

# **AutoSigma 3000/3000DL**

## **Operating Handbook**

**HOCKING**

Drawing No. XX  
Manual Re-order No. 47DH01  
Edition X Amd.X,

**Electrical Conductivity Meter**

# AutoSigma 3000

Copywrite:

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# 1.0 Introduction

## IMPORTANT NOTE

PLEASE READ THE FOLLOWING INFORMATION PRIOR TO USE OF ANY PRODUCT MANUFACTURED BY HOCKING NDT LTD.

Hocking NDT Operating Handbooks provide functional information about a particular instrument or group of instruments. However, proper set-up and use of this equipment and the performance of electromagnetic tests requires familiarity with factors which are beyond the scope of Operating Handbooks. These factors include the following:

- A. Selection of appropriate cables, probes, fixtures, mechanical handling equipment and other accessories.
- B. Selection of proper test frequency, test mode and other test parameters.
- C. Preparation of the test surface.
- D. Characteristics of the test material for example: conductivity, hardness, permeability, geometry, magnetic properties, heat treatment etc.

- E. Environmental factors such as temperature humidity, dust and electrical interference.
- F. Any individual factors that will depend on the particular test object or test being performed.

It is therefore imperative that operators are properly trained in both general procedure for electromagnetic training testing and in the set up and execution of the particular test to be performed. It is the responsibility of the instrument user to ensure that test operators are trained to a sufficiently high standard, suitable equipment is used in the correct manner and that any test variables which may affect specific tests are taken into account. Similarly, compliance with standards such as ASTM, ASNT, API, ASME, BS etc., as well as the observance of any test procedure specified by any government, manufacturer or other regulating authority is the responsibility of the user.

Periodic calibration, cleaning and maintenance may be necessary to ensure proper operation of the equipment. Environmental conditions and regularity of use should be considered when determining the frequency of such checks, then this should be observed.

Incidents such as physical shock, immersion in liquid and exposure to damaging environments such as excessive heat, moisture, dirt or dust can adversely affect equipment performance. The equipment must be examined for damage and recalibrated after any such incident. Do not use any product which you know or suspect to be faulty.

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### **EC Declaration of Conformity**

We Hocking NDT Ltd  
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United Kingdom

declare under sole responsibility that the **AUTOSIGMA 3000DL Conductivity Meter** meets the intent of Directive 89/336/EEC for Electro-magnetic Compatibility.

Compliance was tested to:  
EN 50081 - 1 Emissions  
EN 50082 - 1 Immunity

---

Reference samples used for calibration should, ideally, have the same material properties as the object to be tested, or a known relationship to it, established by a laboratory test.

Equipment calibration should be checked frequently during testing to assure valid test measurements.

As a matter of good practice and wherever possible, suspected defects in critical areas should be cross checked using appropriate alternative indication techniques.

Any question about the use, operation, specifications or special considerations relative to the particular Hocking NDT product you are using should be addressed to your local sales representative, the distributor or Hocking direct.

Eddy current based instrumentation works by measuring minute electromagnetic fields. Interfering signals, even at a level satisfying CE mark requirements, may be able to mask or distort this information. The user is responsible for ensuring that no such effect is occurring.

Hocking NDT pursues a policy of continued development of its products. The company reserves the right to change specifications without prior notice.

## 1.1 How to use this manual

In order to simplify this operating manual, the operational steps, information listings etc, always have the same format. This will enable you to quickly find information.

**Operation steps:**-Altering the Set Up parameters.







Operation steps are laid out in tables as shown in the following example: To set the High alarm to trip at 80.5.

This action table indicates in step form :

To "SWITCH ON" with a press of "ON / OFF" button.

Press the "MENU" button.

Press "INCREMENT/DECREMENT" button repeatedly until the required parameter is accessed.

STEP	WHAT to do	HOW to do it	DISPLAY Shows								
1	From "Off" select measurement mode.	 Press									
2	Enter parameter menu's	 Press	<table border="1"> <tr><td>BACKLIGHT</td><td>OFF</td></tr> <tr><td>HIGH ALARM</td><td>OFF</td></tr> <tr><td>LOW ALARM</td><td>30.7</td></tr> <tr><td>TEMP</td><td>21.5 C</td></tr> </table>	BACKLIGHT	OFF	HIGH ALARM	OFF	LOW ALARM	30.7	TEMP	21.5 C
BACKLIGHT	OFF										
HIGH ALARM	OFF										
LOW ALARM	30.7										
TEMP	21.5 C										
3	Step through the menu to the "High alarm" parameter	 Press	<table border="1"> <tr><td>BACKLIGHT</td><td>OFF</td></tr> <tr><td>HIGH ALARM</td><td>OFF</td></tr> <tr><td>LOW ALARM</td><td>30.7</td></tr> <tr><td>TEMP</td><td>21.5 C</td></tr> </table>	BACKLIGHT	OFF	HIGH ALARM	OFF	LOW ALARM	30.7	TEMP	21.5 C
BACKLIGHT	OFF										
HIGH ALARM	OFF										
LOW ALARM	30.7										
TEMP	21.5 C										
4	Move across to the setting field	 Press	<table border="1"> <tr><td>BACKLIGHT</td><td>OFF</td></tr> <tr><td>HIGH ALARM</td><td>80.5</td></tr> <tr><td>LOW ALARM</td><td>30.7</td></tr> <tr><td>TEMP</td><td>21.5 C</td></tr> </table>	BACKLIGHT	OFF	HIGH ALARM	80.5	LOW ALARM	30.7	TEMP	21.5 C
BACKLIGHT	OFF										
HIGH ALARM	80.5										
LOW ALARM	30.7										
TEMP	21.5 C										
5	Increment/decrement to required level	 Press	<table border="1"> <tr><td>BACKLIGHT</td><td>OFF</td></tr> <tr><td>HIGH ALARM</td><td>80.5</td></tr> <tr><td>LOW ALARM</td><td>30.7</td></tr> <tr><td>TEMP</td><td>21.5 C</td></tr> </table>	BACKLIGHT	OFF	HIGH ALARM	80.5	LOW ALARM	30.7	TEMP	21.5 C
BACKLIGHT	OFF										
HIGH ALARM	80.5										
LOW ALARM	30.7										
TEMP	21.5 C										
6	Return to normal measurement mode	 Press	Normal measurement display.								

Press the SET button to move to the value setting field.

The "INCREMENT or DECREMENT" buttons are then used to set the required value.

Press the "MENU" button to return the instrument to its "Measurement Mode" ready to take readings.

Display figures in this manual may show XXXX, YYYY or ZZZZ as numerical values etc. these indicate that any valid number or menu item may be displayed.

