Phasec 3 Series
Operating Manual
021-002-935 LT
40DH100 SA
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1 Introduction
1.1 Safety information

The Phasec has been designed and tested in accordance with EN61010 Part 1, 2002 Safety Requirement for Electrical and Measuring, Control and Laboratory Use. In order to maintain this condition and to ensure safe operation, it is important that you read the following safety information before putting the instrument into operation.

NOTE: The Phasec may only be used in an industrial environment!

The Phasec can be operated with batteries or a power supply unit.

1.2 Batteries

For battery operation the Phasec uses a lithium-ion battery. Only the products recommended and supplied by us may be used for battery operation. The battery may be charged by means of an external.

Please refer to Chapter 3.2 on Power supply" and to Chapter 6.2 on Care of batteries.

1.3 Software

Current state of the art software is never completely free from errors. Before using any software-controlled test equipment, please make sure that the required functions operate perfectly in the intended combination.

If you have any questions about the use of you test equipment, please contact the nearest representative of GE Inspection Technologies.
1.4  Defects/errors and exceptional stresses
If you have reason to believe that safe operation of your instrument is no longer possible, you must disconnect the instrument and secure it against unintentional reconnection. Remove the batteries if necessary.

Safe operation is not possible if:
- the instrument is visibly damaged
- the instrument no longer operates correctly
- it has been stored for a prolonged period in adverse conditions (see Chapter 6.4 for limitations on storage conditions)
- it has been subjected to heavy stresses during transportation

1.5  Important information on eddy current testing

Please read the following information before using your Phasec. It is important that you understand and utilize this information to avoid any operator errors that might lead to false test results. This could result in personal injuries or damage to property.

1.6  Preconditions for testing with eddy current testing

This operating manual contains essential information on how to operate your test equipment. There are a number of additional factors that affect test results, which are beyond the scope of this manual. This manual only covers the most important factors for a safe and reliable eddy current inspection.
1.7 Operator training
The operation of an eddy current test device requires proper training in eddy current test methods. Operators performing standard tests should be qualified to the relevant regulatory body requirements. Supervisors setting test parameters should be qualified to the relevant regulatory body requirements.

1.8 Basic knowledge
As a general rule, effective use of eddy current equipment for new applications requires the following:

- an understanding of the principles of eddy current testing, particularly aspects which may limit detectability of flaws such as depth of penetration and the way in which different probe configurations respond to different flaw types
- an understanding of other NDT and inspection procedures which may be appropriate or that may be required to verify the results
- knowledge of the application i.e. the way in which the part being tested is manufactured or stressed in use and the probable flaw mechanisms
- a good working knowledge of the equipment to be used plus a written technique to be followed in performing the inspection

1.9 The Phasec
The Phasec is a lightweight and compact eddy current instrument and is especially suitable for:

- locating and measuring defects/discontinuities in metallic materials.
- assessing variations in magnetic and electrical material properties in order to determine material properties

Phasec 3 Common Platform
Three versions of the instrument are available:

<table>
<thead>
<tr>
<th>Version</th>
<th>Phasec 3</th>
<th>Phasec 3 s</th>
<th>Phasec 3d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Frequencies</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Frequency Range</td>
<td>10 Hz – 10 MHz</td>
<td>10 Hz – 10 MHz</td>
<td>10 Hz – 10 MHz</td>
</tr>
<tr>
<td>Conductivity Mode</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Rotary Mode</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>VGA Output</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Analog Outputs</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>12 Way Probe Connector</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>7 Way Auxiliary Connector</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>
1.10 Eddy current technology
The Phasec uses eddy current technology (EC or ET). When compared with other NDT methods eddy current offers:

- High sensitivity to microscopic flaws at or near the metal surface
- High inspection speeds
- No surface preparation required
- Can detect flaws through paint layers
- Good discrimination between flaw types
- No couplant, no consumables, no radiation hazards
- No waste/effluent treatment needed
- Ability to access small and complex geometries
- Skills are easy to acquire
- Complementary to Ultrasonic technology

1.11 Special features
The Phasec instrument features:

- Color display for improved signal interpretation
- Low weight and compact size makes it suitable for use in restricted areas
- Long operating time (6 hours) when using a lithium-ion battery
- High 4 kHz sample rate normal mode and 16 kHz in rotary
- Compatible with a wide range of probes from GE and others including rotary drives.
1.12 How to use this manual

Before operating the Phasec for the first time, it is essential that you read this manual. The manual will show you how to prepare the instrument, give you a description of all the keys and screen displays and will explain the principles of operation. By preparing thoroughly you will avoid any errors or failures of the instrument and be able to use the full range of instrument functions.

1.12.1 Layout and presentation of this manual
For ease of use, all operating steps, notes etc., are always presented in the same way. This will help you find individual pieces of information quickly.

1.12.2 Caution and Note symbols

Caution: ⚠️

The Caution symbol indicates aspects in the operation, which could affect the accuracy of the results or safety.

