

AutoSigma 3000

Technical Reference and Operation Manual

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Introduction **1**

1.1 Important notes

GE Inspection Technologies Operating manuals 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 manuals.

These factors include the following:

- Selection of appropriate cables, probes, fixtures, mechanical handling equipment and other accessories.
- Selection of proper test frequency, test mode and other test parameters.
- Preparation of the test surface.
- Characteristics of the test material for example: conductivity, hardness, permeability, geometry, magnetic properties, heat treatment etc.
- Environmental factors such as temperature humidity, dust and electrical interference.
- 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.

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 GE Inspection Technologies product you are using should be addressed to your local sales representative, the distributor or GE Inspection Technologies 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.











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

1.2 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

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

	Step	Key	Display
1	From "Off" select measurement mode.		
2	Enter parameter menu.		
3	Step through the menu to the "HIGH ALARM" parameter.		
4	Move across to the setting field.		
5	Increment/decrement to required level.		
6	Return to normal measurement mode.		Normal measurement display

This action table indicates in step form:

- Switch on with a press of **ON/OFF** button.
- Press the **MENU** button.
- Press **INCREMENT/DECREMENT** button repeatedly until the required parameter is accessed.
- 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

Notes

Note:

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

Button Operation (Keypad)

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

Standard package and accessories **2**

2.1 Standard package

Product code	Description	Order number
	AutoSigma 3000 DL	47I001DL
	Probe 12.7 mm (60/500 KHz)	47P001
	Cable (Probe)	47A001
	Probe finger support	47A005
	Curve measurement adapter	47A006
	Hard plastic packall case	47A008
	Calibration Certificate	—

2.2 Recommended accessories

Product code	Description	Order number
	Soft Case with Shoulder Strap	47A009
	Probe 8 mm (500 KHz)	47P002
	Cable (Printer)	33A145
	Cable (Data Logger)	47A003
	Computer Interface Cable (PC)	33A146
	Computer Interface Instructions	—
	Operator Reference Block Plate and set of five Operator Reference Blocks	44A016
	See Data Sheet for details	

Preparation for operation **3**

3.1 Battery installation

Power requirements

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

Note:

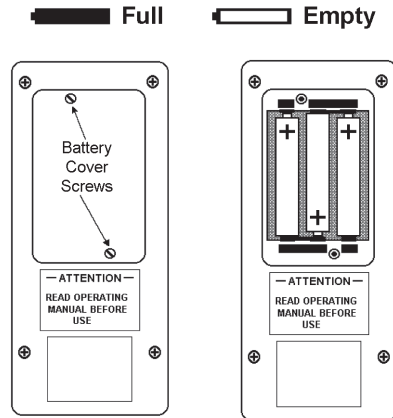
If Ni-Cad batteries are used the battery level indication will not be correct, and they should be removed for charging when the level indicator shows about 25 %. The AutoSigma 3000 has no provision for in situ charging.

- Undo Battery Cover Screws and lift off the cover (the screws are captive in the lid).
- Insert three 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 AutoSigma 3000 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.



 **Note:**

When the battery empty state is displayed, the batteries should be replaced at once.

The AutoSigma 3000 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.

3.2 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.

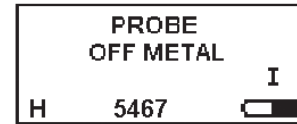
 **Note:**

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.

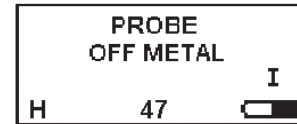
3.3 Probe identification

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



Probe code shown ↑ here on the display.

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



Probe code shown ↑ here on the display.

 **Note:**

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 12.7 mm probe. 500 kHz (H) only may be used for the 8 mm probe.










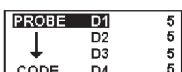

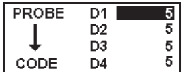
3.4 Entering probe code data






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

6 5 4 7

and is equivalent to data stores

D1 D2 D3 D4

Step	Key	Display
1	From "Off" select measurement mode. 	
2	Open parameter menu. 	
3	Step through the menu to the PROBE parameter. 	
4	Move to the setting field. 	
<p>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 three available four digit slots. Return to the parameter field by pressing SET and continue to PROBE D1 as normal step 5.</p>		
5	Step through the menu to the PROBE D1 parameter. 	
6	Move across to the setting field. 	