### Lists

Lists are arranged as follows with bulleted indents.

- 101.6 %IACS. Highest reading
- 101.2 %IACS. Mean reading
- 99.8 %IACS Lowest reading

### ***Remarks***

*Under this heading you will find special recommendations concerning measurement techniques, or references to important information in other chapters of the manual.*

### **Button Operation (Key - pad)**

- Press :- Button contact then immediate release.
- Long Press :- Button contact for a period of three seconds or more then release.

# 2.0 Standard Package and Accessories

<u>Standard Pack</u>	<u>Order No</u>	<u>Recommended Accessories</u>	<u>Order No</u>
AutoSigma 3000DL	47I001DL	Soft Case with Shoulder Strap	47A009
Probe 12.7mm (60/500KHz)	47P001	Probe 8mm (500KHz)	47P002
Cable (Probe)	47A001	Cable (Printer)	33A145
Probe finger support	47A005	Cable (Data Logger)	47A003
Curve measurement adapter	47A006	Computer Interface Cable (P.C.)	33A146
Hard plastic packall Case	47A008	Computer Interface Instructions	–
Calibration Certificate	–	Operator Reference Block Plate and set of five Operator Reference Blocks.	44A016

See Data Sheet for details

## 3.0 Preparation for Operation

### Power Requirements

The AutoSigma 3000 (AS3000) can only be operated by battery, using 3 “AA” size cells, Alkaline (preferred), Dry Cell, or Ni-Cad.

#### *Remark*

*If Ni-Cad batteries are used the battery level indication will not be correct, and they should be removed for charging when the level indicator shows about 25%. The AS3000 has no provision for in situ charging.*

### 3.1 Battery Installation

Undo “Battery Cover Screws” and lift off the cover (the screws are captive in the lid).

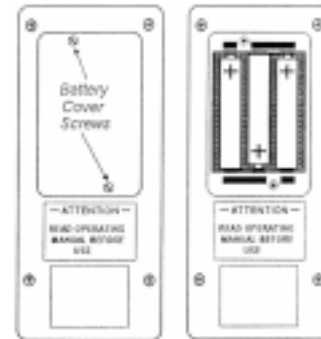
Insert 3 off “AA” alkaline cells as shown. (Alternative cells may be used if alkaline batteries are not available,

but unit operating time may be reduced and battery level indication inaccurate).

If the batteries are installed incorrectly with the polarity reversed, no damage to the AS3000 will occur, but the instrument will not function.

After the batteries have been installed, replace the battery cover and refit the screws. The Icon on the display shows the battery charge.

 **Full.**  **Empty.**



### *Remark*

*When the battery empty state is displayed, the batteries should be replaced at once. The AS3000 automatically turns off when the batteries become too weak for reliable operation. When using the equipment in remote locations it is advisable to carry spare batteries. Discharged or faulty batteries are classified as “Special Waste” and must be disposed of accordingly.*

## **3.2a) Probe Connection**

The connecting cable for the probe is a 5 way LEMO to 5 way LEMO and may be used either way round.

Align the red dots of the LEMO plug and the socket of the cable and plug together, they are polarised and will therefore not engage unless correctly mated. Similarly attach the cable to the instrument. The connectors are self locking and will not become detached without being released by pulling the serrated section of the plug.

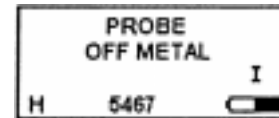
### *Remark*

*Before a probe can be used to take accurate measurements, its Code Number (if not already contained in the probe file) must be entered into the instruments operational memory - see Section 3.3. Instruments supplied from the factory with a probe will already have the code number entered. 12.7 mm diameter probes have a 4 digit code and 8 mm diameter probes a 2 digit code.*

*If an instrument “RESET” is carried out the Probe data will be returned to “5555 or 55” thus requiring the probe code number/s to be re-entered.*

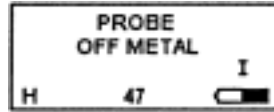
## **3.2b) Probe identification**

12.7mm Probe:- Dual Frequency 60 and 500kHz (L/H) has a four digit code. (See Below).



Probe code shown ↑ here on the display.

8mm Probe:- Single Frequency 500kHz (H) only, has a two digit code.



Probe code shown ↑ here on the display.

*Remark*

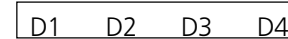
*The H or L indication at the left bottom of the display indicates which operational frequency has been selected for measurement, either frequency for the 12.7mm probe. 500kHz (H) only may be used for the 8mm probe.*

### 3.3 Entering probe Code Data






e.g. 12.7mm H/L probe, code number is 6547. The code is stored in the format below, there are code slots for 3 large and 3 small diameter probes, and their selection is sequential.



and is equivalent to data stores



STEP	WHAT to do	HOW to do it	DISPLAY Shows
1	From "Off" select measurement mode.	Press	PROBE OFF METAL H 5555 I
2	Enter parameter menu's	Press	BACKLIGHT OFF HIGH ALARM OFF LOW ALARM 30.7 TEMP 21.5 C
3	Step through the menu to the "Probe" parameter	Press	RECALL FREQ 1 E FREQUENCY 500K PROBE 5555 STORE 1 E
4	Move to the setting field	Press	RECALL FREQ 1 E FREQUENCY 500K PROBE 5555 STORE 1 E
If the probe code displayed has only two digits present, then after step (4) select the slot required by inc/dec to one of the 3 available four digit slots. Return to the parameter field by pressing "SET" and continue to PROBE D1 as normal Step (5).			
5	Step through the menu to the "Probe D1" parameter	Press	PROBE D1 5 ↓ 5 D2 5 D3 5 CODE D4 5





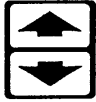

STEP	WHAT to do	HOW to do it	DISPLAY Shows
6	Move across to the setting field	 Press	<pre> PROBE  D1  █ 5         D2   5         ↓         D3   5 CODE    D4   5 </pre>
7	Increment D1 value to 6	 Press	<pre> PROBE  D1  █ 6         D2   5         ↓         D3   5 CODE    D4   5 </pre>
8	Move back to parameter field.	 Press	<pre> PROBE  D1  6         D2   5         ↓         D3   5 CODE    D4   5 </pre>
9	Enter the values for D2,D3 and D4 using the same method.		<pre> PROBE  D1   6         D2   5         ↓         D3   4 CODE    D4  █ 7 </pre>
10	Store these settings in the internal memory.	 Long Press (Single beep will occur when complete).	<pre> PROBE  D1   6         D2   5         ↓         D3   4 CODE    D4  █ 7 </pre>
11	Return to normal measurement mode (ready for "SET PROBE" routine.)	 Press	<pre> PROBE OFF METAL I H 6547 █ </pre>

