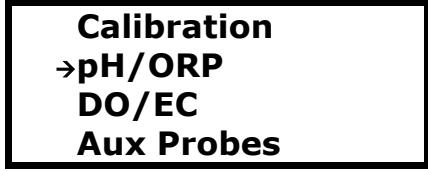
To calibrate the zero point, follow these steps:

1. Fill a calibration bottle with distilled water, remove the storage cap from the pH probe if fitted, wash the Probe in distilled water, then drop the Probe in all the way. **The Sleeve End Cap and Plug must be fitted.** Bang the Probe against the bottom of the bottle several times in order to remove any air bubbles that may be clinging to the probe.
2. Switch the Macro 900 Meter on and wait until the temperature and Cphl readings are stable. If the Cphl reading is very high, there are probably air bubbles adhering to the lenses. Bang the Probe against the bottom of the bottle to remove.
3. Ensure the temperature of the solution is between 5°C and 40°C (41°F - 104°F).
4. Press the **MENU** key then select **Calibration**. The following screen will be displayed.



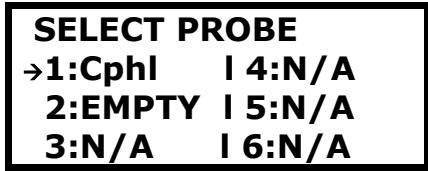
Calibration  
→MacroCal  
DO 100%  
Full Cal

5. Select **Full Cal**. The screen will change to:



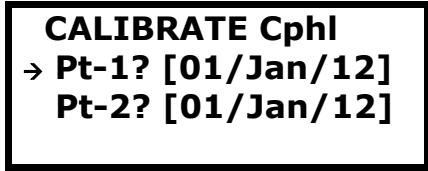
Calibration  
→pH/ORP  
DO/EC  
Aux Probes

6. Select **Aux Probes**. The screen will change to:



SELECT PROBE  
→1:Cphl I 4:N/A  
2:EMPTY I 5:N/A  
3:N/A I 6:N/A

The Cphl probe should have been assigned to AUX socket 1 when it was fitted. Press the OK or right arrow key to select Cphl. The screen will change to:



CALIBRATE Cphl  
→ Pt-1? [01/Jan/12]  
Pt-2? [01/Jan/12]

Calibration point 1 (Pt-1) is the Zero point. Calibration point 2 (Pt-2) is the upper calibration point.

The dates shown to the right of each point are the dates of the last successful calibration.

7. Select Pt-1. The screen will change to:



The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.



The Calibration Report on the top line displays the voltage output from the probe in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

#### 15.4.7. Calibrating Point 2

Remove the Probe from the calibration bottle, shake off any excess water then dry the outer sleeve with a soft cloth.

Fill a calibration bottle with freshly mixed Rhodamine calibration solution and drop the Probe in all the way. Again, bang the Probe against the bottom of the bottle several times in order to remove any air bubbles that may be clinging to the probe.

Follow the procedure detailed above for Zero point calibration as far as step 6, then select Pt-2. Wait while the Meter stabilises and calibrates.

After successful calibration, the 'Calibrating 100%' screen will be displayed along with the Calibration Report, which will show the voltage output from the probe in millivolts (mV). Press the **OK** key to continue. The reading on the Macro 900 Meter directly after calibration should be approximately 118 µg/L at 20°C (this value will vary with temperature).

Calibration is now complete.

#### 15.4.8. Errors During Calibration

If a problem occurs during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.



#### **15.4.9. Lens and Sleeve Maintenance**

On a daily basis, the lenses on the electrode should be wiped over with a soft damp cloth.

Similarly, the inside of the Probe Sleeve and Sleeve Cap should be kept clean and free from any deposits that may cause stray fluorescence.

**Never use an abrasive cleaner on the inside of the Probe sleeve or cap as they have been treated with a non-reflective coating which can be easily damaged.** The inside of the sleeve should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Always re-calibrate the zero point after cleaning the sleeve or lenses.

### **15.5. PT 1554 Rhodamine WT Probe**

Rhodamine WT is a fluorescent red dye that is commonly used in water flow studies and can be measured by the MAP 2000/2100 using the optional PT 1554 Rhodamine WT optical probe.

#### **15.5.1. Principle of Operation**

The optional PT 1554 Rhodamine WT optical probe is a submersible, fixed response fluorometer, which provides excitation at 520nm and detects any resultant fluorescence above 575nm.

The probe induces the Rhodamine to fluoresce, then measures the longer wavelength light which is emitted as a result of the fluorescence process.

#### **15.5.2. Limitations of Use**

Measurement of Rhodamine in the field using fluorescence measurement techniques can be adversely affected by:

- Interference from microbiological species and compounds, which fluoresce at similar wavelengths.
- Differences in the fluorescent response caused by temperature.
- Differences in the fluorescent response caused by ambient light.
- Interference caused by turbidity.

The normal effects of temperature on the fluorescent response of Rhodamine is automatically compensated for by the probe.

#### **15.5.3. Calibrating the RHOD Probe**

The RHOD probe has two calibration points. Careful calibration is essential in order to ensure consistent and reliable results.

When a RHOD probe is first installed, **it MUST be calibrated at both points** in order to set the probe's relative sensitivity and establish its slope.

Subsequently, a single point (Zero) calibration should be carried out daily. Calibration of the RHOD probe Zero point is normally carried out during MacroCal (see [MacroCal Calibration Method](#)).

Full two-point calibration should be carried out every few months.

#### **15.5.4. Calibration Solution Preparation**

In order to 'calibrate' the RHOD probe, a 100 $\mu$ g/L calibration solution of Rhodamine WT should be used. This is exactly the same calibration solution that is recommended for calibration of the BGA-PC probe.

The 100 $\mu$ g/L calibration solution should be freshly prepared by serial dilution from 200g/L standard using deionised water. The following Rhodamine WT standard is recommended:

Part number: 70301027  
Description: Rhodamine WT Liquid  
Supplier: Keystone Europe Ltd.  
Contact: <http://www.dyes.com>

**Be sure to handle chemicals with care and to read and comply with all health and safety advice.**

### 15.5.5. Serial Dilution

The recommended Rhodamine solution is supplied as a 20% or 200g/L solution, dilution of the stock solution should be carried out as follows.

200g/L stock → 100µg/L is recommended to be done as a two-step dilution procedure.

**Step 1;** weigh out 0.5g of 200g/L stock solution in a weigh boat and add this to 1L of deionized water in a volumetric flask, use some of the water from the 1L flask to rinse the weigh boat so no stock Rhodamine remains on the boat. Put a lid on the 1L flask and invert 10 times.

This step results in a 1 in 2000 dilution of the stock, at this point the 1L flask will contain a 100mg/L solution.

**Step 2;** Transfer 1ml of the 100mg/L solution to a 1L volumetric flask and top up to 1L with deionized water. Put a lid on the 1L flask and invert 10 times.

This step results in a 1 in 1000 dilution of the solution from step 1. The concentration of this solution is 100µg/L. This solution can now be used as Pt-2 calibration of the RHOD sensor.

The dilute solution can be stored in a dark bottle in a refrigerator for up to five days. After that time it must be discarded.

### 15.5.6. Zero Point Calibration

To calibrate the zero point, follow these steps:

1. Fill a calibration bottle with distilled water, remove the storage cap from the pH probe if fitted, wash the Probe in distilled water, then drop the Probe in all the way. **The Sleeve End Cap and Plug must be fitted.** Bang the Probe against the bottom of the bottle several times in order to remove any air bubbles that may be clinging to the probe.
2. Switch the Macro 900 Meter on and wait until the temperature and Rhod readings are stable. If the Rhod reading is very high, there are probably air bubbles adhering to the lenses. Bang the Probe against the bottom of the bottle to remove.
3. Ensure the temperature of the solution is between 5°C and 40°C (41°F - 104°F).
4. Press the **MENU** key then select **Calibration**. The following screen will be displayed.

**Calibration**  
→MacroCal  
**DO 100%**  
**Full Cal**

5. Select **Full Cal**. The screen will change to:

**Calibration**  
→pH/ORP  
DO/EC  
**Aux Probes**

6. Select **Aux Probes**. The screen will change to:

**SELECT PROBE**  
→1:Rhod I 4:N/A  
2:EMPTY I 5:N/A  
3:N/A I 6:N/A

The Rhod probe should have been assigned to AUX socket 1 when it was fitted. Press the OK or right arrow key to select Rhod. The screen will change to:

**CALIBRATE Rhod**  
→Pt-1? [01/Jan/12]  
Pt-2? [01/Jan/12]

Calibration point 1 (Pt-1) is the Zero point. Calibration point 2 (Pt-2) is the upper calibration point. The dates shown to the right of each point are the dates of the last successful calibration.

7. Select Pt-1. The screen will change to:

**PLEASE WAIT**  
Stabilising  
000%

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up.

If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

**Offset:2500mV**  
**Calibrating**  
**100%**  
**Press [OK]**

The Calibration Report on the top line displays the voltage output from the probe in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

### **15.5.7. Calibrating Point 2**

Remove the Probe from the calibration bottle, shake off any excess water then dry the outer sleeve with a soft cloth.

Fill a calibration bottle with freshly mixed Rhodamine calibration solution and drop the Probe in all the way.

Again, bang the Probe against the bottom of the bottle several times in order to remove any air bubbles that may be clinging to the probe.

Follow the procedure detailed above for Zero point calibration as far as step 6, then select Pt-2. Wait while the Meter stabilises and calibrates.

After successful calibration, the 'Calibrating 100%' screen will be displayed along with the Calibration Report, which will show the voltage output from the probe in millivolts (mV). Press the **OK** key to continue.

Calibration is now complete.

### **15.5.8. Errors During Calibration**

If a problem occurs during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.

### **15.5.9. Lens and Sleeve Maintenance**

On a daily basis, the lenses on the probe should be wiped over with a soft damp cloth.

Similarly, the inside of the Probe Sleeve and Sleeve Cap should be kept clean and free from any deposits that may cause stray fluorescence.

**Never use an abrasive cleaner on the inside of the Probe sleeve or cap as they have been treated with a non-reflective coating which can be easily damaged.** The inside of the sleeve should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Always re-calibrate the zero point after cleaning the sleeve or lenses.

## 15.6. PT 1555 Fluorescein Dye Probe

Fluorescein is a fluorescent dye that is commonly used in water flow studies and can be measured by the MAP 2000/2100 using the optional PT 1555 Fluorescein Dye optical probe.

### 15.6.1. Principle of Operation

The PT 1555 Fluorescein Dye optical probe is a submersible, fixed response fluorometer, which provides excitation at 470nm and detects any resultant fluorescence above 550nm.

The probe induces the Fluorescein to fluoresce, then measures the longer wavelength light which is emitted as a result of the fluorescence process.

### 15.6.2. Limitations of Use

Measurement of Fluorescein in the field using fluorescence measurement techniques can be adversely affected by:

- Interference from microbiological species and compounds, which fluoresce at similar wavelengths.
- Differences in the fluorescent response caused by temperature.
- Differences in the fluorescent response caused by ambient light.
- Interference caused by turbidity.

The normal effects of temperature on the fluorescent response of Fluorescein is automatically compensated for by the probe.

### 15.6.3. Calibrating the FSCEIN Probe

The FSCEIN probe has two calibration points. Careful calibration is essential in order to ensure consistent and reliable results.

When a FSCEIN probe is first installed, **it MUST be calibrated at both points** in order to set the probe's relative sensitivity and establish its slope.

Subsequently, a single point (Zero) calibration should be carried out daily. Calibration of the FSCEIN probe Zero point is normally carried out during MacroCal (see [MacroCal Calibration Method](#)).

Full two-point calibration should be carried out every few months.

### 15.6.4. Calibration Solution Preparation

In order to 'calibrate' the FSCEIN probe, a 100 $\mu$ g/L calibration solution of Fluorescein Dye should be used.

The 100 $\mu$ g/L calibration solution should be freshly prepared by serial dilution from 200g/L standard using deionised water. The following Fluorescein Dye is recommended:

Part number: 801 073 81  
Description: Keyacid Fluorescein 019187  
Supplier: Keystone Europe Ltd.  
Contact: <http://www.dyes.com>

**Be sure to handle chemicals with care and to read and comply with all health and safety advice.**

#### 15.6.5. Serial Dilution

A three step dilution process should be used as outlined below.

**Step 1;** Weigh out 0.5g Fluorescein dye powder and add to 1L deionized water in a volumetric flask. Invert 10 times or until all powder is dissolved. This gives a stock solution of 500mg/L.

**Step 2;** Transfer 10ml of the 500mg/L stock solution into a 1L volumetric flask and top the flask up to 1L with deionized water. Invert to mix.

This step results in a 1 in 100 dilution of the 500mg/L stock resulting in a 5mg/L stock.

**Step 3;** Transfer 20ml of the 5mg/L stock from step 2 into a 1L volumetric flask. Top up to 1L with deionized water. Invert to mix.

This step results in a 1 in 50 dilution and gives you the 100 $\mu$ g/L FSCEIN calibration standard required for Pt-2.

The dilute solution can be stored in a dark bottle in a refrigerator for up to five days. After that time it must be discarded.

#### 15.6.6. Zero Point Calibration

To calibrate the zero point, follow these steps:

1. Fill a calibration bottle with distilled water, remove the storage cap from the pH probe if fitted, wash the Probe in distilled water, then drop the Probe in all the way. **The Sleeve End Cap and Plug must be fitted.** Bang the Probe against the bottom of the bottle several times in order to remove any air bubbles that may be clinging to the probe.
2. Switch the Macro 900 Meter on and wait until the temperature and Fcein readings are stable. If the Fcein reading is very high, there are probably air bubbles adhering to the lenses. Bang the Probe against the bottom of the bottle to remove.
3. Ensure the temperature of the solution is between 5°C and 40°C (41°F - 104°F).
4. Press the  **MENU** key then select **Calibration**. The following screen will be displayed.

**Calibration**  
→MacroCal  
DO 100%  
Full Cal

5. Select **Full Cal**. The screen will change to:

**Calibration**  
→pH/ORP  
DO/EC  
Aux Probes

6. Select **Aux Probes**. The screen will change to:

**SELECT PROBE**  
→1:Fcein | 4:N/A  
2:EMPTY | 5:N/A  
3:N/A | 6:N/A

The Fcein probe should have been assigned to AUX socket 1 when it was fitted. Press the OK or right arrow key to select Fcein. The screen will change to:

**CALIBRATE Fcein**  
→Pt-1? [01/Jan/12]  
Pt-2? [01/Jan/12]

Calibration point 1 (Pt-1) is the Zero point. Calibration point 2 (Pt-2) is the upper calibration point.