Step	Key	Display
7		<pre> PROBE D1 6 D2 5 ↓ D3 5 CODE D4 6 </pre>
8		<pre> PROBE D1 6 D2 5 ↓ D3 5 CODE D4 6 </pre>
9		<pre> PROBE D1 6 D2 5 ↓ D3 4 CODE D4 7 </pre>
10	 long press	<pre> PROBE D1 6 D2 5 ↓ D3 4 CODE D4 7 </pre>
11		<pre> PROBE OFF METAL I H 6547  </pre>

3.5 General parameter setting

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

Note:

This sequence is used to set any of the adjustable menu parameters as listed in section 3.6.

Step	Key	Display
1	From "Off" select Measurement mode. 	
2	Open the parameter menu. 	
3	Step through the menu to the LANGUAGE parameter. 	
4	Move across to the setting field. 	
5	Increment/Decrement to the required language: German. 	
6	Return to normal measurement mode. 	Normal measurement display



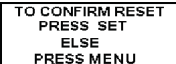

3.6 Start-up

Normal switch on

Press **ON/OFF** button to bring the instrument into operation in the measurement mode with the parameter values as they were when it was last switched off.

Reset switch on

Returns the instrument to its default settings, not active in User mode.

Step	Key	Display
1	From "Off" initialise sequence for access. 	
2	Press for start-up. Release SET button when beep is heard. 	
3	Confirm reset. 	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

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 / 500 kHz
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

3.7 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/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 MegaSiemens/meter. 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 MegaSiemens/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 three standard depths of penetration can be measured without any correction factors being required.

For example at 60 kHz this figure (the “effective depth of penetration”) is around 0.05" (1.25 mm) in Aluminum Alloys (conductivity approximately 35 % IACS) and 0.32" (8 mm) in Titanium alloy (conductivity approximately 1 % IACS). At 500 kHz the corresponding values are 0.02" (0.5 mm) and 0.11" (2.8 mm).

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 60 kHz).

The conductivity of a material changes considerably with temperature, but is normally specified at 20 °C. The AutoSigma 3000 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" (0.5 mm) with the 12.7 mm probe and 0.010" (0.25 mm) with the 8 mm 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" (75 mm).

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).

Basic functions 4

4.1 Measurement method

The instrument uses a probe which is excited by an AC signal (60 kHz “L” or 500 kHz “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 nonmetallic coatings up to 0.020" (0.5 mm) are allowed for in the measurement system (0.010" (0.25 mm) only with the 8 mm 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 MegaSiemens/meter (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.

H	500 kHz Selected.	▲	Upper Alarm Triggered.
L	60 kHz Selected.	▼	Lower Alarm Triggered.
SET	Carry out [Set Probe] Routine.	■	50% Battery life remaining.

4.3 Keypad

The AutoSigma 3000 has a membrane keypad, consisting of eight legend pads. The large central pad with the up and down arrows has two 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

- ON/OFF** This button switches the instrument on and off; a short press is used to switch on and a long press switches the instrument off.
- MENU** This button is used to select set-up parameters and return the instrument to its measurement mode.
- SET** 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.
- SEND** 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 older Basic Model without the DL option the screen will indicate **Data Logger is not fitted**.

- MEM** This button selects the Memory Menu (Files must have been allocated, and the file selection be on a particular file not ALL FILES).
- FILE** This button selects the FILE menu (With ALL FILES cleared it will access the number of files set up).
- C** 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.

Note:

For correct button sequences see chapter 5 “Operation”.

Operation 5

5.1 Switching on

- Press **ON/OFF**.

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 section 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 500 kHz (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 ▲ 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 **ON/OFF**.

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

5.3 Changing working parameters

Follow the sequence in section 3.5.