### 3.4 General Parameter Setting

e.g. changing language to German (D) from "Off" condition

*Remark*

*This sequence is used to set any of the adjustable menu parameters as listed in section "3.5c" (page 3.7).*

STEP	WHAT to do	HOW to do it	DISPLAY Shows								
1	From "Off" select measurement mode.	 Press	Normal measurement display.								
2	Enter parameter menu's	 Press	<table border="1"> <tr><td>BACKLIGHT</td><td>OFF</td></tr> <tr><td>HIGH ALARM</td><td>OFF</td></tr> <tr><td>LOW ALARM</td><td>30.7</td></tr> <tr><td>TEMP</td><td>21.5 C</td></tr> </table>	BACKLIGHT	OFF	HIGH ALARM	OFF	LOW ALARM	30.7	TEMP	21.5 C
BACKLIGHT	OFF										
HIGH ALARM	OFF										
LOW ALARM	30.7										
TEMP	21.5 C										
3	Step through the menu to the "Language" parameter	 Press	<table border="1"> <tr><td>AUDIO ALARM</td><td>OFF</td></tr> <tr><td>POWER DOWN</td><td>15</td></tr> <tr><td>LANGUAGE</td><td>GB</td></tr> <tr><td>BAUD</td><td>1200</td></tr> </table>	AUDIO ALARM	OFF	POWER DOWN	15	LANGUAGE	GB	BAUD	1200
AUDIO ALARM	OFF										
POWER DOWN	15										
LANGUAGE	GB										
BAUD	1200										
4	Move across to the setting field	 Press	<table border="1"> <tr><td>AUDIO ALARM</td><td>OFF</td></tr> <tr><td>POWER DOWN</td><td>15</td></tr> <tr><td>LANGUAGE</td><td><b>GB</b></td></tr> <tr><td>BAUD</td><td>1200</td></tr> </table>	AUDIO ALARM	OFF	POWER DOWN	15	LANGUAGE	<b>GB</b>	BAUD	1200
AUDIO ALARM	OFF										
POWER DOWN	15										
LANGUAGE	<b>GB</b>										
BAUD	1200										
5	Increment/Decrement to the required language.German	 Press	<table border="1"> <tr><td>AUDIO ALARM</td><td>OFF</td></tr> <tr><td>POWER DOWN</td><td>15</td></tr> <tr><td>LANGUAGE</td><td><b>D</b></td></tr> <tr><td>BAUD</td><td>1200</td></tr> </table>	AUDIO ALARM	OFF	POWER DOWN	15	LANGUAGE	<b>D</b>	BAUD	1200
AUDIO ALARM	OFF										
POWER DOWN	15										
LANGUAGE	<b>D</b>										
BAUD	1200										
6	Return to normal measurement mode	 Press	Normal measurement display.								

### 3.5 Start-up

a) A "Normal" switch on



[Press] will bring the instrument into operation in the measurement mode with the parameter values as they were when it was last switched off.

b) A "Reset" switch on, (returns the instrument to it's default settings, not active in "User" mode).

STEP	WHAT to do	HOW to do it	DISPLAY Shows
1	From "Off" initialise sequence for access.	Press and hold	
2	Enter parameter reset mode	Press then release SET button when Beep is heard.	TO CONFIRM RESET PRESS SET ELSE PRESS MENU
3	Confirm reset	Press	Normal measurement display.

The instrument will revert to the default parameter values as below.

- Backlight Off.
- High Alarm Off.
- Low Alarm Off.
- Temperature Units. Celsius.
- Recall 1.
- Frequency 60 kHz.

- Probes, 3 each. 5555 / 55
- Store 1.
- Units %IACS.
- Contrast 7.
- STD 1 60.50.
- STD 2 8.870
- Audio Alarm Off
- Power Down 15 minutes
- Language English (GB).
- Baud Rate 1200.
- D1,D2,D3,D4 5,5,5,5

c) The following list shows the settings available for each parameter.

- | Parameter           | Available States      |
|---------------------|-----------------------|
| • Backlight         | On/Off                |
| • High Alarm        | 1.0 - 110% IACS / Off |
| • Low Alarm         | Off / 1.0 - 110% IACS |
| • Temperature Units | Celsius / Fahrenheit  |
| • Recall            | 1-10.                 |
| • Frequency         | 60 / 500kHz           |
| • Probe Codes       | 3 large and 3 small.. |
| • Store             | 1-10.                 |
| • Units             | %IACS or MS/m.        |
| • Contrast          | 3-10.                 |

- STD 1 30-65% IACS
- STD 2 6-50% IACS.
- Audio Alarm On/Off
- Power Down 15/10/5/1 minutes
- Language English (GB) /German (D) /French (F) etc.
- Baud Rate 9600/4800/2400/1200

### **3.6 Basic Measurement Knowledge**

Conductivity of metals is commonly measured in two sets of units. In the SI system the unit of conductivity is the MegaSiemens/meter (reciprocal ohm-meter). Conductivities of metals at ambient temperature are typically in the range of 1 to 60 MegaSiemens per meter.

For convenience metal conductivities are often expressed as a percentage of the conductivity of a standard sample of copper - the International Annealed Copper Standard (IACS). 100% IACS corresponds to 58 MS/m. Note that since this 'pure' copper standard was established in 1913 pure copper now often has a conductivity greater than 100% IACS

The AutoSigma 3000 measures the conductivity of non-magnetic metals and alloys in the range 0.8 to 110.0 %IACS. It uses the Eddy Current technique for measuring the conductivity of materials in %IACS, or MSiemens/meter, (set from the instruments " Menu" selections).

It is important to understand that eddy current measurement is essentially a 'skin' effect. The eddy current field intensity is greatest at the surface and decreases exponentially with depth. The depth at which the field strength reduces to 1/e (37%) of its surface value is referred to as the 'standard depth of penetration'. This depends primarily on the operating frequency and the conductivity of the metal.

It is generally considered that materials of thickness greater than 3 standard depths of penetration can be measured without any correction factors being required

For example at 60kHz this figure (the "effective depth of penetration") is around 0.05" (1.25mm) in Aluminium Alloys (conductivity approximately 35% IACS) and 0.32" (8mm) in Titanium alloy, (conductivity

approximately 1% IACS). At 500kHz the corresponding values are 0.02" (0.5mm) and 0.11" (2.8mm)

Care must also be taken when measuring non-homogeneous materials, for example materials which have been surface heat-treated, clad or plated, or where the surface is rough or corroded. Measurements at different frequencies will give different results due to the different distribution of energy within layers of different conductivity. Care must be taken to always measure such materials at the same frequency (usually 60kHz).