The dates shown to the right of each point are the dates of the last successful calibration.

7. Select Pt-1. The screen will change to:

**PLEASE WAIT**  
Stabilising  
000%

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

**Offset:2500mV**  
**Calibrating**  
**100%**  
**Press [OK]**

The Calibration Report on the top line displays the voltage output from the probe in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

### **15.6.7. Calibrating Point 2**

Remove the Probe from the calibration bottle, shake off any excess water then dry the outer sleeve with a soft cloth.

Fill a calibration bottle with freshly mixed Fluorescein calibration solution and drop the Probe in all the way.

Again, bang the Probe against the bottom of the bottle several times in order to remove any air bubbles that may be clinging to the probe.

Follow the procedure detailed above for Zero point calibration as far as step 6, then select Pt-2. Wait while the Meter stabilises and calibrates.

After successful calibration, the 'Calibrating 100%' screen will be displayed along with the Calibration Report, which will show the voltage output from the probe in millivolts (mV). Press the **OK** key to continue.

Calibration is now complete.

### **15.6.8. Errors During Calibration**

If a problem occurs during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.

### **15.6.9. Lens and Sleeve Maintenance**

On a daily basis, the lenses on the probe should be wiped over with a soft damp cloth.

Similarly, the inside of the Probe Sleeve and Sleeve Cap should be kept clean and free from any deposits that may cause stray fluorescence.

**Never use an abrasive cleaner on the inside of the Probe sleeve or cap as they have been treated with a non-reflective coating which can be easily damaged.** The inside of the sleeve should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Always re-calibrate the zero point after cleaning the sleeve or lenses.

### 15.7. PT 1557 Refined Oil (Hydrocarbon) Probe

Refined fuels such as benzene, toluene, ethylbenzene, and xylenes (BTEX) can be measured by the MAP 2000/2100 using the optional PT 1557 Refined Oil (Hydrocarbon) optical probe.

#### 15.7.1. Principle of Operation

The PT 1557 Refined Oil (Hydrocarbon) optical probe is a submersible, fixed response fluorometer, which provides excitation at 285nm (deep UV) and detects any resultant fluorescence between 320nm and 380nm.

The probe induces the aromatic hydrocarbons within the refined oil to fluoresce, then measures the longer wavelength light which is emitted as a result of the fluorescence process.



- During operation, the Refined Oil Probe emits high intensity ultraviolet (UV) light, which is harmful to skin and eyes.
- UV light is hazardous to skin and may cause cancer. Avoid exposure to UV light when the Probe is in operational.
- Precautions must be taken to avoid looking directly at the Probe without the use of UV light protective glasses.
- Do not look directly at the lenses on the front face of the Probe when it is operational.
- Ensure the warning label supplied with the Probe is attached to the Macro Accessory Probe.

#### 15.7.2. Limitations of Use

Determination of refined oil in the field using fluorescence measurement techniques will never be as accurate as measurements made in a lab using either Gas or Liquid Chromatography.

Factors adversely affecting accuracy include:

- Interference from other compounds (such as flour and some bacterial spores which fluoresce at similar wavelengths).

- Differences in the fluorescent response between various types of oil.
- Differences in the fluorescent response caused by temperature.
- Differences in the fluorescent response caused by ambient light.
- Interference caused by turbidity.

Fluorescence measurement techniques are ideal for researchers who are interested in detecting the presence or absence of a specific substance and measuring relative fluorescence changes that can be used as an indication of increasing or decreasing concentrations.

Fluorescence measurement techniques are not ideal for quantitative measurement. **In order to obtain more accurate results, data obtained with the fluorometer in the field should be post-calibrated with data from standard laboratory analysis of grab samples acquired during the study.**

#### 15.7.3. Special Precautions When Using the REFOIL Probe

- Always observe the safety advice printed above.
- The UV LED is permanently on when power is supplied to the MAP 2000/2100 and draws 50mA. Switch the MAP 2000/2100 off between readings to save power and prolong the UV LED's life.
- Do not leave the MAP 2000/2100 powered on for prolonged periods if not submerged. This can cause the UV LED to overheat.
- Do not deploy the REFOIL probe in water temperatures above 30°C.
- **Always carry out a zero point (Point 1) calibration as close to operational temperature as possible prior to every use.**

#### 15.7.4. Calibrating the REFOIL Probe

The REFOIL probe has two calibration points. Careful calibration is essential in order to ensure consistent and reliable results. **When a REFOIL probe is first installed, it MUST be calibrated at both points in order to set the probe's relative sensitivity and establish its slope.**

Subsequently, a single point (Zero) calibration should be carried out daily. Calibration of the REFOIL probe Zero point is normally carried out during MacroCal (see [MacroCal Calibration Method](#)).

Full two-point calibration should be carried out every few months.

#### 15.7.5. Calibration Solution Preparation

In order to 'calibrate' the REFOIL probe, a 10ppm calibration solution of 1-5, naphthalenedisulfonic acid disodium salt should be used. This solution contains naphthalene, an aromatic hydrocarbon, which has **similar** fluorescence characteristics to many Refined Oils.

The 10ppm calibration solution should be freshly prepared by serial dilution from pure 1-5, naphthalenedisulfonic acid disodium salt. The following Naphthalene salt is recommended:

Part number: 250899

Description: 1, 5-Naphthalenedisulfonic acid disodium salt hydrate (95% pure)

Supplier: Sigma Aldrich

Contact: [www.sigma-aldrich.com](http://www.sigma-aldrich.com)

**Be sure to handle chemicals with care and to read and comply with all health and safety advice.**

#### 15.7.6. Serial Dilution

10ppm Napthalene salt can be prepared either as a one or two step process dependent upon the accuracy of the scales used.

##### **One step process:**

Weigh out 10.5mg of the recommended salt and add to 1L of deionized water in a volumetric flask. Invert or mix until all salt has dissolved. This gives the Pt-2 10ppm stock solution required for calibration.

##### **Two step process:**

**Step 1:** Weigh out 1.05g of the recommended salt and add to 1L deionized water in a volumetric flask. Invert or mix until all salt has dissolved. This gives a 1000ppm stock solution.

**Step 2:** Transfer 10ml of the 1000ppm stock solution to a 1L volumetric flask and top up with 1L of deionized water. Invert 10 times. This step results in a 1 in 100 dilution of the 1000ppm stock giving the 10ppm standard required for Pt-2 calibration.

The dilute solution can be stored in a dark bottle in a refrigerator for up to five days. After that time it must be discarded.

**Important note:** When calibrating the Refined Oil sensor with naphthalenedisulfonic acid disodium salt, the readings given will be in  $\mu\text{g/L}$  (ppb) naphthalene. In order to display readings with respect to a specific type of refined oil, it is necessary to prepare a 10ppm solution of the target oil type and use that to calibrate the probe in place of the naphthalene solution.

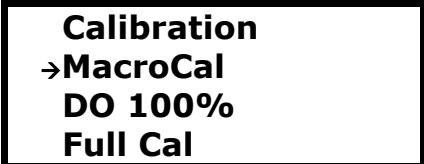
#### 15.7.7. Zero Point Calibration

To calibrate the zero point, follow these steps:

1. Fill a calibration bottle with distilled water, remove the storage cap from the pH probe if fitted, wash the Probe in distilled water, then drop the Probe in all the way. **The Sleeve End Cap and Plug must be fitted.** Bang the Probe against the bottom of the bottle several times in order to remove any air bubbles that may be clinging to the probe.
2. Switch the Macro 900 Meter on and wait until the temperature and Oil readings are stable. If the Oil reading is very high, there are probably air bubbles adhering to the lenses. Bang the Probe against the bottom of the

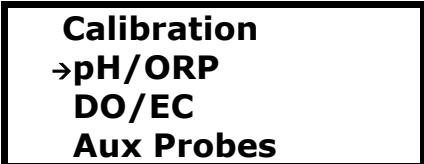
bottle to remove.

3. Ensure the temperature of the solution is between 5°C and 40°C (41°F - 104°F).
4. Press the **MENU** key then select **Calibration**. The following screen will be displayed.



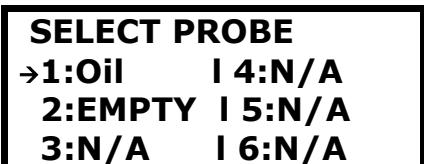
**Calibration**  
→MacroCal  
DO 100%  
Full Cal

5. Select **Full Cal**. The screen will change to:



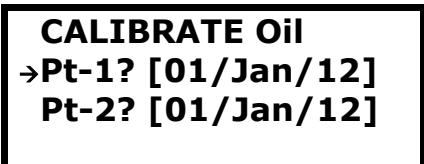
**Calibration**  
→pH/ORP  
DO/EC  
Aux Probes

6. Select **Aux Probes**. The screen will change to:



**SELECT PROBE**  
→1:Oil      4:N/A  
2:EMPTY      5:N/A  
3:N/A      6:N/A

The Oil probe should have been assigned to AUX socket 1 when it was fitted. Press the OK or right arrow key to select Oil. The screen will change to:



**CALIBRATE Oil**  
→Pt-1? [01/Jan/12]  
Pt-2? [01/Jan/12]

Calibration point 1 (Pt-1) is the Zero point. Calibration point 2 (Pt-2) is the upper calibration point. The dates shown to the right of each point are the dates of the last successful calibration.

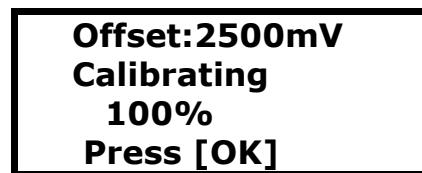
7. Select Pt-1. The screen will change to:



**PLEASE WAIT**  
Stabilising  
000%

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes

place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.



The Calibration Report on the top line displays the voltage output from the probe in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

#### 15.7.8. Calibrating Point 2

Remove the Probe from the calibration bottle, shake off any excess water then dry the outer sleeve with a soft cloth.

Fill a calibration bottle with freshly mixed 1-5, naphthalenedisulfonic acid disodium salt calibration solution and drop the Probe in all the way. Again, bang the Probe against the bottom of the bottle several times in order to remove any air bubbles that may be clinging to the probe.

Follow the procedure detailed above for Zero point calibration as far as step 6, then select Pt-2. Wait while the Meter stabilises and calibrates.

After successful calibration, the 'Calibrating 100%' screen will be displayed along with the Calibration Report, which will show the voltage output from the probe in millivolts (mV). Press the **OK** key to continue.

Calibration is now complete.

#### 15.7.9. Errors During Calibration

If a problem occurs during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.

#### 15.7.10. Lens and Sleeve Maintenance

On a daily basis, the lenses on the probe should be wiped over with a soft damp cloth.

Similarly, the inside of the Probe Sleeve and Sleeve Cap should be kept clean and free from any deposits that may cause stray fluorescence.

**Never use an abrasive cleaner on the inside of the Probe sleeve or cap as they have been treated with a non-reflective coating which can be easily damaged.** The inside of the sleeve should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Always re-calibrate the zero point after cleaning the sleeve or lenses.



## 16. Optional ISE Electrodes Calibration and Maintenance

### 16.1. ISE Electrode Limitations

All ion selective electrodes suffer from interference from ions which are similar in nature to the target ion. For this reason, ISE Electrodes are not recommended for use in brackish or salt water due to the high level of interfering ions.

In order to achieve accurate readings with ISE electrodes, the Probe needs to be either placed in flowing water, or needs to be stirred or raised and lowered continuously to ensure a minimum flow rate of 0.3m/s over the electrode. **If there is no water flow across the ISE electrode, the ions in the immediate area of the electrode will be depleted and the reading will start to fall. This also applies to calibration, where the probe should be stirred at all times.**

### 16.2. Calibration Points

All ISE electrodes have three calibration points. Careful calibration is essential in order to ensure consistent and reliable results. Prior to initial calibration, all ISE Electrodes should be soaked in their relevant Point 1 calibration solution for 20 – 30 minutes.

When an ISE electrode is first installed, **it MUST be calibrated at three points** in order to establish the electrode's slope and thermal characteristics. Two of the calibration points must be at the same temperature whilst the third must be at least 10°C cooler. Subsequently, a two-point calibration should be carried out weekly and a single point calibration should be carried out daily. The ISE electrode should be replaced every 6-12 months.

### 16.3. Special Notes Concerning ISE Electrodes during pH Calibration

The high ionic concentration of pH calibration solutions (buffers), including MacroCal, can cause significant offsets in ISE electrodes.

These offsets are temporary, but best avoided because they can cause significant errors during both calibration and normal operation. For this reason all ISE electrodes are supplied with a red rubber sealing cap.

**The caps should be fitted to all ISE Electrodes during pH calibration or when using MacroCal** in order to protect the ISE electrodes from the effects of the buffer solution.

At all other times, the ISE electrodes should be left uncovered.



#### **16.4. PT 1541 Ammonium/Ammonia Electrode**

Ammonium (NH<sub>4</sub>) and Ammonia (NH<sub>3</sub>) can be measured by the MAP 2000/2100 using the optional PT 1541 Ammonium/Ammonia electrode within pH 5 – 8 range.

The Ammonium ISE electrode will suffer interference from Potassium, Sodium and Magnesium ions, which are similar in nature.

##### **16.4.1. Ammonium Calibration Solution Preparation**

When an Ammonium ISE electrode is first installed, it must be calibrated at three points. In order to achieve this, three batches of Ammonium calibration solution must be prepared.

The solutions required are two 200mL batches of Ammonium (as NH<sub>4</sub>) at a concentration of 10ppm and one 250mL batch of Ammonium (as NH<sub>4</sub>) at a concentration of 100ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard. The following Ammonium standard is recommended:

Part number: SS-702-1610  
Description: 500mL Ammonium 1000ppm as NH<sub>4</sub> ISE  
Supplier: T E Laboratories Ltd, Ireland.  
Contact: <http://www.tellab.ie>

**Be sure to handle chemicals with care and to read and comply with all health and safety advice.**

##### **Preparing the 100ppm solution**

250mL of 100ppm solution is required. To prepare this, mix 25mL of 1000ppm calibration standard with 225mL of deionised water.

Dispense 200mL of the 100ppm solution into a calibration bottle and retain 50mL for preparation of the 10ppm solution.

##### **Preparing the 10ppm solution**

A total of 400mL of 10ppm solution is required. To prepare this, mix 40mL of the 100ppm solution you have just prepared with 360mL of deionised water. Dispense the 10ppm solution into two calibration bottles (200mL each).

##### **Achieving the correct temperature**

During three point calibration, the 100ppm solution and one batch of the 10ppm solution must be at exactly the same temperature. The second batch of 10ppm solution must be at least 10°C cooler.