Note:

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 8 mm (two digit) probe code in place, you cannot select a frequency of 60 kHz (only useable with 12.7 mm 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 i.e. two digit number is present (8 mm probe) when trying to set a 12.7 mm probe which should have a four digit code number or vice-versa. The display will show an error (see Figure 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 Figure 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 DL 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.

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 the block values. From the normal measurement mode proceed as follows, e.g. setting STD 1 (60.1) and STD 2 (8.91).

Step	Key	Display
1	Open the parameter menu. 	
2	Step through the menu to the STD 1 parameter. 	
3	Move across to the setting field. 	
4	Decrement to required level. 	
5	Return to parameter field. 	
6	Step to the STD 2 parameter. 	
7	Move across to the setting field. 	

Step	Key	Display
8	Increment to required level. 	
9	Return to normal measurement mode. 	Normal measurement display

User reference blocks

Can be used to set the AutoSigma 3000 DL, 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.

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 “Specifications” chapter 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 GE Inspection Technologies 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 STD 1 should ideally be 50 % IACS or more and STD 2 should be 35 % IACS or less.

It is possible to set the AutoSigma 3000 DL by using one user reference block and one 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 (i.e. IACS or MS/m) The probe code must also be appropriate to the probe in use. Proceed following section 5.4 to set the reference block values. Then with the instrument on and in the Measurement mode:

	Step	Key	Display
1	From Measurement mode initiate probe setting.		<div style="border: 1px solid black; padding: 5px; text-align: center;"> SET PROBE <hr/> PUT PROBE IN AIR PRESS SET </div>
2	Hold probe in the air to set liftoff. Press SET and wait for sounder to beep.		<div style="border: 1px solid black; padding: 5px; text-align: center;"> SET PROBE <hr/> PUT PRB ON STD1 PRESS SET </div>
3	Move probe onto the STD 1 block. Press SET and wait for sounder to beep.		<div style="border: 1px solid black; padding: 5px; text-align: center;"> SET PROBE <hr/> PUT PRB ON STD2 PRESS SET </div>
4	Move probe onto the STD 2 block. Press SET and wait for sounder to beep, then remove probe.		Instrument will return to the Measurement mode automatically, ready to take readings.

Notes:

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.

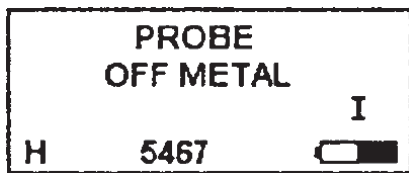
If the blocks are used in the wrong sequence or the probe has not contacted the STD's correctly, the display will indicate VALUE OUT OF RANGE SEQUENCE WILL RESTART the procedure will then restart at step 1 as in the table above. This setting procedure can be aborted at any time by pressing the **MENU** button.

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 (steps 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 set probe routine as in sections 5.4 and 5.5.

With the probe in air the display should be as below. With (H) if 500 kHz is selected or (L) if 60 Hz 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 500 kHz range. Surface unevenness and non-metallic coatings of up to 0.020" (0.5 mm) are compensated for in the measurement system of the 12.7 mm probe, and 0.010" (0.25 mm) with the 8 mm probe. If, however, the probe is too far from the surface PROBE OFF METAL will be displayed.






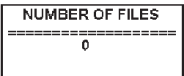


 **Note:**

Correction tables for curved surface measurement etc., are given in application note AN 9603 (available from GE Inspection Technologies).

5.7 Data logging (internal)

Clearing the entire memory

With the instrument in the Measurement mode:

	Step	Key	Display
1	Open the file menu.		
2	If XX is 0, memory is already cleared. If not press arrow keys repeatedly until the adjoining is displayed.		
3	Clear the files with a long press on the C key.		
4	Return to Measurement mode.		


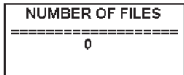

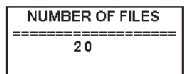

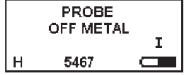
If the number of data files require setting follow section 5.7 from the point where the number of files is displayed as **0**.

Setting the number of data files

 **Note:**

This can only be performed when the entire memory is clear.

With the instrument in the Measurement mode:

Step	Key	Display
1		
2		
3		

 **Note:**

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

No of files	Locations	No of files	Locations
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

– With a reading on the display (e.g. 99.8) that is to be logged press **SEND**.