The conductivity of a material changes considerably with temperature, but is normally specified at 20 degrees Celsius. The AS3000 indicates the materials 20°C conductivity value by applying a standard correction algorithm, valid for the most common aluminium alloys. For the best accuracy, the instrument, material to be tested, probe, and calibration standards should be at the same temperature, close to 20°C.

Other key factors are coating thickness/lift-off and material curvature.

Measurements can be made through layers of paint or other non-conductive coatings up to a thickness of 0.020" (0.5mm) with the 12.7mm probe and 0.010" with the 8mm probe.

Use on curved surfaces requires some caution, with concave surfaces the effect is primarily lift-off and the instrument will compensate up to the point where the spacing of the centre of the probe from the material becomes excessive. With convex surfaces the indicated conductivity will decrease as the radius decreases. Correction tables are required for radii below approximately 3" (75mm).

To ensure proper operation the calibration standards, instruments and probes should be checked and recalibrated on a regular basis (e.g. check on standards before each use and factory re-calibration every year).

## 4.0 Basic Functions

### 4.1 Measurement Method

The instrument uses a probe which is excited by an AC signal (60kHz "L" or 500kHz "H") from the main unit. This AC signal uses the material to be measured as a coupling medium to a detector coil also in the probe. From the phase and amplitude of the detected signal the instrument calculates the conductivity of the coupling medium.

Only conductivity of non-magnetic metallic materials can be measured using this system. Conductivity changes considerably with temperature so the probe is fitted with a thermistor. It's temperature is monitored in order to display a mathematically adjusted conductivity reading relative to 20°C. The instrument will indicate the necessity for a "Probe Reset" after a temperature change of +/- 3°C. The "SET ROUTINE" should be carried out just before a measurement if absolute accuracy is required.

A certain amount of surface unevenness and non-metallic coatings up to 0.020" (0.5mm) are allowed for

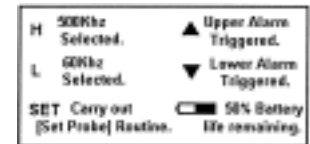
in the measurement system (0.010" only with the 8mm probe). When the probe has exceeded this "lift-off" distance, PROBE OFF METAL will be displayed.

### 4.2 Display

The display is a back lit LCD, the back light can be set "ON" or "OFF". When in MEASUREMENT Mode the display will indicate the numerical value of the material being measured in "%IACS" ( I ) or "MSiemens/m" ( S ) depending on the units selected. "PROBE OFF METAL" is displayed if the probe is in air and not in close proximity to a measurable material.

Other display modes can be selected which are used for setting up operational parameters, or logging files (see Chapter 5). In these Modes the display will highlight the parameter being set and its current status. In the measurement mode "Alarm States" are indicated by icons at the bottom of the display. The frequency, probe code selected, measurement units and state of charge of the battery are also shown at the bottom of the display.

#### Lower Display Icons



## 4.3 Keypad

The AS3000 has a membrane keypad, consisting of 8 legend pads. The large central pad with the up and down arrows has 2 switches, one under each arrow. The upper arrow is the [INCREMENT] control and the lower arrow is the [DECREMENT] control, they operate on the parameter field or value selected. The other pads only have one switch each. The basic function of the other keys are as follows.

### Key operation on standard model



This button switches the instrument "ON" and "OFF"; a short press is used to switch "ON" and a long press switches the instrument "OFF".



This button is used to select "Set-Up Parameters" and return the instrument to its "MEASUREMENT" mode.



This button toggles the display between the menu parameter and its value field, and is also used in conjunction with the [ON] button to

"Reset" the instrument to its "Default settings".



This button, on the basic version, is used to enter the probe data into the internal memory.

### Additional key operations on DL Option

Note:- if these keys are pressed on the Basic Model the screen will indicate Data Logger is not fitted.



This button selects the "Memory Menu" (files must have been allocated, and the file selection be on a particular file not "All Files".)



This button selects the "FILE" menu (with "All Files" cleared it will access the "Number of files" set up)



Depending on which menu is currently selected, a long press of this button will clear a single FILE, all FILES or a single MEMORY location.

When the instrument is in the correct mode, a press on this button will log the current valid reading into the active memory location within the active file. The active location is automatically incremented, but if the location is full then an error message is displayed indicating that the location or file is FULL. It is also used to enter the probe code into the internal memory.

*Remark*

*For correct button sequences see Chapter 5 “Operation”.*

## 5.0 Operation

### 5.1 Switching On

(for normal use)



The instrument switches on in the normal Measurement mode and will operate according to previously set parameters. A "SET PROBE" routine should be carried out before use (See Para 5.5) The display will show the conductivity of the material on which the probe is placed or "PROBE OFF METAL" if the probe is in air. The display also shows information such as the Operating Frequency, Measurement Units, Probe Code Number, Battery State and Alarms (see below). Also the word "SET" will appear on the bottom line if the probe temperature has drifted +/- 3°C since the last SET routine was carried out. If the "SET" icon appears then the "SET PROBE" routine should be carried out to restore high accuracy measurement.

### Example

Taking a reading of 60.5% IACS (I) at a frequency of 500kHz (H) with a probe whose code number is 5467.

At the bottom right a battery level of 50% is indicated and to its left the presence of the s Icon indicates the upper alarm level has been exceeded.



### Normal Measurement Display



**Display showing excessive temperature change.  
Set Probe routine must be carried out.**

## 5.2 Switching Off



Long press

The instrument will Beep twice if settings have been changed and power down.

## 5.3 Changing working parameters

(Follow the sequence in Section 3.4)

### *Remark*

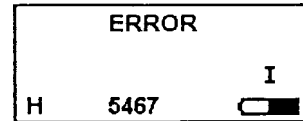
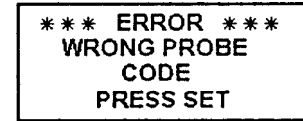
*The settings of some parameters are dependent on others and if a conflict is encountered “ERROR” messages will appear on the screen and/ or the instrument will “Beep”. Some are as follows:*

*With an 8mm (TWO digit) probe code in place, you cannot select a Frequency of 60kHz (only useable with 12.7mm Probe). If it is attempted the instrument will “Beep” and not carry out the change. It is then necessary to move to the “PROBE” parameter and recall the correct FOUR digit code number appropriate to the 12.7 mm probe to be used.*

*When the “SET PROBE” routine is being carried out, if the wrong probe code is in place ie:- TWO digit number is present (8mm probe) when trying to SET a 12.7mm probe which should have a FOUR digit code number or vice-versa. The display will show an error (see Fig below), and will prompt a press of the “SET” button which will move the display to the “PROBE” field ready to select the code number for the probe being ”SET”.*

*When the code number has been incremented to the correct one, a press on the MENU button will take the instrument back to the normal measurement display which has the code indicated on the bottom line and will show ERROR. (See Fig. below)*










*To re-commence the “SET PROBE” routine, once the correct probe code has been entered, press ”SET”*



## 5.4 Entering Reference Block Values

Before the AutoSigma 3000 can be set, the reference block values need to be entered. It is recommended that the STD blocks supplied with the unit are used as these will provide the most effective and accurate setting. As an alternative User Reference Blocks may be used, these will limit the instruments range and can reduce accuracy.