In order to achieve this, one batch of the 10ppm solution should be put into a refrigerator and the other two solutions should be put into a water bath at 25°C.

Once all three solutions are at a stable temperature, calibration can begin.

### 16.4.2. Three-point Calibration

During three-point calibration, the MAP 2000/2100 and Macro 900 Meter must remain switched on. If the Macro 900 Meter is switched off between points, the calibration process will be aborted and must be re-started from point 1. To calibrate the ISE electrode follow these steps:

#### Point 1.

1. Remove the storage cap from the pH electrode, wash the Probe in distilled water, dry the probe thoroughly then drop the Probe in to the warm **10ppm** solution.
2. Switch the Macro 900 Meter on and stir the probe until the temperature and NH4 readings are completely stable. A minimum of five minutes is recommended.
3. Ensure the temperature of the solution is between 20°C and 40°C (68°F - 104°F).
4. Press the **MENU** key then select **Calibration**. The following screen will be displayed.

```
Calibration
→MacroCal
DO 100%
Full Cal
```

5. Select **Full Cal**. The screen will change to:

```
Calibration
→pH/ORP
DO/EC
Aux Electrodes
```

6. Select **Aux Electrodes**. The screen will change to:

```
SELECT ELECTRODE
→1:TURB  | 4:N/A
          2:NH4  | 5:N/A
          3:N/A  | 6:N/A
```

The Ammonium (NH4) electrode should have been assigned to AUX socket 2 when it was fitted. Move the pointer down to 2:NH4 then press the OK or right arrow key to select.

7. The screen will change to:

```
CALIBRATE NH4
→Pt-1? [01/Jan/12]
          Pt-2? [01/Jan/12]
          Pt-3? [01/Jan/12]
```

Calibration point 1 (Pt-1) is the warm 10ppm point. Calibration point 2

(Pt-2) is the warm 100ppm point. Calibration point 3 (Pt-3) is the cool 10ppm point.

The dates shown to the right of each point are the dates of the last successful calibration.

8. Select Pt-1. The screen will change to:

**PLEASE WAIT**  
**Stabilising**  
**000%**

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

**Output:348mV**  
**Calibrating**  
**100%**  
**Press [OK]**

The Calibration Report on the top line displays the voltage output from the ISE electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe along with the temperature.

## Point 2

1. Remove the probe from the 10ppm solution and wash thoroughly in deionised water. Dry the probe then drop it into to the warm **100ppm** solution.
2. Stir the probe until the temperature and NH4 readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is within 1°C of the previous 10ppm calibration point.** If the solution is warmer or cooler than this, calibration will fail.
4. Referring to steps 4-7 above, select Pt-2 and press OK.

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the 100ppm solution is more than 1°C different from the Pt-1 calibration temperature, an OUT OF TEMP RANGE calibration error will be

reported. If this happens, adjust the temperature and try again.

### Point 3

1. Remove the probe from the 100ppm solution and wash thoroughly in deionised water. Dry the probe then drop it into to the **cool 10ppm** solution.
2. Stir the probe until the temperature and NH4 readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is at least 10°C cooler than the previous 100ppm calibration point.** If the solution is too warm, calibration will fail.
4. Referring to steps 4-7 above, select Pt-3 and press OK.

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the cool 10ppm solution is less than 10°C cooler than the Pt-1 and Pt-2 calibration temperatures, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

#### **16.4.3. Two-point Calibration**

Two-point calibration should be carried out weekly. For this, 10ppm and 100ppm solutions are required. The two solutions can be at any temperature between 5°C and 30°C but they both must be the same temperature (within 1°C).

If the temperature of the two solutions differ by more than 1°C, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

During two-point calibration, the MAP 2000/2100 and Macro 900 Meter must remain switched on. If the Macro 900 Meter is switched off between points, the calibration process will be aborted and must be re-started from point 1.

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 and 2 only.

#### **16.4.4. Single-point Calibration**

Single-point calibration should be carried out daily. For this, just 10ppm solution is required. The solution can be at any temperature between 5°C and 30°C.

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 only.

#### **16.4.5. Errors During Calibration**

If a problem occurs during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.

## 16.5. PT 1542 Nitrate Electrode

Nitrate (NO<sub>3</sub>) can be measured by the MAP 2000/2100 using the optional PT 1542 Nitrate electrode within a pH range of 3 – 10.

The Nitrate ISE electrode will suffer interference from Chloride, Bromide, Fluoride, Sulphate, Chlorate and Perchlorate ions, which are similar in nature.

### 16.5.1. Nitrate Calibration Solution Preparation

When a Nitrate ISE electrode is first installed, it must be calibrated at three points. In order to achieve this, three batches of Nitrate calibration solution must be prepared.

The solutions required are two 200mL batches of Nitrate at a concentration of 10ppm and one 250mL batch of Nitrate at a concentration of 100ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard. The following Nitrate standard is recommended:

Part number: SS-712-1610  
Description: 500mL Nitrate 1000ppm ISE  
Supplier: T E Laboratories Ltd, Ireland.  
Contact: <http://www.tellab.ie>

**Be sure to handle chemicals with care and to read and comply with all health and safety advice.**

#### Preparing the 100ppm solution

250mL of 100ppm solution is required. To prepare this, mix 25mL of 1000ppm calibration standard with 225mL of deionised water.

Dispense 200mL of the 100ppm solution into a calibration bottle and retain 50mL for preparation of the 10ppm solution.

#### Preparing the 10ppm solution

A total of 400mL of 10ppm solution is required. To prepare this, mix 40mL of the 100ppm solution you have just prepared with 360mL of deionised water. Dispense the 10ppm solution into two calibration bottles (200mL each).

#### Achieving the correct temperature

During three point calibration, the 100ppm solution and one batch of the 10ppm solution must be at exactly the same temperature. The second batch of 10ppm solution must be at least 10°C cooler.

In order to achieve this, one batch of the 10ppm solution should be put into a refrigerator and the other two solutions should be put into a water bath at 25°C.

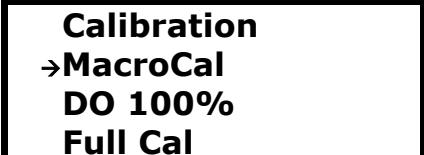
Once all three solutions are at a stable temperature, calibration can begin.

### 16.5.2. Three-point Calibration

During three-point calibration, the MAP 2000/2100 and Macro 900 Meter must remain switched on. If the Macro 900 Meter is switched off between points, the calibration process will be aborted and must be re-started from point 1. To calibrate the ISE electrode follow these steps:

#### Point 1.

1. Remove the storage cap from the pH electrode, wash the Probe in distilled water, dry the probe thoroughly then drop the Probe in to the warm **10ppm** solution.
2. Switch the Macro 900 Meter on and stir the probe until the temperature and NO<sub>3</sub> readings are completely stable. A minimum of five minutes is recommended.
3. Ensure the temperature of the solution is between 20°C and 40°C (68°F - 104°F).
4. Press the **MENU** key then select **Calibration**. The following screen will be displayed.



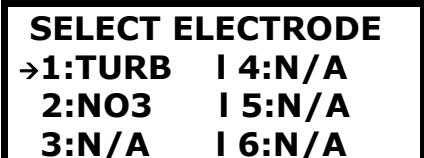
Calibration  
→MacroCal  
DO 100%  
Full Cal

5. Select **Full Cal**. The screen will change to:



Calibration  
→pH/ORP  
DO/EC  
Aux Electrodes

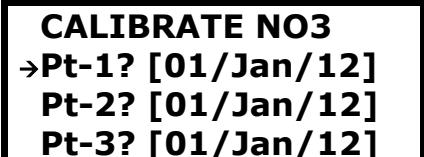
6. Select **Aux Electrodes**. The screen will change to:



SELECT ELECTRODE  
→1:TURB | 4:N/A  
2:NO3 | 5:N/A  
3:N/A | 6:N/A

The Nitrate (NO<sub>3</sub>) electrode should have been assigned to AUX socket 2 when it was fitted. Move the pointer down to 2:NO<sub>3</sub> then press the OK or right arrow key to select.

7. The screen will change to:



CALIBRATE NO3  
→Pt-1? [01/Jan/12]  
Pt-2? [01/Jan/12]  
Pt-3? [01/Jan/12]

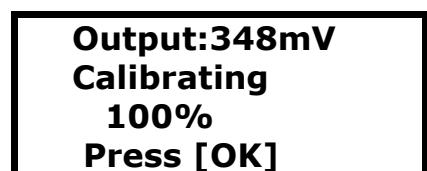
Calibration point 1 (Pt-1) is the warm 10ppm point. Calibration point 2 (Pt-2) is the warm 100ppm point. Calibration point 3 (Pt-3) is the cool 10ppm point.

The dates shown to the right of each point are the dates of the last successful calibration.

8. Select Pt-1. The screen will change to:



The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.



The Calibration Report on the top line displays the voltage output from the ISE electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe along with the temperature.

## Point 2

1. Remove the probe from the 10ppm solution and wash thoroughly in deionised water. Dry the probe then drop it into to the warm **100ppm** solution.
2. Stir the probe until the temperature and NO<sub>3</sub> readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is within 1°C of the previous 10ppm calibration point.** If the solution is warmer or cooler than this, calibration will fail.
4. Referring to steps 4-7 above, select Pt-2 and press OK.

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the 100ppm solution is more than 1°C different from the

Pt-1 calibration temperature, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

### Point 3

1. Remove the probe from the 100ppm solution and wash thoroughly in deionised water. Dry the probe then drop it into to the **cool 10ppm** solution.
2. Stir the probe until the temperature and NO<sub>3</sub> readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is at least 10°C cooler than the previous 100ppm calibration point.** If the solution is too warm, calibration will fail.
4. Referring to steps 4-7 above, select Pt-3 and press OK.

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the cool 10ppm solution is less than 10°C cooler than the Pt-1 and Pt-2 calibration temperatures, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

#### 16.5.3. Two-point Calibration

Two-point calibration should be carried out weekly. For this, 10ppm and 100ppm solutions are required. The two solutions can be at any temperature between 5°C and 30°C but they both must be the same temperature (within 1°C).

If the temperature of the two solutions differ by more than 1°C, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

During two-point calibration, the MAP 2000/2100 and Macro 900 Meter must remain switched on. If the Macro 900 Meter is switched off between points, the calibration process will be aborted and must be re-started from point 1.

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 and 2 only.

#### 16.5.4. Single-point Calibration

Single-point calibration should be carried out daily. For this, just 10ppm solution is required. The solution can be at any temperature between 5°C and 30°C.

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 only.

### **16.5.5. Errors During Calibration**

If a problem occurs during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.

## 16.6. PT 1543 Chloride Electrode

Chloride (Cl) can be measured by the MAP 2000/2100 using the optional PT 1543 Chloride electrode within a pH range of 2 – 11.

The Chloride ISE electrode will suffer interference from Bromide, Iodide, Cyanide and Sulphide ions, which are similar in nature.

### 16.6.1. Chloride Calibration Solution Preparation

When a Chloride ISE electrode is first installed, it must be calibrated at three points. In order to achieve this, three batches of Chloride calibration solution must be prepared.

The solutions required are two 200mL batches of Chloride at a concentration of 10ppm and one 250mL batch of Chloride at a concentration of 100ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard. The following Chloride standard is recommended:

Part number: SS-706-1610  
Description: 500mL Chloride 1000ppm ISE  
Supplier: T E Laboratories Ltd, Ireland.  
Contact: <http://www.tellab.ie>

**Be sure to handle chemicals with care and to read and comply with all health and safety advice.**

#### Preparing the 100ppm solution

250mL of 100ppm solution is required. To prepare this, mix 25mL of 1000ppm calibration standard with 225mL of deionised water.

Dispense 200mL of the 100ppm solution into a calibration bottle and retain 50mL for preparation of the 10ppm solution.

#### Preparing the 10ppm solution

A total of 400mL of 10ppm solution is required. To prepare this, mix 40mL of the 100ppm solution you have just prepared with 360mL of deionised water. Dispense the 10ppm solution into two calibration bottles (200mL each).

#### Achieving the correct temperature

During three point calibration, the 100ppm solution and one batch of the 10ppm solution must be at exactly the same temperature. The second batch of 10ppm solution must be at least 10°C cooler.

In order to achieve this, one batch of the 10ppm solution should be put into a refrigerator and the other two solutions should be put into a water bath at 25°C.

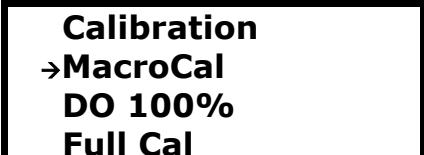
Once all three solutions are at a stable temperature, calibration can begin.

### 16.6.2. Three-point Calibration

During three-point calibration, the MAP 2000/2100 and Macro 900 Meter must remain switched on. If the Macro 900 Meter is switched off between points, the calibration process will be aborted and must be re-started from point 1. To calibrate the ISE electrode follow these steps:

#### Point 1.

1. Remove the storage cap from the pH electrode, wash the Probe in distilled water, dry the probe thoroughly then drop the Probe in to the warm **10ppm** solution.
2. Switch the Macro 900 Meter on and stir the probe until the temperature and Cl readings are completely stable. A minimum of five minutes is recommended.
3. Ensure the temperature of the solution is between 20°C and 40°C (68°F - 104°F).
4. Press the **MENU** key then select **Calibration**. The following screen will be displayed.



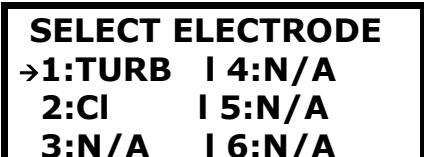
Calibration  
→MacroCal  
DO 100%  
Full Cal

5. Select **Full Cal**. The screen will change to:



Calibration  
→pH/ORP  
DO/EC  
Aux Electrodes

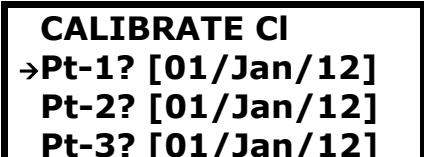
6. Select **Aux Electrodes**. The screen will change to:



SELECT ELECTRODE  
→1:TURB | 4:N/A  
2:Cl | 5:N/A  
3:N/A | 6:N/A

The Chloride (Cl) electrode should have been assigned to AUX socket 2 when it was fitted. Move the pointer down to 2:Cl then press the OK or right arrow key to select.