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). 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:

LOGGING	
FILE	1
LOCATION	1
VALUE	99.8

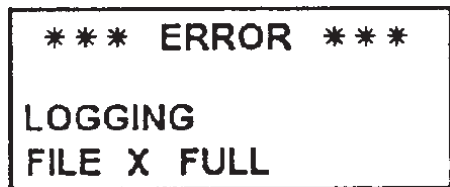
Logging in a reading (general)

Note:

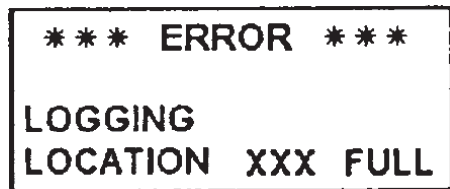
The number of files must have been set and there must be space left in file locations for logging to be successful, if not appropriate messages will appear on the display.

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. 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 or file location 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.

Selecting a file for logging





With the instrument in the Measurement mode:

	Step	Key	Display
1	Open the file menu.		
2	Select the next file required (e.g. 2).		
3	Return to Measurement mode.		

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.

Clearing a file







With the instrument in the Measurement mode:

Step	Key	Display
1		<pre> FILE ===== XX ACTIVE (or FULL) </pre>
2		<pre> FILE ===== YY ACTIVE (or FULL) </pre>
3		<pre> FILE ===== YY EMPTY </pre>
4		

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.

Accessing a file location containing stored data

With the instrument in the Measurement mode:

Step	Key	Display
1		<pre> FILE ===== YY ACTIVE (or FULL) </pre>
2		<pre> FILE ===== XX ACTIVE (or FULL) </pre>
3		Normal measurement display
4		<pre> MEMORY FILE XX LOCATION YY VALUE ZZZ </pre>
5		<pre> MEMORY FILE XX LOCATION 14 VALUE 67.1 </pre>
6		Normal measurement display

 **Note:**

Whilst selecting locations steps 4 and 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.

- Alternatively if you wish to clear this location continue from step 4.
- Long press **C** 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 DL 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 DL 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 DL.

 **Note:**

When in User mode the reset switch on facility is not available.

Storing a customised mode

- In order to store a customised operating mode, select **MENU** then select STORE with the arrow keys.
- In the SET mode, select the required store location (1 to 10) with the arrow keys and apply a long press to **SEND**.

Two beeps will confirm that the MENU SETTINGS have been stored.

Recalling a customised mode

- To recall a customised operating mode select RECALL from the menu with the arrow keys.
- In the SET mode select the required location (1 to 10) with the arrow keys and apply a long press to **SEND**.

Two beeps will confirm that the MENU SETTINGS have been recalled.

Setting the operating mode to User or Supervisor

The AutoSigma 3000 DL 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).

Note:

To access the AutoSigma 3000 DL using a PC running windows go into “Terminal” program (usually in accessories group) choose “Settings”; “Communications” in the comms box select the COM port connected to the AutoSigma 3000 DL (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 AutoSigma 3000 DL 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.

External data handling devices **6**

6.1 Connection

The 7 way 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 RS-232 format are to be connected, converter leads are required. Product codes: 47A004 (PC), 47A002 (Printer)

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

Pin 1 0 V

Pin 2 +5 VA

Pin 3 TXDATA1

Pin 4 ~CTSREQ

Pin 5 RXCLOCK

Pin 6 0 V

Pin 7 ~MITSEL

6.2 Sending serial data to an external device

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

The AutoSigma 3000 DL 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 i.e. file active or file full.




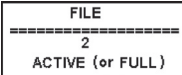

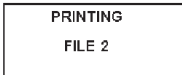
A long press on the **SEND** button is used to initiate data out transfer with the File menu set to a single file or ALL FILES.

Note:

For correct handling of transmitted data PCs and printers should be set to Xon / Xoff protocol.

Sending a single file

With the instrument in the Measurement mode:

	Step	Key	Display
1	Open the file menu.		
2	If file to be transferred is not current (i.e. the displayed one), select the file required (e.g. 2).		
3	Transfer the file with a long press; after the press the display will indicate the transfer.		