5.4a) Ensure that the instrument is set to the correct units for the block values to be entered. If not change the "UNITS" parameter value field before moving to the "STD" parameters and entering

STEP	WHAT to do	HOW to do it	DISPLAY Shows								
1	Enter parameter menu's	 Press	<table border="1"> <tr><td>BACKLIGHT</td><td>OFF</td></tr> <tr><td>HIGH ALARM</td><td>OFF</td></tr> <tr><td>LOW ALARM</td><td>30.7</td></tr> <tr><td>TEMP</td><td>21.5 C</td></tr> </table>	BACKLIGHT	OFF	HIGH ALARM	OFF	LOW ALARM	30.7	TEMP	21.5 C
BACKLIGHT	OFF										
HIGH ALARM	OFF										
LOW ALARM	30.7										
TEMP	21.5 C										
2	Step through the menu to the "STD1" parameter	 Press	<table border="1"> <tr><td>UNITS</td><td>IACS</td></tr> <tr><td>CONTRAST</td><td>7</td></tr> <tr><td>STD 1</td><td>60.50</td></tr> <tr><td>STD 2</td><td>8.870</td></tr> </table>	UNITS	IACS	CONTRAST	7	STD 1	60.50	STD 2	8.870
UNITS	IACS										
CONTRAST	7										
STD 1	60.50										
STD 2	8.870										
3	Move across to the setting field	 Press	<table border="1"> <tr><td>UNITS</td><td>IACS</td></tr> <tr><td>CONTRAST</td><td>7</td></tr> <tr><td>STD 1</td><td>60.50</td></tr> <tr><td>STD 2</td><td>8.870</td></tr> </table>	UNITS	IACS	CONTRAST	7	STD 1	60.50	STD 2	8.870
UNITS	IACS										
CONTRAST	7										
STD 1	60.50										
STD 2	8.870										
4	Decrement to required level	 Press	<table border="1"> <tr><td>UNITS</td><td>IACS</td></tr> <tr><td>CONTRAST</td><td>7</td></tr> <tr><td>STD 1</td><td>60.10</td></tr> <tr><td>STD 2</td><td>8.870</td></tr> </table>	UNITS	IACS	CONTRAST	7	STD 1	60.10	STD 2	8.870
UNITS	IACS										
CONTRAST	7										
STD 1	60.10										
STD 2	8.870										
5	Return to parameter field	 Press	<table border="1"> <tr><td>UNITS</td><td>IACS</td></tr> <tr><td>CONTRAST</td><td>7</td></tr> <tr><td>STD 1</td><td>60.10</td></tr> <tr><td>STD 2</td><td>8.870</td></tr> </table>	UNITS	IACS	CONTRAST	7	STD 1	60.10	STD 2	8.870
UNITS	IACS										
CONTRAST	7										
STD 1	60.10										
STD 2	8.870										
6	Step to the "STD2" parameter	 Press	<table border="1"> <tr><td>UNITS</td><td>IACS</td></tr> <tr><td>CONTRAST</td><td>7</td></tr> <tr><td>STD 1</td><td>60.10</td></tr> <tr><td>STD 2</td><td>8.870</td></tr> </table>	UNITS	IACS	CONTRAST	7	STD 1	60.10	STD 2	8.870
UNITS	IACS										
CONTRAST	7										
STD 1	60.10										
STD 2	8.870										
7	Move across to the setting field	 Press	<table border="1"> <tr><td>UNITS</td><td>IACS</td></tr> <tr><td>CONTRAST</td><td>7</td></tr> <tr><td>STD 1</td><td>60.10</td></tr> <tr><td>STD 2</td><td>8.870</td></tr> </table>	UNITS	IACS	CONTRAST	7	STD 1	60.10	STD 2	8.870
UNITS	IACS										
CONTRAST	7										
STD 1	60.10										
STD 2	8.870										
8	Increment to required level	 Press	<table border="1"> <tr><td>UNITS</td><td>IACS</td></tr> <tr><td>CONTRAST</td><td>7</td></tr> <tr><td>STD 1</td><td>60.10</td></tr> <tr><td>STD 2</td><td>8.910</td></tr> </table>	UNITS	IACS	CONTRAST	7	STD 1	60.10	STD 2	8.910
UNITS	IACS										
CONTRAST	7										
STD 1	60.10										
STD 2	8.910										
9	Return to normal measurement mode	 Press	Normal measurement display.								

the block values. From the normal measurement mode proceed as follows, eg:- setting STD1 (60.1) and STD2 (8.91).

### **5.4b) User Reference Blocks**

Can be used to set the Autosigma 3000, provided that STD 1 is within the range 30 to 63% IACS, STD 2 is within the range 6 to 50% IACS and STD 1 is at least 10% IACS above STD 2. The values are entered in the unit in the same way as the STD blocks; detailed in 5.4a) and the probe setting as in 5.5

### **5.4c) Considerations**





If User Reference Blocks are used, accuracy can be compromised and range limited.

The absolute accuracy of the instrument will be dependent on the accuracy of the User Reference Blocks and will no longer be to the accuracy stated in the Specification section of these instructions. It is not recommended that measurements are made outside the range of the two sample values; as the accuracy will be totally dependent on the absolute accuracy of the User Reference Blocks.

For the Relative Reading Accuracy to be the same as for Hocking STD blocks, the two User Reference Block values must be accurate and lie either side of the measurement range. e.g. If the measurement range is to be between 40 and 45% IACS then STD1 should ideally be 50% IACS:or more and STD2 35% IACS: or less. It is possible to Set the AutoSigma 3000 by using one User Reference Block and one Hocking STD block, provided that the above rules are complied with, the absolute accuracy will again be dependent on the accuracy of the User Reference Block.