7. The screen will change to:



CALIBRATE Cl  
→Pt-1? [01/Jan/12]  
Pt-2? [01/Jan/12]  
Pt-3? [01/Jan/12]

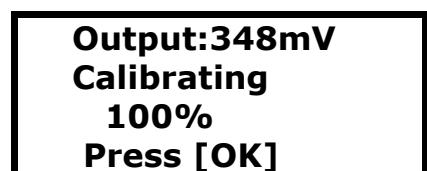
Calibration point 1 (Pt-1) is the warm 10ppm point. Calibration point 2 (Pt-2) is the warm 100ppm point. Calibration point 3 (Pt-3) is the cool 10ppm point.

The dates shown to the right of each point are the dates of the last successful calibration.

8. Select Pt-1. The screen will change to:



The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.



The Calibration Report on the top line displays the voltage output from the ISE electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe along with the temperature.

## Point 2

1. Remove the probe from the 10ppm solution and wash thoroughly in deionised water. Dry the probe then drop it into to the warm **100ppm** solution.
2. Stir the probe until the temperature and Cl readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is within 1°C of the previous 10ppm calibration point.** If the solution is warmer or cooler than this, calibration will fail.
4. Referring to steps 4-7 above, select Pt-2 and press OK.

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the 100ppm solution is more than 1°C different from the

Pt-1 calibration temperature, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

### Point 3

1. Remove the probe from the 100ppm solution and wash thoroughly in deionised water. Dry the probe then drop it into to the **cool 10ppm** solution.
2. Stir the probe until the temperature and Cl readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is at least 10°C cooler than the previous 100ppm calibration point.** If the solution is too warm, calibration will fail.
4. Referring to steps 4-7 above, select Pt-3 and press OK.

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the cool 10ppm solution is less than 10°C cooler than the Pt-1 and Pt-2 calibration temperatures, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

#### 16.6.3. Two-point Calibration

Two-point calibration should be carried out weekly. For this, 10ppm and 100ppm solutions are required. The two solutions can be at any temperature between 5°C and 30°C but they both must be the same temperature (within 1°C).

If the temperature of the two solutions differ by more than 1°C, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

During two-point calibration, the MAP 2000/2100 and Macro 900 Meter must remain switched on. If the Macro 900 Meter is switched off between points, the calibration process will be aborted and must be re-started from point 1.

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 and 2 only.

#### 16.6.4. Single-point Calibration

Single-point calibration should be carried out daily. For this, just 10ppm solution is required. The solution can be at any temperature between 5°C and 30°C.

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 only.

### **16.6.5. Errors During Calibration**

If a problem occurs during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.

## 16.7. PT 1544 Calcium Electrode

Calcium (Ca2) can be measured by the MAP 2000/2100 using the optional PT 1544 Calcium electrode within a pH range of 4 – 9.

The Calcium ISE electrode will suffer interference from Magnesium, Barium, Lead, Zinc and Sodium ions, which are similar in nature.

### 16.7.1. Calcium Calibration Solution Preparation

When a Calcium ISE electrode is first installed, it must be calibrated at three points. In order to achieve this, three batches of Calcium calibration solution must be prepared.

The solutions required are two 200mL batches of Calcium at a concentration of 10ppm and one 250mL batch of Calcium at a concentration of 100ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard. The following Calcium standard is recommended:

Part number: SS-705-1610  
Description: 500mL Calcium 1000ppm ISE  
Supplier: T E Laboratories Ltd, Ireland.  
Contact: <http://www.tellab.ie>

**Be sure to handle chemicals with care and to read and comply with all health and safety advice.**

#### Preparing the 100ppm solution

250mL of 100ppm solution is required. To prepare this, mix 25mL of 1000ppm calibration standard with 225mL of deionised water.

Dispense 200mL of the 100ppm solution into a calibration bottle and retain 50mL for preparation of the 10ppm solution.

#### Preparing the 10ppm solution

A total of 400mL of 10ppm solution is required. To prepare this, mix 40mL of the 100ppm solution you have just prepared with 360mL of deionised water. Dispense the 10ppm solution into two calibration bottles (200mL each).

#### Achieving the correct temperature

During three point calibration, the 100ppm solution and one batch of the 10ppm solution must be at exactly the same temperature. The second batch of 10ppm solution must be at least 10°C cooler.

In order to achieve this, one batch of the 10ppm solution should be put into a refrigerator and the other two solutions should be put into a water bath at 25°C.

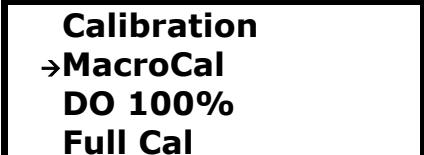
Once all three solutions are at a stable temperature, calibration can begin.

### 16.7.2. Three-point Calibration

During three-point calibration, the MAP 2000/2100 and Macro 900 Meter must remain switched on. If the Macro 900 Meter is switched off between points, the calibration process will be aborted and must be re-started from point 1. To calibrate the ISE electrode follow these steps:

#### Point 1.

1. Remove the storage cap from the pH electrode, wash the Probe in distilled water, dry the probe thoroughly then drop the Probe in to the warm **10ppm** solution.
2. Switch the Macro 900 Meter on and stir the probe until the temperature and Ca2 readings are completely stable. A minimum of five minutes is recommended.
3. Ensure the temperature of the solution is between 20°C and 40°C (68°F - 104°F).
4. Press the **MENU** key then select **Calibration**. The following screen will be displayed.



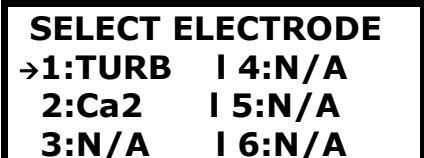
Calibration  
→MacroCal  
DO 100%  
Full Cal

5. Select **Full Cal**. The screen will change to:



Calibration  
→pH/ORP  
DO/EC  
Aux Electrodes

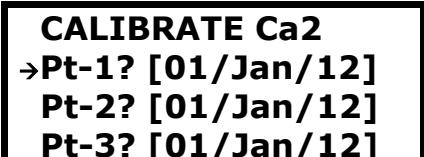
6. Select **Aux Electrodes**. The screen will change to:



SELECT ELECTRODE  
→1:TURB | 4:N/A  
2:Ca2 | 5:N/A  
3:N/A | 6:N/A

The Calcium (Ca2) electrode should have been assigned to AUX socket 2 when it was fitted. Move the pointer down to 2:Ca2 then press the OK or right arrow key to select.

7. The screen will change to:



CALIBRATE Ca2  
→Pt-1? [01/Jan/12]  
Pt-2? [01/Jan/12]  
Pt-3? [01/Jan/12]

Calibration point 1 (Pt-1) is the warm 10ppm point. Calibration point 2 (Pt-2) is the warm 100ppm point. Calibration point 3 (Pt-3) is the cool 10ppm point.

The dates shown to the right of each point are the dates of the last successful calibration.

8. Select Pt-1. The screen will change to:

**PLEASE WAIT**  
**Stabilising**  
**000%**

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

**Output:348mV**  
**Calibrating**  
**100%**  
**Press [OK]**

The Calibration Report on the top line displays the voltage output from the ISE electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe along with the temperature.

## Point 2

1. Remove the probe from the 10ppm solution and wash thoroughly in deionised water. Dry the probe then drop it into to the warm **100ppm** solution.
2. Stir the probe until the temperature and Ca2 readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is within 1°C of the previous 10ppm calibration point.** If the solution is warmer or cooler than this, calibration will fail.
4. Referring to steps 4-7 above, select Pt-2 and press OK.

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the 100ppm solution is more than 1°C different from the

Pt-1 calibration temperature, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

### Point 3

1. Remove the probe from the 100ppm solution and wash thoroughly in deionised water. Dry the probe then drop it into to the **cool 10ppm** solution.
2. Stir the probe until the temperature and Ca2 readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is at least 10°C cooler than the previous 100ppm calibration point.** If the solution is too warm, calibration will fail.
4. Referring to steps 4-7 above, select Pt-3 and press OK.

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the cool 10ppm solution is less than 10°C cooler than the Pt-1 and Pt-2 calibration temperatures, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

#### 16.7.3. Two-point Calibration

Two-point calibration should be carried out weekly. For this, 10ppm and 100ppm solutions are required. The two solutions can be at any temperature between 5°C and 30°C but they both must be the same temperature (within 1°C).

If the temperature of the two solutions differ by more than 1°C, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

During two-point calibration, the MAP 2000/2100 and Macro 900 Meter must remain switched on. If the Macro 900 Meter is switched off between points, the calibration process will be aborted and must be re-started from point 1.

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 and 2 only.

#### 16.7.4. Single-point Calibration

Single-point calibration should be carried out daily. For this, just 10ppm solution is required. The solution can be at any temperature between 5°C and 30°C.

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 only.

### **16.7.5. Errors During Calibration**

If a problem occurs during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.

## 16.8. PT 1545 Fluoride Electrode

Fluoride (F) can be measured by the MAP 2000/2100 using the optional PT 1545 Fluoride electrode within a pH range of 4 – 8.

The Fluoride ISE electrode will suffer interference from hydroxide (OH-) ions, which are similar in nature.

### 16.8.1. Fluoride Calibration Solution Preparation

When a Fluoride ISE electrode is first installed, it must be calibrated at three points. In order to achieve this, three batches of Fluoride calibration solution must be prepared.

The solutions required are two 200mL batches of Fluoride at a concentration of 0.5ppm and one 250mL batch of Fluoride at a concentration of 5ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard. The following Fluoride standard is recommended:

Part number: SS-709-1610  
Description: 500mL Fluoride 1000ppm ISE  
Supplier: T E Laboratories Ltd, Ireland.  
Contact: <http://www.tellab.ie>

**Be sure to handle chemicals with care and to read and comply with all health and safety advice.**

#### Preparing the 5ppm solution

250mL of 5ppm solution is required.

To prepare this, first make an intermediate dilution of 50ppm. To do this, mix 6mL of 1000ppm calibration standard with 114mL of deionised water. This will produce 120mL of 50ppm solution.

Next mix 25mL of the 50ppm solution with 225mL of deionised water. This will produce 250mL of 5ppm solution.

Dispense 200mL of the 5ppm solution into a calibration bottle and retain the rest for preparation of the 0.5ppm solution.

#### Preparing the 0.5ppm solution

A total of 400mL of 0.5ppm solution is required. To prepare this, mix 40mL of the 5ppm solution you have just prepared with 360mL of deionised water. Dispense the 0.5ppm solution into two calibration bottles (200mL each).

#### Achieving the correct temperature

During three point calibration, the 5ppm solution and one batch of the 0.5ppm solution must be at exactly the same temperature. The second batch of 0.5ppm solution must be at least 10°C cooler.

In order to achieve this, one batch of the 0.5ppm solution should be put into a refrigerator and the other two solutions should be put into a water bath at 25°C.

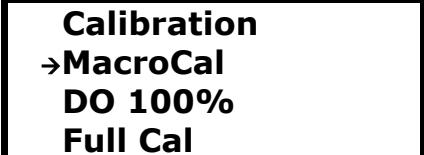
Once all three solutions are at a stable temperature, calibration can begin.

### 16.8.2. Three-point Calibration

During three-point calibration, the MAP 2000/2100 and Macro 900 Meter must remain switched on. If the Macro 900 Meter is switched off between points, the calibration process will be aborted and must be re-started from point 1. To calibrate the ISE electrode follow these steps:

#### Point 1.

1. Remove the storage cap from the pH electrode, wash the Probe in distilled water, dry the probe thoroughly then drop the Probe in to the warm **0.5ppm** solution.
2. Switch the Macro 900 Meter on and stir the probe until the temperature and F readings are completely stable. A minimum of five minutes is recommended.
3. Ensure the temperature of the solution is between 20°C and 40°C (68°F - 104°F).
4. Press the **MENU** key then select **Calibration**. The following screen will be displayed.



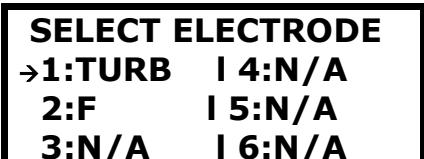
Calibration  
→MacroCal  
DO 100%  
Full Cal

5. Select **Full Cal**. The screen will change to:



Calibration  
→pH/ORP  
DO/EC  
Aux Electrodes

6. Select **Aux Electrodes**. The screen will change to:



SELECT ELECTRODE  
→1:TURB I 4:N/A  
2:F I 5:N/A  
3:N/A I 6:N/A

The Fluoride (F) electrode should have been assigned to AUX socket 2 when it was fitted. Move the pointer down to 2:F then press the OK or right arrow key to select.

7. The screen will change to:

**CALIBRATE F**  
→Pt-1? [01/Jan/12]  
Pt-2? [01/Jan/12]  
Pt-3? [01/Jan/12]

Calibration point 1 (Pt-1) is the warm 0.5ppm point. Calibration point 2 (Pt-2) is the warm 5ppm point. Calibration point 3 (Pt-3) is the cool 0.5ppm point.

The dates shown to the right of each point are the dates of the last successful calibration.

8. Select Pt-1. The screen will change to:

**PLEASE WAIT**  
**Stabilising**  
**000%**

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

**Output:348mV**  
**Calibrating**  
**100%**  
**Press [OK]**

The Calibration Report on the top line displays the voltage output from the ISE electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe along with the temperature.

## Point 2

1. Remove the probe from the 0.5ppm solution and wash thoroughly in deionised water. Dry the probe then drop it into to the warm **5ppm** solution.
2. Stir the probe until the temperature and F readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is within 1°C of the previous 0.5ppm calibration point.** If the solution is warmer or cooler than this, calibration will fail.
4. Referring to steps 4-7 above, select Pt-2 and press OK.

The Meter will wait until the readings are stable, then it will send the calibration

command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the 5ppm solution is more than 1°C different from the Pt-1 calibration temperature, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

### Point 3

1. Remove the probe from the 5ppm solution and wash thoroughly in deionised water. Dry the probe then drop it into to the **cool 0.5ppm** solution.
2. Stir the probe until the temperature and F readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is at least 10°C cooler than the previous 5ppm calibration point.** If the solution is too warm, calibration will fail.
4. Referring to steps 4-7 above, select Pt-3 and press OK.

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the cool 0.5ppm solution is less than 10°C cooler than the Pt-1 and Pt-2 calibration temperatures, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

### 16.8.3. Two-point Calibration

Two-point calibration should be carried out weekly. For this, 0.5ppm and 5ppm solutions are required. The two solutions can be at any temperature between 5°C and 30°C but they both must be the same temperature (within 1°C).

If the temperature of the two solutions differ by more than 1°C, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

During two-point calibration, the MAP 2000/2100 and Macro 900 Meter must remain switched on. If the Macro 900 Meter is switched off between points, the calibration process will be aborted and must be re-started from point 1.