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

Note:




To terminate a data transfer when in progress press **SEND**. Display will respond for a short period with



then revert to the file selection.

Sending the entire memory

With the instrument in the Measurement mode:

	Step	Key	Display
1	Open the file menu.		<pre>FILE ----- YY ACTIVE (or FULL)</pre>
2	Press the arrow keys repeatedly to select all the files.		<pre>FILE ----- ALL FILES ----</pre>
3	Transfer the files with a 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.

 **Note:**

To terminate a data transfer when in progress press **SEND**. Display will respond for a short period with



then revert to file selection ALL FILES.

 **Note:**

During data transfers all instrument operations are suspended.

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

Instrument Banner	Instrument name.
File Header	Various Fields including the file number for the data to follow.
Readings	A list of the measurement values and their locations.
Statistics	Various statistics

then repeated for each file transferred.

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

```


Specifications 7

Specifications

Conductivity Range	0.8 % IACS to 110 % IACS (0.45 to 64 MegaSiemens/m)
Operating Frequencies	60 and 500 kHz Sinewave
Resolution	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)
Accuracy	[+/-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	12.7 mm diameter, for 60 kHz, and 500 kHz. 8 mm probe operates at 500 kHz only. Probes are interchangeable 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 alterna- tive probe usage.

Lift-Off	12.7 mm probe compensated to 0.020" (0.5 mm), 0.010" (0.25 mm) on 8 mm probe. At 20 °C display changes to PROBE OFF METAL when the compensated probe Lift-Off distance has been exceeded.
Conductivity Standards	Attached to case top, removable for value verification, and temperature sinking to material to be measured.
Display	Graphics LCD 122 × 32 pixels with electroluminescent backlight Backlight has on and off modes.
Alarm	Triggered at upper and lower selected values, indicated by LCD display icons
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 illuminating SET at the bottom of the display.
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.
Automatic Temperature Compensation	Conductivity measurements are corrected to the 20 °C value when measured at other temperatures.

Specifications

Data Logger Memory	Up to 500 readings, up to 50 files (DL model)
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
Packall Case	Small light rigid case. 9" × 12.25" × 4.25" (229 × 311 × 108 mm, H × W × D). To hold unit, probe, probe cable, and operating manual, with further space for extra accessories
Power Source	3 × 1.5 V AA size alkaline batteries, approx. 100 hrs life without backlight
Auto Switch Off	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).
Case	High impact polycarbonate, splash proof 6.5" × 3.0" × 1.6" (165 × 76 × 41 mm, H × W × D)
Weight	14.5 oz (0.4 kg) including batteries
Environmental Range	0 to 95 % relative humidity, 0 °C to +50 °C for reliable operation

Maintenance and care 8

8.1 Cleaning

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



Attention:

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.

Appendix 9

9.1 EC Declaration of Conformity

We declare that the AutoSigma 3000 DL Conductivity Meter conforms to the following European directive:

- 89/336 (Electromagnetic compatibility)

The conformity of the above-mentioned product with the regulations of the directive 89/336 is proven by the observance of the standard specifications

- EN 50081-1 Emissions
- EN 50082-1 Immunity

9.2 Manufacturer / Service address

The AutoSigma 3000 DL is manufactured by:

GE Inspection Technologies Ltd

129-135 Camp Road

St Albans, Hertfordshire, AL1 5HL

GREAT BRITAIN

Phone +44 1727 795500

Fax +44 1727 795400

The AutoSigma 3000 DL is manufactured according to state-of-the-art methods using high-quality components. Thorough in-process inspections or intermediate tests and a quality management system certified to DIN EN ISO 9001 ensure an optimum quality of performance of the instrument.

Should you nevertheless detect an error on your instrument, switch the instrument off. Inform your local GE Inspection Technologies Service indicating the error and describing it.

Keep the shipping container for any repairs possibly required which cannot be made on the spot.

If there is anything special that you would like to know about the use, handling, operation and specifications of the instruments, please contact your nearest GE Inspection Technologies representative or directly:

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