### **5.5 Probe Setting (SET PROBE)**

Before the probe setting on the Reference blocks can take place, the value of the blocks must be entered in the STD 1 and STD 2 menu slots in the units selected (ie IACS or MS/m) The probe code must also be appropriate to the probe in use - see 3.2a. Proceed following (5.4) to set the Reference block values. Then with the instrument ON and in the MEASUREMENT Mode:

STEP	WHAT to do	HOW to do it	DISPLAY Shows
1	From measurement mode initiate probe setting.	 Press	SET PROBE PUT PROBE IN AIR PRESS SET
2	Hold probe in Air to set liftoff.	 Press and wait for sounder to Beep.	SET PROBE PUT PRB ON STD1 PRESS SET
3	Move probe onto the STD1 block.	 Press and wait for sounder to Beep	SET PROBE PUT PRB ON STD2 PRESS SET
4	Move probe onto STD2 block.	 Press and wait for sounder to Beep then remove probe.	Instrument will return to the measurement mode automatically, ready to take readings.

*Remark*

*a) If the calibration process has been interrupted during the procedure the system will time out (indicated by five short beeps) after approximately 6 seconds and return to the measurement mode with the setting factors unaltered.*

*If the blocks are used in the wrong sequence or the probe has not contacted the STD's correctly, the display will indicate **"VALUE OUT OF RANGE SEQUENCE WILL RESTART"** the procedure will then restart at Step 1 as in the table above.*

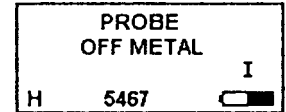
*This setting procedure can be aborted at any time by pressing the 'MENU' button.*

*b) Because the Air temperature can be different from the STD sample temperature, it is recommended that the probe is placed on the STD, for approximately 10 seconds prior to the "SET" procedure and held on each block for 5 seconds before SET is pressed (stages 3 and 4 above). By allowing the probe temperature to settle to that of the STD blocks optimum setting is ensured.*

### 5.6 Taking a Conductivity Measurement

Ensure the instrument is "ON" and in "MEASUREMENT Mode" see section (5.1). Carry out Probe Set Routine as section (5.5,5.4).

With the probe in "AIR" the display should be as below. With (H) if 500kHz. is selected or (L) if 60kHz is selected. The battery indication should show some content, and if the "Icon" shows empty new batteries should be fitted.



The instrument is now ready to take a measurement. The probe should be at the same temperature as the material to be measured, if there is a difference the

probe and STD blocks should be allowed to stabilise on the surface of the material to be measured. The SET PROBE routine should then be carried out at the temperature the measurements are to be taken at.

Place the probe on the surface of the material to be measured, making sure it is as flat as possible on the surface and not overhanging the edge, the display will then indicate the conductivity in the units selected.

If the material's ambient temperature drifts beyond +/- 3°C the display will indicate that a PROBE SET routine is advisable. (SET will appear on the bottom line of the display).

If measurements are to be carried out on round bars or curved surfaces the correct probe and guide should be used for ease of use and accuracy of results.

Thin sections may be measured using the high frequency 500kHz range.

Surface unevenness and non-metallic coatings of up to 0.020" (0.5mm) are compensated for in the measurement system of the 12.7mm probe, and 0.010" (0.25mm) with the 8mm probe. If, however, the probe







is too far from the surface " PROBE OFF METAL " will be displayed.

*Remark*

*Correction tables for curved surface measurement etc., are given in Application note AN9603. (Available from Hocking NDT.)*

## 5.7 Data Logging (Internal)


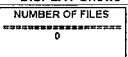


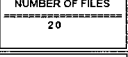

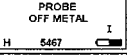
### 5.7a) Clearing the Entire Memory

STEP	WHAT to do	HOW to do it	DISPLAY Shows
1	Select the file Menu	 Press	FILE ----- XX ACTIVE (EMPTY or FULL)
2	If XX is "0" Memory is already cleared if not.	  Repeat presses until	FILE ----- ALL FILES -----
3	Clear the files	 Long Press	NUMBER OF FILES ----- 0
4	Return to measurement mode	 Press	PROBE OFF METAL H 5487 I 

With the instrument in the MEASUREMENT mode.

If the number of data files require setting follow section (5.7b) from the point where the number of files is displayed as "0".

### 5.7b) Setting the number of data files

STEP	WHAT to do	HOW to do it	DISPLAY Shows
1	Select the file Menus	 Press	
2	Select the number of files required (eg 20)	  Repeat presses until	
3	Return to measurement mode	 Press	

### (partitioning the memory)

*Remark*

*This can only be performed when the entire memory is clear. (See Section 5.7a )*

With the Instrument in the MEASUREMENT mode then

*Remark*

*The number of available files is 1 to 50 . Incrementing or decrementing past these points will result in the number reverting to the other end of the available range.*

*The number of storage locations in the files will depend on the number of files selected - see the following file capacity table.*

### Data Logging

Storage File capacity table.

No of Files	Locations	No of Files	Locations
01	500	26	19
02	250	27	18
03	166	28	17
04	125	29	17
05	100	30	16
06	83	31	16
07	71	32	15
08	62	33	15
09	55	34	14
10	50	35	14
11	45	36	13
12	41	37	13

13	38	38	13
14	35	39	12
15	33	40	12
16	31	41	12
17	29	42	11
18	27	43	11
19	26	44	11
20	25	45	11
21	23	46	10
22	22	47	10
23	21	48	10
24	20	49	10
25	20	50	10

### 5.7c) Logging in a reading (general)

*Remark*

*The number of files must have been set and there must be space left in file locations for logging to be successful, if not appropriate messages will appear on the display.*

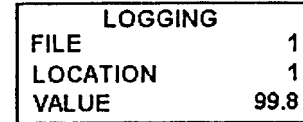


With a reading on the display (eg.99.8) that is to be logged [Press]

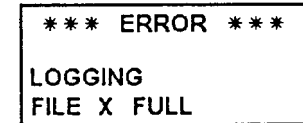
If no logging has taken place since the number of files have been set, the reading will be logged into location

“1” of file “1” (Unless a file location is deliberately selected for the reading see 5.7f). If previous logging has taken place the next location will automatically be selected to receive the new log.

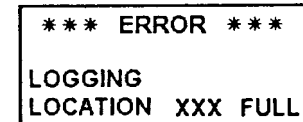
Whilst logging is taking place the display will indicate:



When complete the display will revert to reading “99.8” and the next location (2) will then be automatically selected for further logging. Logging can then be repeated until File 1 is full. When this occurs the display will respond with.







When this occurs another FILE must be selected for logging to continue. (See 5.7d). If during logging a file location is selected that already contains a stored value then the display will indicate this as follows.



When this occurs another FILE (See 5.7d ) or FILE LOCATION (5.7e) must be selected for logging to continue, or the file location cleared ( Press “MEM” to display the contents then a Long Press on “C” to clear the file.)