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 and 2 only.

### 16.8.4. Single-point Calibration

Single-point calibration should be carried out daily. For this, just 0.5ppm

solution is required. The solution can be at any temperature between 5°C and 30°C.

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 only.

#### **16.8.5. Errors During Calibration**

If a problem occurs during calibration, an error message will be displayed. Refer to **Error! Reference source not found.** in section 10 for error message handling.

## 17. Macro 900 Link PC Software

Macro 900 Link is a utility program designed to run under Microsoft® Windows® XP®, Vista® or 7 on a stand-alone PC with a minimum screen resolution of 1024 x 768, a CD drive and an available USB 2.0 socket.

### 17.1. Software Installation

**These instructions describe installation on a PC running Windows® Vista®. Other versions of Windows® may vary slightly.**

**IMPORTANT: Install the software BEFORE plugging your Macro 900 Meter into your PC.**

Place the Macro 900 Link CD in your PC's CD drive. Browse your CD drive and click on '**setup.exe**'. You will be given the usual Windows® security warnings. Allow the software to install. Once installed, Macro 900 Link will run automatically. **Leave the CD in your drive.** To communicate with the Macro 900 Meter, two further software 'drivers' need to be installed.

### 17.2. Driver Installation

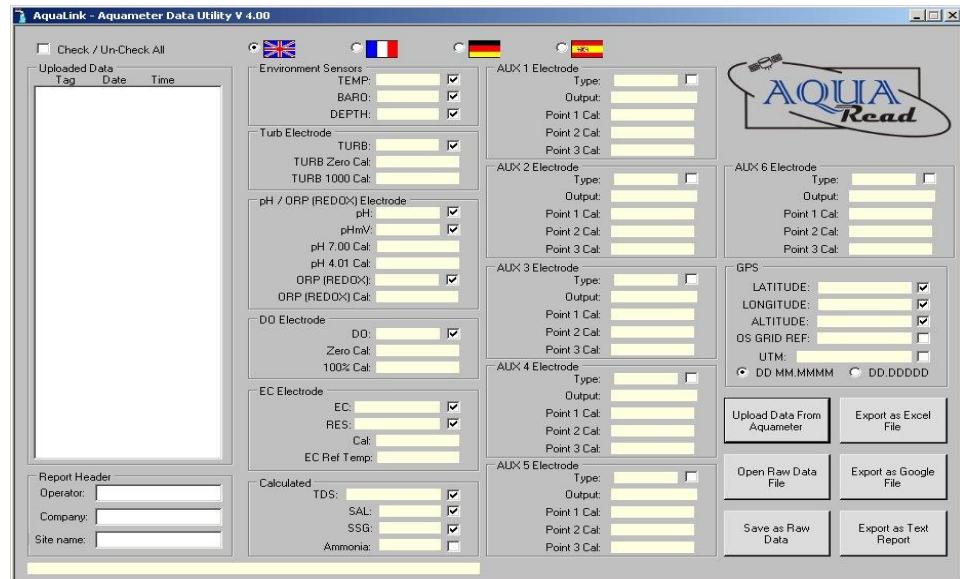
Ensure your Macro 900 Meter has batteries installed but is switched off. Connect the Macro 900 Meter to your PC using the USB cable supplied. The Macro 900 Meter will switch itself on automatically and display 'USB CONNECTED' on its screen as you plug into your PC.

The 'Found New Hardware' wizard on your PC will automatically activate. Select the recommended option: '**Locate and install driver software**'. **If given the option, do not allow Windows® to search the Internet for drivers.** The next screen will ask you to '**Insert the disk that came with your Macro 900 Meter**'. The CD should still be in your drive. Click on the '**Next**' button. Wait while the first driver is installed.

The next screen will ask you to '**Insert the disk that came with your USB Serial Port**'. The CD should still be in your drive. Click on the '**Next**' button. Wait while the second driver is installed. When this has completed, Macro 900 Link is ready to use. The CD can now be removed and is not required for subsequent operation.

### 17.3. Running Macro 900 Link

Select Macro 900 Link from your Programs menu. After an introductory splash-screen has been displayed, the following screen will appear:

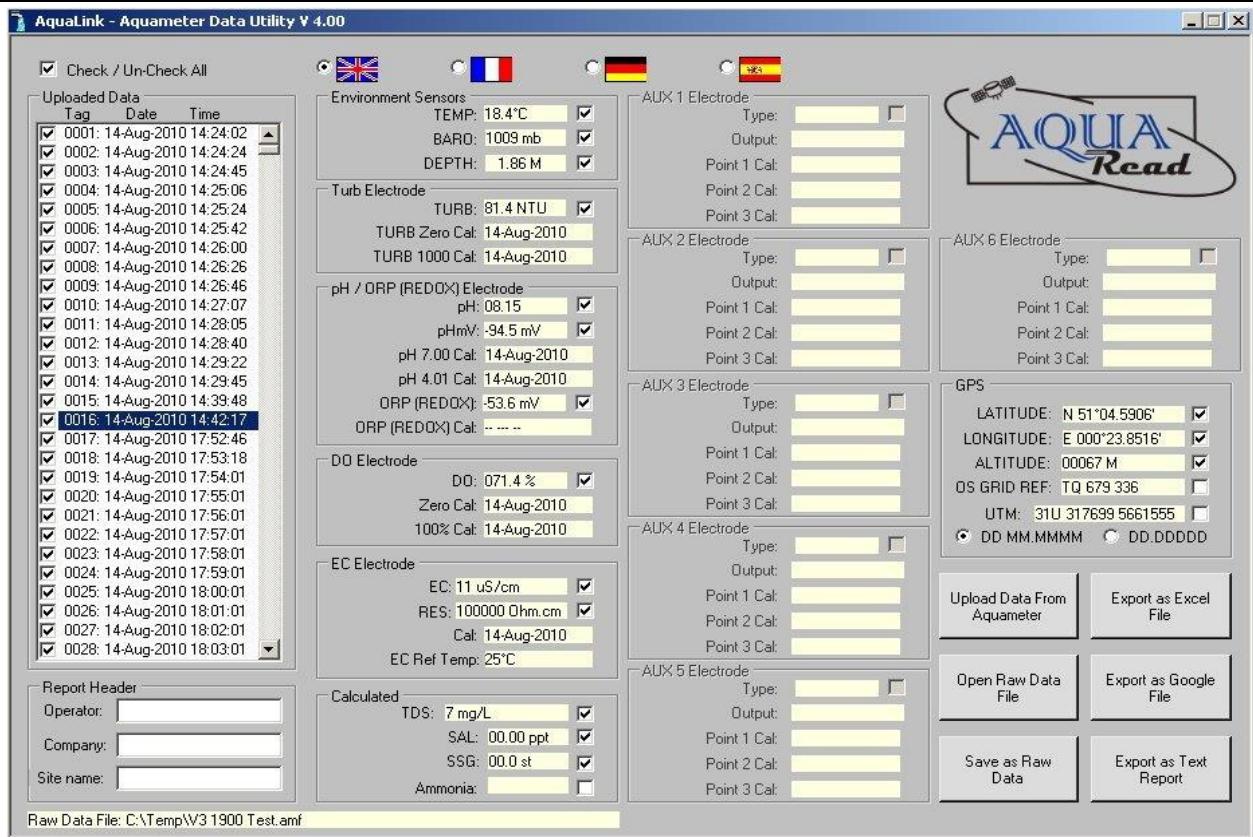


Select your preferred operating language by clicking on one of the national flags.

#### 17.4. Uploading Data From Your Macro 900 Meter

Ensure your Macro 900 Meter has batteries installed but is switched off. Connect the Macro 900 Meter to your PC using the USB cable supplied. The Macro 900 Meter should switch itself on automatically and display 'USB CONNECTED' on its screen.

Click the '**Upload Data From Macro 900 Meter**' button. Macro 900 Link will search for the Macro 900 Meter then upload all the available logged data from the Meter to your PC. A progress bar and file counter will be displayed during this process. Once upload is complete, the memory Tag, date and time for all the logged data that has been uploaded will be displayed in the **Uploaded Data** column on the left of the screen.



To view any of the logged data records, simply click on the desired Tag, date and time label as shown above. The data for the highlighted label will be displayed in the individual data boxes, which are grouped by electrode function. Any data that is unavailable or out of range will be displayed as dashes. To move up and down the Tag/date/time column, use either your mouse or the cursor up/down keys.

Remember, the Macro 900 Meter stores all logged data in a raw Probe format, so can be made to output logged data in several different forms, dependent upon the Meter's current settings. See [Important Information About Memory Mode](#) in section 8 for more information.

### 17.5. Displaying GPS Co-ordinates

On the right of the screen, the position at which the data was logged is displayed in the GPS boxes. Latitude and longitude can be displayed as Degrees and decimal Minutes (DD MM.MMMM) or as decimal Degrees (DD.DDDDD). Select one format or the other by clicking one of the two options at the bottom of the GPS box. Positional accuracy of lat/lion co-ordinates is +/- 10 meters with a 3D Position fix.

GPS position is also displayed as an Ordnance Survey Great Britain (OSGB) grid reference, (if the position falls within the United Kingdom) and UTM (Universal Transverse Mercator) co-ordinates. Positional accuracy of OSGB co-ordinates is +/- 1 digit (i.e. +/- 100 metres). Positional accuracy of UTM co-ordinates is +/- 10 metres with a 3D Position fix.

## 17.6. On Screen Help

Help has been provided in this software in the form of 'Tool Tips'. If you want to know what a control button does or what a data box displays, simply move your mouse pointer over the item in question. A multi-lingual Tool Tip will appear after a few seconds to give you more information.

## 17.7. Saving Logged Data

Once a set of logged data has been uploaded from the Macro 900 Meter, it can be saved on your PC as a Raw Data file. These files use a proprietary Palintest format and are saved with an .amf (Macro 900 Meter file) extension.

To save the uploaded data, click the '**Save as Raw Data**' button. You will be asked for a file name in the normal Windows® format. The file name you choose will automatically be given the .amf extension.

**Useful Tip:** Once you have saved the logged data, it is a good idea to clear the Macro 900 Meter's memory so next time you log data, you don't get both your old data and new data uploaded to your PC. See [Clearing the Memory](#) in section 8.

## 17.8. Retrieving Logged Data

Once a Raw Data file has been saved using the above technique, it can be easily retrieved by clicking on the '**Open Raw Data**' button. When a raw data file is opened, it will appear exactly as uploaded data and the file name will be displayed in the box below the Report Header box.

## 17.9. Exporting Data

Macro 900 Link can export data in three different formats. Before exporting data, the actual data to be exported must be selected.

First, select which data records you want to export by checking the relevant check-boxes in the Uploaded Data column. You can check or un-check all data records simultaneously by checking or un-checking the 'Check / Un-Check All' box above the Uploaded Data column.

Next, select which individual data classes you want to export by checking or un-checking the check-boxes next to each individual data box. You are now ready to export your data.

## 17.10. Exporting Text Reports

To export a text report, first fill in the boxes in the group marked **Report Header** on the left of the screen. This information will be used at the beginning of your report. Next, click on the '**Export as Text Report**' button. You will be asked to specify a file name. A .txt extension will automatically be added.

A report will be generated that consists of a cover page giving the start and end date, time and position, the total number of readings, an analysis of the highest and lowest readings, the variance between the highest and lowest readings, the average readings and the GLP data. Each block of individual readings, laid out in chronological order, follows this page.

This report can be imported into any text editor or word processor package.

**Useful Tip:** Of the two text editors supplied with Windows®, Microsoft® WordPad is the preferred text editor for viewing Macro 900 Link Text Reports as this handles text file formatting better than Microsoft® Notepad.

A typical report cover page follows.

## 17.11. Typical Text Report Cover Page

Macro 900 Link REPORT						
File name:	C:\Test\3 day test 024690136.txt					
Operator name:	G.E.M.					
Company name:	Palintest Ltd					
Site name:	Test Site 4					
Start date and time:	24-Jul-2009 10:09:33					
Start position:	Lat: N 51°21.4989' Lon: E 001°24.3232' OSGB: TR 370 677					
End date and time:	27-Jul-2009 13:01:00					
End position:	Lat: N 51°21.4988' Lon: E 001°24.3233' OSGB: TR 370 677					
Total number of readings: 877						
Highest readings						
Temp: 19.8C	Tag: 0648	Date: 26-Jul-2009	Time: 15:51:00			
Baro: 1020mb	Tag: 0315	Date: 25-Jul-2009	Time: 12:19:00			
Turb: 05.8 NTU	Tag: 0560	Date: 26-Jul-2009	Time: 08:46:00			
pH: 7.63	Tag: 0565	Date: 26-Jul-2009	Time: 09:09:00			
pHmV: -36.3mV	Tag: 0009	Date: 24-Jul-2009	Time: 10:49:01			
ORP: 365.7mV	Tag: 0320	Date: 25-Jul-2009	Time: 12:44:00			
DO: 79.4% Sat	Tag: 0742	Date: 27-Jul-2009	Time: 01:46:00			
EC: 810uS/cm	Tag: 0588	Date: 26-Jul-2009	Time: 10:51:00			
RES: 1,445 Ω•cm	Tag: 0285	Date: 25-Jul-2009	Time: 09:49:00			
TDS: 526mg/L	Tag: 0588	Date: 26-Jul-2009	Time: 10:51:00			
SAL: 0.40ppt	Tag: 0001	Date: 24-Jul-2009	Time: 10:09:33			
SSG: 0.0st	Tag: 0001	Date: 24-Jul-2009	Time: 10:09:33			
Lowest readings						
Temp: 17.9C	Tag: 0254	Date: 25-Jul-2009	Time: 07:14:01			
Baro: 1005mb	Tag: 0838	Date: 27-Jul-2009	Time: 09:46:00			
Turb: 04.1 NTU	Tag: 0830	Date: 27-Jul-2009	Time: 09:06:00			
pH: 7.55	Tag: 0003	Date: 24-Jul-2009	Time: 10:19:01			
pHmV: -40.8mV	Tag: 0556	Date: 26-Jul-2009	Time: 08:24:00			
ORP: 354.4mV	Tag: 0820	Date: 27-Jul-2009	Time: 08:16:00			
DO: 30.1% Sat	Tag: 0427	Date: 25-Jul-2009	Time: 21:39:00			
EC: 782uS/cm	Tag: 0149	Date: 24-Jul-2009	Time: 22:29:01			
RES: 1,358 Ω•cm	Tag: 0651	Date: 26-Jul-2009	Time: 18:11:13			
TDS: 508mg/L	Tag: 0145	Date: 24-Jul-2009	Time: 22:09:01			
SAL: 0.39ppt	Tag: 0017	Date: 24-Jul-2009	Time: 11:29:01			
SSG: 0.0st	Tag: 0001	Date: 24-Jul-2009	Time: 10:09:33			
Variance Average values						
Temp: 1.9C	18.81C					
Baro: 15mb	1013mb					
Turb: 1.7 NTU	4.87 NTU					
pH: 0.08	7.60					
pHmV: 4.5mV	-39.09mV					
ORP: 11.3mV	358.45mV					
DO: 49.3% Sat	59.10% Sat					
EC: 28uS/cm	792.2uS/cm					
Res: 87 Ω•cm	1,415.4 Ω•cm					
TDS: 18mg/l	514.4mg/l					
SAL: 0.01ppt	0.391ppt					
SSG: 0.0st	0.00st					
Calibration (GLP) data						
Turb Zero: 24-Jul-2009	Turb 1000: 23-Jul-2009					
pH 7.00: 24-Jul-2009	pH 4.01: 23-Jul-2009					
DO Zero: 23-Jul-2009	DO 100%: 24-Jul-2009					
EC: 24-Jul-2009	ORP: 23-Jul-2009					

Blocks of individual readings, laid out in chronological order, follow this cover page. The readings picked out on the cover page can be cross-referenced to the blocks of individual readings using the Tag numbers.

### **17.12. Exporting Excel® Files**

To export an Excel® file, click on the '**Export as Excel File**' button. You will be asked to specify a file name. An .xls extension will automatically be added. Excel® files are exported in a Tab delimited text format. This means that each data field is separated by a Tab, and each data record appears on a new line.

Excel® files are saved with an .xls extension and can be opened directly in Microsoft® Excel®. When opening an .xls file created by Macro 900 Link for the first time, Excel® may automatically run a 'Text Import Wizard'. Follow the three simple steps to import the file. Save the file afterwards as a 'Microsoft Excel Workbook'.

### **17.13. Exporting Google™ Files**

To export a Google™ file, click on the '**Export as Google File**' button. You will be asked to specify a file name. A .kml extension will automatically be added. **Please note: only data logged with a valid GPS position can be exported to Google™ files.**

Google™ files are exported in Google's proprietary Keyhole Markup Language with a .kml extension, and can be directly imported into either Google™ Maps or Google™ Earth, where the data is overlaid on maps or satellite images respectively.

Google™ Maps has a maximum import limit of 200 data records per file. If you intend to view your data in Google™ Maps, you must select 200 or less records for export in each file. If you select more than 200 records, Google™ Maps will truncate your file as it is loaded. If you have selected more than 200 data records for export, Macro 900 Link will warn you of this limitation.

Google™ Earth does not suffer from the same limitation, so you can export a full set of records in your file.

### **17.14. Importing Files into Google™ Maps**

To view your files in Google™ Maps, you will need to log on to the Google™ website, select the Maps tag then create a Google™ Account. This is free of charge at present. Once you are signed in, follow these steps:

1. Click on '**My Maps**'.
2. Click on the '**Create New Map**' button.
3. Click on '**Import**'.
4. An Import KML box will appear. Click on '**Browse**'.
5. Browse for the file you exported from Macro 900 Link, and select it.
6. Back in the Import KML box, click the '**Upload from file**' button.
7. Once the file has been imported, click on '**Done**'

You will now be able to view your data overlaid on Google™ Maps. Each data point is represented by a yellow pushpin, and all the data points are listed in a column on the left of the map. To view the data associated with each pin, either click on the pin, or click on the data point in the list.

### **17.15. Importing Files into Google™ Earth**

To view your files in Google™ Earth, you will need to log on to the Google™ website and install the Google™ Earth application on your computer. This is free of charge at present.

Once you have downloaded Google™ Earth and have it running, follow these steps:

1. Click on '**File**'.
2. Select '**Open**' from the list.
3. Browse for the file you exported from Macro 900 Link, and select it.

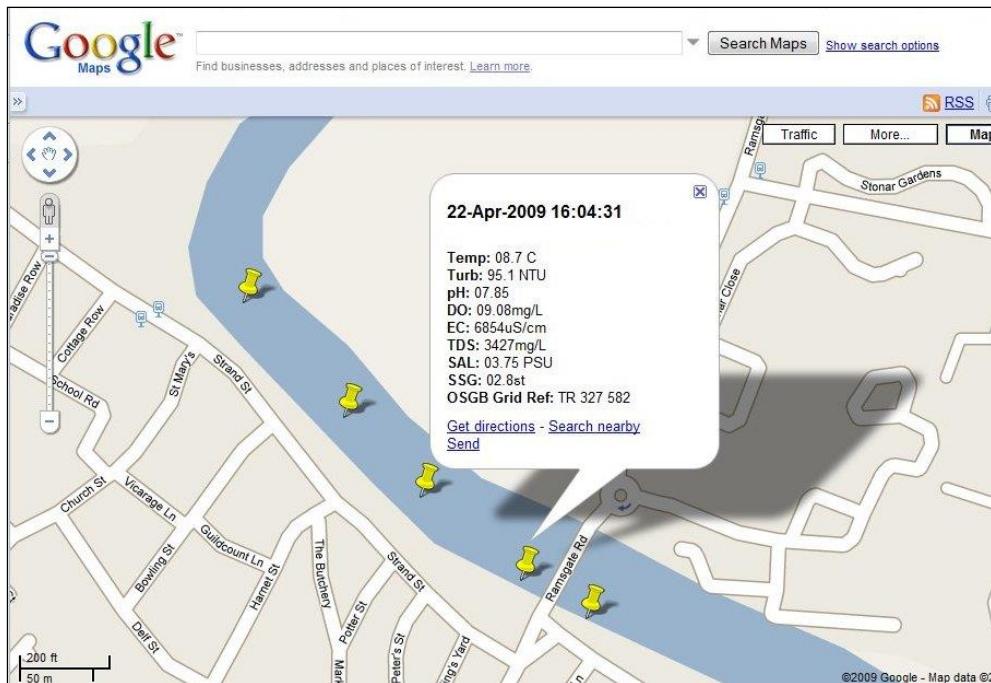
You will now be able to view your data overlaid on Google™ Earth Satellite images. Each data point is represented by a yellow pushpin, and all the data points are listed in a column on the left of the screen. To view the data associated with each pin, either click on the pin or click on the data point in the list.

Please note: Although you have downloaded the Google™ Earth application and are running it from your PC, you still need to be connected to the Internet in order for the application to access satellite images.

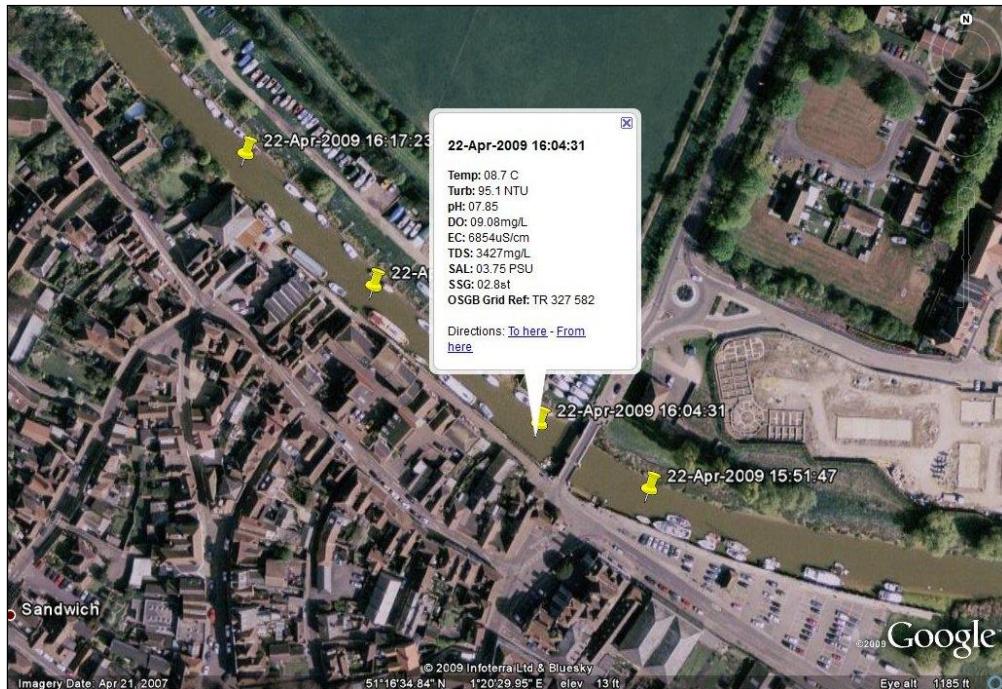
Typical Google™ Maps and Google™ Earth images follow.

## 17.16. Google™ Examples

The following two images show the same logged data displayed first in Google™ Maps, then in Google™ Earth.



The data displayed on Google™ Maps is useful, but for real detail, Google™ Earth is the answer.



Zooming in on the satellite photos in Google™ Earth is a great way to spot potential sources of pollution. If one of the readings you have taken shows an abnormality, the chances are that you will be able to spot the possible source of the problem (a riverside factory for example) directly on the satellite photo.

## 18. Limited Warranty

All Palintest Macro 900 Meters are guaranteed for three years, Probes, Flow-Through Cells and individual electrodes are guaranteed for one year from date of purchase against defects in workmanship and materials when used for their intended purpose and maintained according to instructions.

This warranty is limited to repair or replacement free of charge. Accidental damage, misuse, tampering, lack of prescribed maintenance, water ingress through unprotected Meter and Probe sockets, and damage caused by leaking batteries are not covered.

If service is required, contact your Palintest representative or Palintest Instrument Service. Report the model number, date of purchase, serial number and problem.

**Please note:** The majority of perceived problems can be rectified by careful study of this instruction manual, use of the [TROUBLESHOOTING](#) section below, or with a little help from our engineers over the phone. **Always contact our Service Department prior to returning any equipment.**

### 18.1. Cleaning Prior To Return

In order to protect the health and safety of our employees, any equipment returned for service must be thoroughly cleaned and decontaminated prior to despatch, and must be accompanied by a completed copy of the Decontamination Certificate printed below. Any equipment returned for service without a satisfactory Decontamination Certificate, or any equipment deemed by our engineers to be contaminated, will be quarantined pending receipt of a properly completed Decontamination Certificate.

**Never clean the Probe with concentrated acid or alkaline based cleaning products such as Decon 90. These products can strip the anodised finish from the Probe and damage some of the plastic components.**

**18.2. Decontamination Certificate**

Please print this certificate, complete all sections, and enclose it with any returned equipment.

**Decontamination Certificate**

Company Name: \_\_\_\_\_

Address:

---

---

---

---

---

---

---

---

Postal code: \_\_\_\_\_

Country: \_\_\_\_\_

Phone: \_\_\_\_\_ email: \_\_\_\_\_

Product: \_\_\_\_\_ Serial No.: \_\_\_\_\_

Contaminant \_\_\_\_\_ (if known): \_\_\_\_\_

Decontamination \_\_\_\_\_ Procedure: \_\_\_\_\_

Certified by (print name) : \_\_\_\_\_ Title: \_\_\_\_\_

Date: \_\_\_\_\_

Signature: \_\_\_\_\_

## 19. TROUBLESHOOTING

This section details some of the common difficulties you may encounter when using the Macro 900 Meter, MAPs and Macro 900 Link software.

Problem	Cause / Remedy
The Macro 900 Meter will not turn on when the on/off key is pressed.	✓ Batteries are probably dead or incorrectly fitted. Check you have fresh batteries fitted and that they are inserted the correct way round.
The Macro 900 Meter turns on but turns off again almost immediately.	✓ Batteries are probably nearly dead or incorrectly fitted. Check you have fresh batteries fitted and that they are inserted the correct way round.
The Macro 900 Meter cannot find the Macro Accessory Probe.	✓ Probably a poor connection. Switch the Macro 900 Meter off, disconnect the Macro Accessory Probe, ensure there is no debris or moisture in the plugs and sockets, then re-connect ensuring they are fully inserted and that the screw collars are fully tightened.
The GPS Macro 900 Meter will not show a position fix.	✓ The Macro 900 Meter probably does not have a good enough view of the available satellites. Ensure there are no obstructions between the Macro 900 Meter and the open sky. Remember, GPS <b>does not</b> work indoors.
The Macro 900 Link software cannot find the Macro 900 Meter.	✓ The USB drivers may not be properly installed. Reinstall the USB drivers carefully following the instructions. ✓ There may be a problem with the USB socket on the PC, try an alternative socket.
The 'USB CONNECTED' message does not appear on the Macro 900 Meter when it is connected to a PC.	✓ The batteries in the Macro 900 Meter may be dead or incorrectly fitted. Check you have fresh batteries fitted and that they are inserted the correct way round. The USB cable <b>does not</b> power the Macro 900 Meter. ✓ There may be a problem with the USB socket on the PC, try an alternative socket.
ERROR 01 appears on the Macro 900 Meter screen.	✓ This indicates that the pH electrode has dropped below 85% efficiency. Try cleaning the pH electrode and re-calibrating as described in the relevant section of this manual. If that does not cure the problem, replace the electrode.
ERROR 02 appears on the Macro 900 Meter screen.	✓ This indicates that the Optical DO electrode needs calibrating or the cap needs replacing. Perform a full DO calibration, first at DO Zero then at 100% DO. If that does not cure the problem, replace the Optical DO Cap
COMMS ERROR appears on the Macro 900 Meter screen.	✓ This indicates that the MAP has stopped responding to requests for data from the Macro 900 Meter. Check the MAP plug is fully inserted. Restart the meter to reset the MAP.
Battery electrolyte leakage detected in the battery compartment.	✓ Remove and discard the batteries immediately. Thoroughly clean the battery compartment and terminals. If the battery terminals are corroded, contact our Service Department for return instructions.
Dissolved Oxygen readings are inaccurate or unstable.	✓ The DO electrode may need calibrating. Recalibrate. ✓ The DO membrane may be dirty. Clean the DO membrane. ✓ Calibration may have been carried out at an extreme temperature. Recalibrate at a temperature as close to the sample temperature as possible.