### 5.7d) Selecting a File for logging






With the instrument in the MEASUREMENT mode then

STEP	WHAT to do	HOW to do it	DISPLAY Shows
1	Select the file Menu	 Press	<pre> FILE ----- 1 FULL                     </pre>
2	Select the next file required (eg 2)	 Press 	<pre> FILE ----- 2 EMPTY                     </pre>
3	Return to measurement mode	 Press	

With the instrument returned to the MEASUREMENT mode further logging or measuring can take place. Further logged readings will automatically be placed in the next available empty file location.

### 5.7e) Clearing a file (when partially used or full)

With the instrument in the MEASUREMENT mode then






STEP	WHAT to do	HOW to do it	DISPLAY Shows
1	Select the file Menu	 Press	<pre> FILE ----- XX ACTIVE (or FULL)                     </pre>
2	Select the file to be cleared if not the current file (ie The one displayed)	 Repeat presses 	<pre> FILE ----- YY ACTIVE (or FULL)                     </pre>
3	Clear the displayed FILE	 Long Press	<pre> FILE ----- YY EMPTY                     </pre>
4	Return to measurement mode	 Press	

With the instrument returned to the MEASUREMENT mode further logging or measuring can take place. Further logged readings will automatically be placed in location 1 of FILE YY.

### 5.7f) Accessing a file location containing stored data

(to read, or clear for accepting new data)

With the instrument in the MEASUREMENT mode then

STEP	WHAT to do	HOW to do it	DISPLAY Shows
1	Select the file Menu	 Press	<pre> FILE ----- XX ACTIVE (or FULL)                     </pre>
2	Select the file to be cleared if not the current file (ie The one displayed)	 Repeat presses 	<pre> FILE ----- YY ACTIVE (or FULL)                     </pre>
3	Clear the displayed FILE	 Long Press	<pre> FILE ----- YY EMPTY                     </pre>
4	Return to measurement mode	 Press	

### Remark

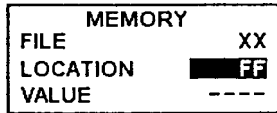
Whilst selecting locations Step 4,5 you may move to another file simply by pressing the “FILE” button and incrementing to the required file. Press “FILE” again to revert to location selection.

## 5.7f) (Contd)

Alternatively if you wish to clear this location continue from [4]



[Long press] will clear the location and the display will show



This indicates that file (XX) location (FF) is empty and can now accept a logged reading.

To log to this location.



Press “FILE” again to revert to location selection.

## 5.8 Customising the Operating Mode

The operating mode of the AutoSigma 3000 can be customised to suit a particular measurement procedure. Menu items can be selected and given a value or a mode, a complete menu can then be “STORED”, this customised menu can then be “RECALLED” when required.

The AutoSigma 3000 may be set to “User” mode where the Menu cannot be selected or changed, or “Supervisor” mode where the Menu is fully functional. This is achieved by sending instructions from a PC to the AutoSigma 3000.

### Remark

When in “USER” mode the “Reset Switch On” facility is not available.

## 5.8a) Storing a Customised Mode

In order to “STORE” a Customised Operating Mode, select “MENU” then select “STORE” with  $\uparrow/\downarrow$ , in the “SET” mode, select the required store location (1 to 10) with  $\uparrow/\downarrow$  and apply a long press to “SEND”, two

beeps will confirm that the "MENU SETTINGS" have been "STORED".

### **5.8b) Recalling a Customised Mode**

To "RECALL" a Customised Operating Mode select "RECALL" from the "MENU" with  $\uparrow/\downarrow$  and in the "SET" mode select the required location (1 to 10) with  $\uparrow/\downarrow$  and apply a long press to "SEND", two beeps will confirm that the "MENU SETTINGS" have been "RECALLED".

### **5.8c) Setting the Operating Mode to "User" or "Supervisor"**

The AutoSigma 3000 normally works in the "SUPERVISOR" mode where the MENU is fully functional, it is supplied set to this mode, the instrument may also be set to "USER" mode where the MENU cannot be selected or changed.

To change between the "USER" or "SUPERVISOR" mode the unit should be ON and in the read mode and connected to a suitable PC, via cable part no **33A146** (PC serial cable).

#### *Remark*

*To access the AutoSigma using a PC running windows go into "TERMINAL" prog (usually in accessories group) choose "Settings"; "Communications" in the comms box select the COM port connected to the AutoSigma. (COM1 or COM2) then set [baud rate] 1200; [data bits] 8; [stop bits] 1; [parity] none; [flow control]; Xon/Xoff; Leave [parity check] and [carrier detect] unselected.*

*Hit [OK]. On pressing "RETURN" on the keyboard the screen should respond with">".*

To select "USER" type USER (slowly; 0.5 sec between characters) and press "RETURN"; the unit will now be in the "USER" mode and can be disconnected from the PC. In "USER" mode the MENU cannot be selected and the settings present when the AS3000 is converted will be retained.

To select "SUPERVISOR", with the PC connected; type SUPER (slowly) and "RETURN"; the unit will now be in "SUPERVISOR" mode, the unit may now be disconnected from the PC.

## 6.0 Connection to External Data Handling Devices

The 7way Lemo Data Output socket is provided for connection to Data Handling Devices, Printers and PCs.

The communication link protocol depends on the cable connected using an ASCII Data transfer. A Mitutoyo data cable is automatically sensed so an external Data Logger can request a reading.

If printers or PCs etc that use serial RS232 format are to be connected, converter leads are required. Product codes: 47A004(PC) 47A002 (Printer)

Signal identification of connections to the 7Pin LEMO Data Output socket.

Pin 1	-	-	0V
Pin 2	-	-	+5VA
Pin 3	-	-	TXDATA1
Pin 4	-	-	~ CTSREQ

Pin 5	-	-	RXCLOCK
Pin 6	-	-	0V
Pin 7	-	-	~ MITSEL

### 6.1 Sending serial data to an external device

Connect the external equipment to the instrument via the correct interface cable and switch it on.

The AS3000 will recognise the connection and change the use of the "SEND" button from internal data logging to external serial data transfer.

Individual files or the entire memory can be transmitted, but only files containing stored data will be transferred. ie. (file active or file full).





A long press on the "SEND" button is used to initiate data out transfer with the FILE menu set to a single file or "All Files".

#### *Remark*

*For correct handling of transmitted data PCs and printers should be set to XON / XOFF protocol.*

## 6.1a) Sending a Single File


With the instrument in the MEASUREMENT mode then

STEP	WHAT to do	HOW to do it	DISPLAY Shows
1	Select the file Menu	 Press	<pre> FILE ----- YY ACTIVE (or FULL)                     </pre>
2	If file to be transferred is not current (ie the displayed one) Select the file required (eg 2)	 Repeat presses 	<pre> FILE ----- 2 ACTIVE (or FULL)                     </pre>
3	Transfer the file	 Long press :-after the press the display will indicate the transfer	<pre> PRINTING FILE 2                     </pre>

When transmission is complete the display will revert to the file selection.