Problem	Cause / Remedy
pH and/or ORP readings are slow, inaccurate or unstable or calibration is impossible.	<ul style="list-style-type: none"> <li>✓ The electrodes may need re-calibrating. Recalibrate.</li> <li>✓ The electrodes may need cleaning. Clean as described in the relevant section of this manual.</li> <li>✓ The electrodes may have been allowed to dry out. Re-hydrate as described in the relevant section of this manual.</li> <li>✓ The electrodes may be damaged. Replace the electrodes.</li> <li>✓ The electrode may be loose allowing water to enter the electrode socket. Remove the electrode, blow out the socket with compressed air then leave the probe and electrode in a warm place for at least 48 hours to dry out.</li> </ul>
EC readings are inaccurate or unstable.  OUT OF CAL RANGE error shows during calibration of EC.	<ul style="list-style-type: none"> <li>✓ Have you got the Probe Sleeve fitted? EC will not work without the Probe Sleeve fitted.</li> <li>✓ The Probe may not be inserted deep enough into the sample being measured. Ensure the sample level reaches the minimum depth line on the outside of the Probe®.</li> <li>✓ Trapped air bubbles may be causing problems. Tap and swish the Probe to dislodge them.</li> <li>✓ The Probe Sleeve may be loose. The Probe Sleeve must be absolutely rigid with respect to the Probe Body for correct EC operation. If you can move the Probe Sleeve to and fro whilst holding the Probe Body, tighten then recalibrate.</li> <li>✓ The EC electrode may need recalibrating. Recalibrate.</li> <li>✓ The EC electrode may be dirty. Clean the EC electrode then recalibrate.</li> </ul>
Turbidity readings are inaccurate or unstable.	<ul style="list-style-type: none"> <li>✓ Have you got the Probe Sleeve and end cap fitted? Turbidity will not work without the Probe Sleeve and end cap fitted.</li> <li>✓ Trapped air bubbles may be causing interference. Tap and swish the Probe to dislodge them.</li> <li>✓ The sample being measured may contain air bubbles. Under these conditions, optical turbidity measurements can not be taken.</li> <li>✓ The Probe may not be inserted deep enough into the sample being measured. Ensure the sample level reaches the minimum depth line on the outside of the Probe.</li> <li>✓ The Probe Sleeve may be loose. The Probe Sleeve must be absolutely rigid with respect to the Probe Body for correct turbidity operation. If you can move the Probe Sleeve to and fro whilst holding the Probe Body, tighten then recalibrate.</li> <li>✓ The Turbidity electrodes may need recalibrating. Recalibrate.</li> <li>✓ The lenses on the turbidity electrodes may be dirty. Clean the lenses then recalibrate.</li> </ul>

## 20. DECLARATION OF CONFORMITY

Palintest Ltd declares that the equipment described herein is in compliance with the essential requirements and other relevant provisions of Directives



## 21. Appendix 1. The Tech Behind Palintest's Optical DO Measurement System

### 21.1. Principle of Operation

The Palintest Micro 800 Optical DO Meter measurement system works on the principle of Dynamic Luminescence Quenching. A gas-permeable chemical known as a luminophore is excited with short bursts of blue light, which causes molecules in the luminophore to emit red photons. The presence of oxygen in contact with the luminophore causes the emission of the red photons to be quenched or delayed. By measuring the delay of the returned red photons with respect to the blue excitation, it is possible to determine the level of dissolved oxygen present.

Whilst this sounds very simple in principle, the optical system and the high-speed electronics required to obtain good accuracy are extremely complex.

Housed in a resin filled, marine grade aluminium body that measures just 8mm (0.3") diameter by 13mm (0.5") long, the fully waterproof Optical DO Sensor Module contains blue excitation and red reference LEDs, optical filters, a photon detector, temperature sensor, driver circuitry and high gain amplification circuitry.



The Optical DO Sensor Module

The incredibly small size of the Sensor Module allows it to fit comfortably into the end of a standard 12mm diameter DO electrode in place of a traditional Clark Cell. The addition of a replaceable cap containing a lens coated with the luminophore material completes the DO section of the electrode.

## **21.2. Sensor Cap Life**

All optical dissolved oxygen sensors work on the same principle, and all must have the sensor cap containing the luminophore replaced periodically due to a phenomenon known as photo bleaching.

When a sensor cap is new, the luminophore will return a large number of red photons when excited. As time goes on, a bleaching effect takes place and the number of red photons returned reduces to a point where they are no longer detectable.

The amount of photo bleaching that the luminophore suffers is in direct proportion to the amount of time it is excited by the sensor's blue light source. It therefore follows that the faster a reading can be taken, the less time the luminophore needs to be excited and the longer it will last.

The high-speed circuitry within the Optical DO module requires just eleven milliseconds to take a reading! This incredibly fast reading time increases the useful life of the luminophore considerably.

Another technique used to prolong the life of the luminophore in the Optical DO module is variable excitation brightness. When the luminophore is new, the brightness of the excitation is reduced to a minimum in order to prevent unnecessary photo bleaching. As the output from the luminophore gradually reduces, the brightness of the excitation is increased in order to squeeze the maximum possible life from the sensor cap.

The combination of low duty cycle and variable excitation brightness can stretch the useful life of a sensor cap as far as several years.

## 22. Appendix 2. Flow Through Cell

### 22.1. Introduction

The Palintest Flow Through Cell (Flowcell) is designed for use with any model of Macro Accessory Probe and most third party pumping devices.

The Flowcell allows sample water to flow up through the probe, passing over all the individual electrodes simultaneously. This eliminates air contact with pumped samples from groundwater boreholes allowing truly representative measurements to be obtained.

Made from marine grade aluminium and 6mm wall thickness acrylic, the Flowcell is ruggedly constructed for hard use in the field. The base flange includes four holes to allow the unit to be pegged down if necessary.

### 22.2. Spigot Installation

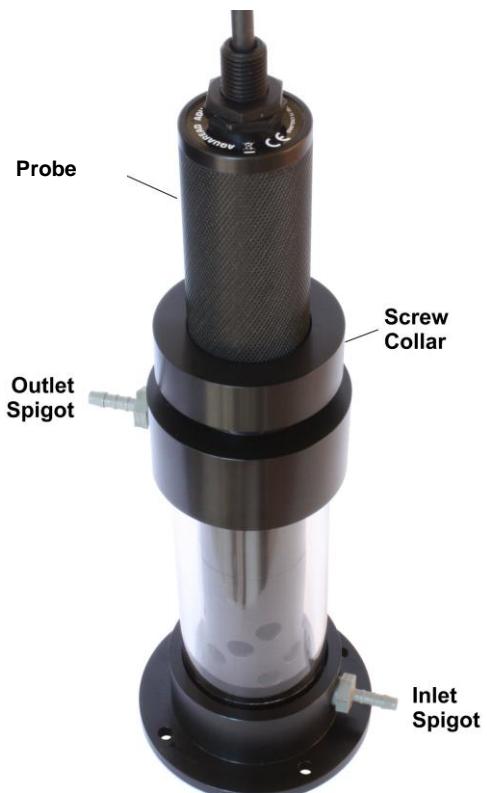
The Palintest Flowcell is supplied with two pairs of spigots, one pair to fit 6mm (1/4") ID tube and one pair to fit 10mm (3/8") ID tube.

The spigots have a tapered thread so should be screwed into the inlet and outlet holes of the Flowcell until they are tight. At this point, they should seal due to the taper. If a spigot will not seal properly, remove it then re-insert with some PTFE plumber's tape wrapped around the thread.

### 22.3. Probe Installation

The probe sleeve and protective Sleeve End Cap must be fitted to the MAP.

Loosen the screw collar located at the top of the Flowcell and slide the MAP in all the way, ensuring it is properly seated in the recess where the clear tube enters the base. Tighten the collar to clamp the MAP in place.



### 22.4. Operation

Connect the Flowcell to a pumping device so that sample water enters at the bottom and exits at the top. Adjust the flow rate so that there is no visible turbulence or cavitation within the Flowcell. Connect a Macro 900 Meter and monitor the readings. If the readings are jumpy or erratic, reduce the flow rate. The ideal flow rate is around 30 litres/hour (8 US gallons/hour), although the MAP is capable of operating at flow rates as low as 15 litres/hour (4 US

gallons/hour). Flow rates above 60 litres/hour (16 US gallons/hour) are not recommended.

## 22.5. Caution

The maximum operating pressure of the Flowcell is 300mb (4.4 PSI). Select your pumping device accordingly. If necessary, use a three-way bypass valve so that this limit is not exceeded.

## 22.6. Cleaning

After use, rinse the Flowcell thoroughly with fresh water. To remove stubborn deposits, scrub the inside of the Flowcell with a bottlebrush and non-abrasive detergent, then rinse thoroughly.

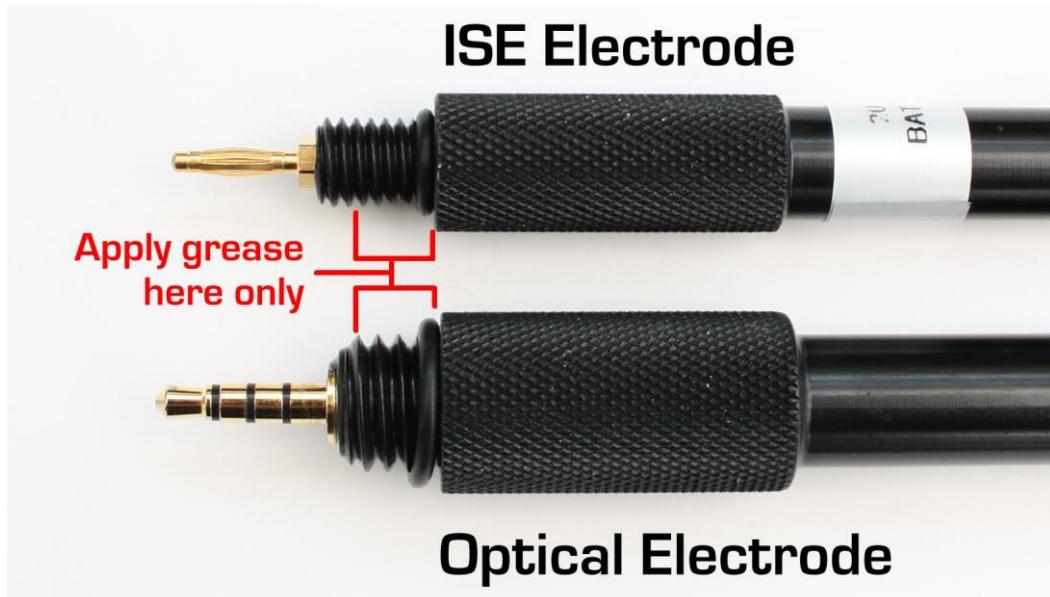
**Never clean the Flowcell with concentrated acid or alkaline based cleaning products such as Decon 90. These products can strip the anodised finish from the Flowcell and damage the plastic components.**

## 22.7. Flowcell Troubleshooting

Problem	Cause / Remedy
DO readings are abnormally high or are fluctuating wildly.	Aeration of sample water. Check all joints for air leaks. Reduce flow rate to avoid cavitation.
Turbidity readings are abnormally high.	Air bubbles adhering to the Turbidity Electrode lenses. Agitate Flowcell to dislodge. Aeration of sample water. Check all joints for air leaks. Reduce flow rate to avoid cavitation.
Sample water is leaking from around the top of the screw collar.	Screw collar is not tight enough. Tighten up. Grease / PTFE tape has not been applied to the joint between the Probe Sleeve and Probe Body (single part sleeves only). See 'MAP Preparation Prior to First Use' on previous page. Operating pressure is too high. Reduce pressure / flow rate.
Probe is forced up out of the Flowcell during use.	Operating pressure is much too high. Reduce pressure / flow rate.

## 23. Appendix 3. Fitting AUX Electrodes

There are two different types of AUX Electrodes designed for use with the MAP 2000/2100. These are Optical Probes and ISE Electrodes. Optical Probes can be identified by the four-section gold connector whilst ISE Electrodes feature a single pin gold connector.



Optical Probes are designed to fit into the MAP 2000/2100 socket labelled AUX1. ISE Electrodes are designed to fit into the MAP 2000/2100 socket labelled AUX2.

### 23.1. Installing AUX Electrodes

First, identify the type of electrode you are installing, then remove the blanking plug from the relevant AUX socket on the MAP 2000/2100. To remove the blanking plug and subsequently tighten the AUX Electrode, use the red lanyard that is attached to the pH/ORP storage cap as a belt wrench as shown below.



Apply a small amount of silicone grease (supplied with the MAP 2000/2100) to the threaded section and the O-ring of the AUX Electrode (see photograph).

**ENSURE NO GREASE IS APPLIED TO THE GOLD CONTACTS.**

Using a clean cloth or tissue paper, polish the gold contacts ensuring they are completely clean. Carefully insert the electrode into the AUX socket and tighten firmly until the O-ring is completely compressed.

### 23.2. Socket Assignment and Calibration

After installation, it is essential to connect the MAP 2000/2100 to a Macro 900 Meter and assign the new electrode type to the relevant AUX Socket. On the Macro 900 Meter, press the MENU key, then select Setup & Install followed by Socket Assignment. When the Socket Assignment option has been selected, the following screen will be displayed.

**SOCKET  
ASSIGNMENTS**

→1:EMPTY | 4:N/A  
2:EMPTY | 5:N/A  
3:N/A | 6:N/A

Using the up and down arrow keys, select the AUX socket you wish to assign then move the cursor to the right by pressing the right arrow key. When the cursor has moved to the right of the AUX socket number, use the up and down arrow keys to select the appropriate electrode type. The tables below show the available electrode options and the selection that should be made on this screen:

MAP 2000/2100 type Optical Probes (AUX1 only)

Electrode Part No.	Function	Macro 900 Meter Selection
PT 1551	Turbidity	TURB
PT 1556	Chlorophyll	Cphl
PT 1552	Phycocyanin (Blue-Green Algae PC)	BGA-PC
PT 1553	Phycoerythrin (Blue-Green Algae PE)	BGA-PE
PT 1554	Rhodamine WT Dye	Rhod
PT 1555	Fluorescein Dye	Fcein
PT 1556	Refined Oil	OIL

MAP 2000/2100 type ISE Electrodes (AUX2 only)

Electrode Part No.	Function	Macro 900 Meter Selection
PT 1541	Ammonium/Ammonia	NH4
PT 1543	Chloride	Cl
PT 1545	Fluoride	F
PT 1542	Nitrate	NO3
PT 1544	Calcium	Ca2

When the desired electrode type is showing, move the cursor back to the left of the socket number then press OK to send the selection to the MAP 2000/2100. The socket assignments are stored in the MAP 2000/2100. If you press the ESC

key whilst in this screen, any changes you have made will not be transferred to the MAP 2000/2100.

Finally, refer to the relevant section of this manual and carry out a full two-point (optical) or three-point (ISE) calibration of the new electrode. **YOUR NEW ELECTRODE WILL NOT GIVE SENSIBLE READINGS UNTIL IT HAS BEEN FULLY CALIBRATED.**

**Please note: changing an AUX Socket assignment will clear all the calibration data for that socket.**

If you subsequently remove an electrode, be sure to replace the blanking plug and set the socket assignment back to EMPTY.

## 24. Appendix 4. Standard Electrodes Detailed Specification

<b>Optical Dissolved Oxygen</b>	Range	0 – 500.0% / 0 – 50.00 mg/L
	Resolution	0.1% / 0.01mg/L
	Accuracy	0 - 200%: $\pm 1\%$ of reading. 200% - 500%: $\pm 10\%$
<b>Conductivity (EC)</b>	Range	0 – 200 mS/cm (0 - 200,000 $\mu$ S/cm)
	Resolution	3 Auto-range scales: 0 – 9999 $\mu$ S/cm, 10.00 – 99.99 mS/cm, 100.0 – 200.0mS/cm
	Accuracy	$\pm 1\%$ of reading or $\pm 1\mu$ S/cm if greater (see note 2)
<b>TDS*</b>	Range	0 – 100,000 mg/L (ppm)
	Resolution	2 Auto-range scales: 0 – 9999mg/L, 10.00 – 100.00g/L
	Accuracy	$\pm 1\%$ of reading or $\pm 1\text{mg/L}$ if greater (see note 2)
<b>Resistivity*</b>	Range	5 $\Omega\text{-cm}$ – 1 $\text{M}\Omega\text{-cm}$
	Resolution	2 Auto-range scales: 5 – 9999 $\Omega\text{-cm}$ , 10.0 – 1000.0 $\text{K}\Omega\text{-cm}$
	Accuracy	$\pm 1\%$ of reading or $\pm 1 \Omega\text{-cm}$ if greater (see note 2)
<b>Salinity*</b>	Range	0 – 70 PSU / 0 – 70.00 ppt (g/Kg)
	Resolution	0.01 PSU / 0.01 ppt
	Accuracy	$\pm 1\%$ of reading or $\pm 0.1$ unit if greater (see note 2)
<b>Seawater Specific Gravity*</b>	Range	0 – 50 $\sigma_t$
	Resolution	0.1 $\sigma_t$
	Accuracy	$\pm 1.0 \sigma_t$
<b>pH</b>	Range	0 – 14 pH / $\pm 625\text{mV}$ (see note 3)
	Resolution	0.01 pH / $\pm 0.1\text{mV}$
	Accuracy	$\pm 0.1 \text{ pH} / \pm 5\text{mV}$
<b>ORP</b>	Range	$\pm 2000\text{mV}$ (see note 3)
	Resolution	0.1mV
	Accuracy	$\pm 5\text{mV}$
<b>Temperature</b>	Range	-5°C – +50°C (23°F – 122°F)
	Resolution	0.1 ° C/F
	Accuracy	$\pm 0.5^\circ \text{C}$

\* Readings calculated from EC and temperature electrode values  
 Palintest Ltd reserves the right to change specifications without notice

### Notes:

1. The accuracy figures quoted throughout this document represent the equipment's capability at the calibration points at 25°C. These figures do not take into account errors introduced by variations in the accuracy of calibration solutions and errors beyond the control of the manufacturer that may be introduced by environmental conditions in the field. Accuracy in the field is also dependent upon **full calibration** and minimal time between calibration and use.
2. The EC electrode can be calibrated at various points for use in fresh, brackish or salt water. The accuracy of the electrode, and therefore all derived readings, relies upon the readings being within a reasonable range of the calibration point. For taking measurements in fresh surface or ground water, use Palintest MacroCal solution. If this is not available, use a third party 1413 $\mu$ S/cm EC Calibration Standard. For taking readings in brackish or salt water, use 12,880 $\mu$ S/cm (12.88mS/cm) EC Calibration Standard.
3. The measurement of pH and ORP relies upon the ability of the electrode to

pass a minute electrical current through the water under test. For this reason, when using the standard pH/ORP electrode, the water under test must have a minimum EC (electrical conductivity) of 100 $\mu$ S/cm. Special low EC pH electrodes are available to special order.

## 25. Appendix 5. Optical Probes Detailed Specification and FAQs

### 25.1. What are the excitation and detection wavelengths?

Each Palintest Optical Probe (with the exception of Turbidity) is effectively a stand-alone, fixed frequency fluorometer, specially tuned to excite and detect fluorescence of selected substances in water.

The Turbidity electrode is not a fluorometer. This electrode employs a Nephelometric measurement technique in accordance with ISO 7027.

The following table shows the excitation peak wavelengths and detection ranges for each electrode.

Electrode	Excitation Peak Wavelength	Detection Range
Chlorophyll	470nm	>630nm
Blue-Green Algae Phycocyanin (BGA-PC)	590nm	>655nm
Blue-Green Algae Phycoerythrin (BGA-PE)	520nm	>575nm
Fluorescein Dye	470nm	>550nm
Rhodamine WT	520nm	>575nm
Refined Oil	285nm	330nm – 370nm
Turbidity	850nm	850nm

Each fluorometer electrode (with the exception of the Refined Oil Electrode) emits short pulses of high energy light at the excitation wavelength and responds to fluorescence in the detection range. The deep UV excitation of the Refined Oil Electrode is permanently on.

### 25.2. How does the Refined Oil sensor work?

The Refined Oil sensor detects volatile organic compounds (VOCs) that are found in petroleum derivatives. These include benzene, toluene, ethylbenzene, and xylenes (BTEX).

The sensor is a fixed frequency *in situ* fluorometer that uses deep UV wavelengths (285nm) to excite the VOCs. An emission filter is then used to detect any fluorescence generated by the VOCs between 330 and 370nm.

The electrode measures the VOCs immediately in front of the sensor face so will measure at whatever depth the probe is lowered to. Naturally, the probe will only detect compounds that are actually mixed/dissolved in the water, not those floating on the surface.

The Refined Oil electrode is ideal for customers who are interested in detecting the presence or absence of VOC's and measuring relative fluorescence changes that can be used as an indication of increasing or decreasing concentrations.

The electrode is not intended for absolute, quantitative measurements. This can only really be done using Gas or Liquid Chromatography in a laboratory.

### 25.3. I can see algae in the water but my sensor is giving low readings. Why?

Palintest Chlorophyll and Blue-Green Algae sensors are not designed to measure floating macroscopic (visible to the naked eye) algae or plant material.

The sensors measure the fluorescence from the microscopic phytoplankton suspended within the body of the water below the surface. Carpets of floating algae are often seen on environmental water that has low subsurface phytoplankton concentrations. In these circumstances, the fluorescent algae sensors will return low readings.

### 25.4. What is the Range and Resolution of the Optical Probes?

<b>Turbidity</b>	Range	0 – 3000 NTU
	Resolution	2 Auto-range scales: 0.0 99.9 NTU, 100 – 3000 NTU
	Repeatability	± 5% of reading
	MLD <sup>(1)</sup>	0.0 NTU
	MLR <sup>(2)</sup>	5.0 NTU
<b>Chlorophyll</b>	Range	0 – 500 µg/L (ppb)
	Resolution	0.1 µg/L
	Repeatability	± 5% of reading (see note 3)
	MLD <sup>(1)</sup>	0.1µg/L
	MLR <sup>(2)</sup>	5 µg/L
<b>Phycocyanin (BGA-PC) (Freshwater Blue-Green Algae)</b>	Range	0 – 300,000 cells/mL
	Resolution	1 cell/mL
	Repeatability	± 10% of reading (see note 3)
	MLD <sup>(1)</sup>	200 cells/mL
<b>Phycoerythrin (BGA-PE) (Marine Blue-Green Algae)</b>	Range	0 – 200,000 cells/mL
	Resolution	1 cell/mL
	Repeatability	± 10% of reading (see note 3)
	MLD <sup>(1)</sup>	400 cells/mL
<b>Rhodamine WT Dye</b>	Range	0 – 500 µg/L (ppb)
	Resolution	0.1 µg/L
	Repeatability	± 5% of reading (see note 3)
	MLD <sup>(1)</sup>	0.1 µg/L
	MLR <sup>(2)</sup>	5 µg/L
<b>Fluorescein Dye</b>	Range	0 – 500 µg/L (ppb)
	Resolution	0.1 µg/L
	Repeatability	± 5% of reading (see note 3)
	MLD <sup>(1)</sup>	0.1 µg/L
	MLR <sup>(2)</sup>	5 µg/L
<b>Refined Oil</b>	Range	0 – 10,000 µg/L (ppb) (Naphthalene)
	Resolution	0.1 µg/L
	Repeatability	± 10% of reading (see note 3)
	MLD <sup>(1)</sup>	100 µg/L (Naphthalene)

Palintest Ltd reserves the right to change specifications without notice

#### Notes:

1. MLD (Minimum Level of Detection) is the minimum value the electrode is physically capable of measuring.
2. MLR (Minimum Level of Repeatability) is the value below which optical electrode readings

become generally unreliable and unrepeatable (unless taken under ideal conditions) due to interfering factors such as refraction from visible air bubbles and microscopic aeration.

### **25.5. What is the Accuracy of the Optical Probes?**

All Optical Probes, with the exception of the Turbidity Electrode, employ fluorescent measurement techniques. Interference from microbiological species and compounds which fluoresce at similar wavelengths and differences in fluorescence caused by temperature, ambient light and turbidity can all cause inaccuracies.

Fluorescence measurement is ideal for researchers who are interested in detecting the presence or absence of a specific substance in reasonable concentrations and measuring relative fluorescence changes that can be used as an indication of increasing or decreasing concentrations.

Fluorescence measurement techniques are not ideal for quantitative measurement and it is therefore impossible to specify an absolute accuracy.

**In order to obtain accurate results, data obtained with a fluorescent electrode in the field must be post-calibrated with data from standard laboratory analysis of grab samples acquired during the study.**

## 26. Appendix 6. ISE Electrodes Detailed Specification

<b>Ammonium / Ammonia<sup>†</sup></b>	Range	0 – 9,000mg/L (ppm)
	Resolution	2 Auto-range scales: 0.00 - 99.99 mg/L, 100.0 – 8,999.9 mg/L
	Accuracy	± 10% of reading or 2ppm (whichever is greater)
	MLD <sup>(1)</sup>	1.0 ppm
	Interfering Ions <sup>(2)</sup>	Potassium, Sodium and Magnesium
	pH Range <sup>(3)</sup>	5 – 8
<b>Chloride</b>	Range	0 – 20,000mg/L (ppm)
	Resolution	2 Auto-range scales: 0.00 - 99.99 mg/L, 100.0 – 19,999.9 mg/L
	Accuracy	± 10% of reading or 2ppm (whichever is greater)
	MLD <sup>(1)</sup>	2.0 ppm
	Interfering Ions <sup>(2)</sup>	Bromide, Iodide, Cyanide and Sulphide
	pH Range <sup>(3)</sup>	2 - 11
<b>Fluoride</b>	Range	0 – 1,000mg/L (ppm)
	Resolution	2 Auto-range scales: 0.00 - 99.99 mg/L, 100.0 – 999.9 mg/L
	Accuracy	± 10% of reading or 2ppm (whichever is greater)
	MLD <sup>(1)</sup>	0.05 ppm
	Interfering Ions <sup>(2)</sup>	Hydroxide (OH-)
	pH Range <sup>(3)</sup>	4 - 8
<b>Nitrate</b>	Range	0 – 30,000mg/L (ppm)
	Resolution	2 Auto-range scales: 0.00 - 99.99 mg/L, 100.0 – 29,999.9 mg/L
	Accuracy	± 10% of reading or 2ppm (whichever is greater)
	MLD <sup>(1)</sup>	0.5 ppm
	Interfering Ions <sup>(2)</sup>	Chloride, Bromide, Fluoride, Sulphate, Chlorate and Perchlorate
	pH Range <sup>(3)</sup>	3 - 10
<b>Calcium</b>	Range	0 – 2,000mg/L (ppm)
	Resolution	2 Auto-range scales: 0.00 - 99.99 mg/L, 100.0 – 1,999.9 mg/L
	Accuracy	± 10% of reading or 2ppm (whichever is greater)
	MLD <sup>(1)</sup>	0.05 ppm
	Interfering Ions <sup>(2)</sup>	Magnesium, Barium, Lead, Zinc and Sodium
	pH Range <sup>(3)</sup>	4 - 9

<sup>†</sup> Ammonia readings are calculated from Ammonium, pH and temperature electrode values.  
Palintest Ltd. reserves the right to change specifications without notice

### Notes:

1. MLD (Minimum Level of Detection) is the minimum value the electrode is physically capable of measuring.
2. Each ion selective electrode is prone to interference from ions that are similar in nature to the target ion. The main interfering ions for each electrode type are listed here. If the water under test contains interfering ions, the electrode will produce erroneous readings. **Ion Selective Electrodes are not recommended for use in brackish or salt water** due to the high level of interfering ions.

3. Each ion selective electrode will only operate within a specific pH and EC range. The pH limits vary and are listed against each electrode. All ion selective electrodes work in conjunction with the pH electrode during measurement. For this reason, the selected MAP must have a working pH or pH/ORP electrode fitted and the conductivity (EC) of the water under test must be greater than 50 $\mu$ S/cm.
4. All ion selective electrodes exhibit calibration drift over time. Drift should not be a major problem where the electrodes can be frequently calibrated. However, if the electrodes are to be used in long-term deployment studies, drift is almost certain to occur.

5. During long term deployment of ion selective electrodes, the user should obtain grab samples during the course of the deployment for analysis in the laboratory by chemical means and use the results to apply post calibration to the recorded results.
6. Accuracy in the field is dependent upon full three-point calibration and minimal time between calibration and use.
7. In order to achieve accurate readings with ISE electrodes, the Probe needs to be either placed in flowing water, or needs to be stirred or raised and lowered continuously to ensure a minimum flow rate of 0.3m/s over the electrode. **If there is no water flow across the ISE electrode, the ions in the immediate area of the electrode will be depleted and the reading will start to fall. This also applies to calibration, where the probe should be stirred at all times.**

### 26.1. Special Notes Concerning ISE Electrodes during pH Calibration

The high ionic concentration of pH calibration solutions (buffers), including MacroCal, can cause significant offsets in ISE electrodes.

These offsets are temporary, but best avoided because they can cause significant errors during both calibration and normal operation.

For this reason all ISE electrodes are supplied with a red rubber sealing cap.

**The caps should be fitted to all ISE Electrodes during pH calibration or when using MacroCal** in order to protect the ISE electrodes from the effects of the buffer solution.

At all other times, the ISE electrodes should be left uncovered.