### Remark

To terminate a data transfer when in progress:

 [Press] Display will respond for a short period with,





```

PRINTING
ABORTED
                    
```

then revert to the file selection.

## 6.1b) Sending the Entire Memory


With the instrument in the MEASUREMENT mode then

STEP	WHAT to do	HOW to do it	DISPLAY Shows
1	Select the file Menu	 Press	<pre> FILE ----- YY ACTIVE (or FULL)                     </pre>
2	Select all the files	 Repeat presses 	<pre> FILE ----- ALL FILES -----                     </pre>
3	Transfer the files	 Long press :-after the press the display will indicate the transfer	<pre> PRINTING ALL FILES                     </pre>

After transmission the display will return to "ALL FILES".

### Remark

To terminate a data transfer when in progress.

 [Press] Display will respond for a short period with,

```

PRINTING
ABORTED
                    
```

then revert to file selection "ALL FILES".

*Remark*

*During Data Transfers all instrument operations are suspended.*

### 6.1c) Report Format of Transferred Data

Data transmitted to a serial printer is formatted as the example shown below, and is suitable for any IBM compatible serial printer.

Sections of the formatted report.

- (1) Instrument Banner      Instrument name.
- (2) File Header              Various Fields including the file number for the data to follow.
- (3) Readings                 A list of the measurement values and their locations.
- (4) Statistics                 Various statistics

(2) through to (4) are then repeated for each file transferred.

(5) "End of Report" message.

### Example of a report

```
*****
*   AutoSigma 3000 DL   *
*****

-- FILE HEADER --
FILE NUMBER: 1
FILE NAME:

SERIAL NUMBER:
REVISIONS: 1.0
OPERATOR ID:

PROBE ID:
DATE:
COMMENTS:

-- READINGS --
1  101.1 %IACS
2  101.4 %IACS
3   83.4 %IACS
4   83.6 %IACS
5   83.6 %IACS
6   83.9 %IACS
7   83.3 %IACS

- FILE STATISTICS -
READINGS      7
MIN      83.36
MAX     101.49
RANGE   18.13
MEAN    88.66

END OF REPORT
```

## 7.0 Product Specification

<b>Conductivity Range</b>	0.8% IACS to 110% IACS (0.45 to 64 MSiemens/m)
<b>Operating Frequencies</b>	60 & 500kHz Sinewave.
<b>Resolution</b>	10 to 110% IACS, readings 10.0 to 110.0 (1 dec. place)  0.8 to <10 % IACS, readings 0.80 to 9.99 (2 dec places)
<b>Accuracy</b>	[ +/-0.5% IACS at 100% IACS reducing to +/- 0.1% IACS at 10% IACS +/-0.1% IACS below 10% IACS ] at 20°C.  [ +/-0.8% IACS at 100% IACS reducing to +/-0.2% IACS at 10% IACS +/-0.2% IACS below 10% IACS ] over range 0°C to 40°C with probe in contact with metal

### Probes

12.7mm diameter, for 60kHz, and 500kHz. 8mm Probe operates at 500kHz only. Probes are inter changeable with simple customer re-setting procedure.

The probe field is sharply defined and enables accurate measurements to be made even with the probe in line with the extreme edge of the metal.

Special probe guides are available for measuring curved surfaces. The data for three probes of each size can be stored in the probe data field allowing for alternative probe usage.

### Lift-Off

12.7mm probe compensated to 0.020<sup>2</sup> (0.5mm), 0.010" on 8mm probe. At 20°C display changes to "PROBE OFF METAL" when the

compensated probe “Lift-Off” distance has been exceeded.

illuminating “SET” at the bottom of the display.

**Conductivity Standards**

Attached to case top . Removable for value verification, and temperature sinking to material to be measured.

**Temperature Measurement**

By probe thermistor (Accurate to 0.5°C) Range 0°C to +50°C (32°F to 122°F). The display shows the temperature at which the last measurement was taken.

**Display**

Graphics LCD 122 x 32 pixels with electroluminescent backlight. Backlight has “On” and “Off” modes.

**Automatic Temperature Compensation**

Conductivity measurements are corrected to the 20°C value when measured at other temperatures.

**Alarm**

Triggered at upper and lower selected values, indicated by LCD display icons.

**Data Logger Memory**

Up to 500 readings. Up to 50 Files.

**Calibration**

Automatically set when “SET PROBE” sequence is carried out with the probe placed in turn on the calibration blocks. The probe thermistor detects when a change in temperature of more than 3°C has occurred since the last calibration and signals the necessity for re-calibration by

**Serial Port**

RS 232 serial LEAD available for serial printer or PC etc. Compatible with KB ‘DMEDL’ software

**Shoulder Bag**

To protect unit for mobile applications.

<b>Packall Case</b>	Small light rigid case. 9"Hx 12.25"Wx4.25"D (225x310x107mm). To hold Unit, Probe, Probe Cable, Operators Handbook, space for extra	<b>Environmental Range</b>	0 to 95% relative humidity 0°C to +50°C for reliable operation.
and with further accessories.			
<b>Power Source</b>	3 x 1.5V AA Size Alkaline Batteries. Approx. 100hrs life without Backlight.		
<b>Auto Switch Off</b>	If the instrument is not used for "N" minutes, or if the battery falls to an unusable low level, the instrument switches "Off" automatically. ("N" is user selectable.)		
<b>Case</b>	High impact polycarbonate. Splash proof. 6.5"Lx 3.0"W x 1.6"D (165x76x41mm)		
<b>Weight</b>	14.5oz (0.4kg) including batteries.		

## **8.0 Maintenance & Care**

### **8.1 Cleaning**

Use a soft cloth moistened with a soap or mild detergent to clean the case, buttons and display window.

**Caution:**

Do not use abrasive cleaning agents of any kind as these will erase the legend graphics and scratch the display window.

Do not use solvent cleaners of any kind, as they may cause irreparable damage to case and contents.

### **8.2 Care of Batteries**

**Note:**

On removal of the batteries the instruments will retain its settings and stored data (DL model). Memory storage does not rely on battery power (make sure the instrument is switched "OFF" before removal of the batteries).

When the batteries no longer have enough power to drive the instrument, remove and dispose of them

correctly. Do not leave discharged batteries in the battery holders.

If the instrument is to be stored for some time without being used, remove batteries before storing.

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