Notes:

Note contains special recommendations for a function or references to other chapters.
1.12.3 Listings
Listings are presented in the following form:
  • variant A
  • variant B

1.12.4 Operating steps
Operating steps appear as shown in the following example:
  • Loosen two screws at the bottom
  • Remove the cover
2 Standard package and accessories
2.1 Introduction

This chapter contains information about the standard package and the accessories available for the Phasec. It describes

- accessories included in the standard package
- recommended accessories
- recommended spare parts and consumable items

2.2 Standard package

<table>
<thead>
<tr>
<th>Qty</th>
<th>Order number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Phasec 3 40i011</td>
<td>Phasec Instrument</td>
</tr>
<tr>
<td></td>
<td>Phasec 3s 40i012</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phasec 3d 40i013</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>40a038</td>
<td>Supervisor PC Software</td>
</tr>
<tr>
<td>1</td>
<td>40a601</td>
<td>USB Cable</td>
</tr>
<tr>
<td>1</td>
<td>39a030</td>
<td>Li-ion battery pack assembly</td>
</tr>
<tr>
<td>1</td>
<td>39a035 plus 29axxx</td>
<td>Charger and power cable as appropriate for destination country</td>
</tr>
<tr>
<td>1</td>
<td>47090</td>
<td>Quick Reference Card</td>
</tr>
<tr>
<td>1</td>
<td>40dh100</td>
<td>Operating manual</td>
</tr>
<tr>
<td>1</td>
<td>40a600</td>
<td>Case boot with integral stand</td>
</tr>
<tr>
<td>Qty</td>
<td>Order number</td>
<td>Description</td>
</tr>
<tr>
<td>-----</td>
<td>--------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>40a142</td>
<td>Soft carrying case</td>
</tr>
<tr>
<td>1</td>
<td>40i013-cal</td>
<td>Calibration certificate</td>
</tr>
</tbody>
</table>

The above items may be ordered using the standard package Order;
- Phasec 3 40K511
- Phasec 3s 40k512
- Phasec 3d 40k513

## 2.3 Recommended accessories

<table>
<thead>
<tr>
<th>Application Starter Packages</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order number</td>
<td>Description</td>
</tr>
<tr>
<td>ASP1P2</td>
<td>Application Starter Package Weld Inspection Package for Phasec 3/3s/3d</td>
</tr>
<tr>
<td>ASP2P2</td>
<td>Application Starter Package Surface Crack Detection Package for Phasec 3/3s/3d</td>
</tr>
<tr>
<td>ASP3P2</td>
<td>Application Starter Package Conductivity Measurement Package for Phasec 3/3s/3d</td>
</tr>
</tbody>
</table>
### Rotary Probe

<table>
<thead>
<tr>
<th>Order number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>33A100</td>
<td>DRIVE UNIT-MINIATURE, mini probe 600-3000 rpm</td>
</tr>
<tr>
<td>33A103</td>
<td>LEAD,PHASEC 2200 to MIN-DRV 2m (Lemo 12W pl to Lemo 12W pl)</td>
</tr>
<tr>
<td>33A150</td>
<td>Test Block, Rotating probe, Total 12 holes; Holes 3/16&quot;, 1/4&quot;, 5/16&quot;, 3/8&quot;, 7/16&quot;, 1.6 sound holes and 6 holes with EDM flaws Aluminium</td>
</tr>
</tbody>
</table>

### Standard probe cables

<table>
<thead>
<tr>
<th>Order number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>40A001</td>
<td>LEAD, Probe lemo 12w to Microdot 1.5M Locator probe to Phasec 2/3</td>
</tr>
<tr>
<td>40A027</td>
<td>LEAD, Probe Lemo 12w Right Angle to Microdot Plug 1.5m Long Locator probe to Phasec 2/3</td>
</tr>
<tr>
<td>40A002</td>
<td>ADAPTER straight fixed, Probe lemo 12w to BNC Locator probe to Phasec 2/3</td>
</tr>
<tr>
<td>29A001</td>
<td>LEAD, Probe 1.5m BNC/Microdot</td>
</tr>
<tr>
<td>5A011</td>
<td>LEAD, Probe 1.5m (BNC-BNC Lightweight cable)</td>
</tr>
<tr>
<td>33A170</td>
<td>LEAD, Conductivity only-PHASEC 2/3 Lemo 5W pl to Lemo 12W pl 1.5m Auto-detect</td>
</tr>
<tr>
<td>33A135</td>
<td>LEAD, Conductivity/FastScan-PHASEC 2200 Lemo 5W pl to Lemo 12W pl 1.5m</td>
</tr>
<tr>
<td>LMC-0C</td>
<td>CABLE,I/D. Probe cbl-C 3m Lemo 12way disconnect</td>
</tr>
<tr>
<td>Order number</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>40A003</td>
<td>ADAPTER, 12W Lemo to 7W Lemo free Socket Locator 2/2s to Phasec 2/3 0.25m long</td>
</tr>
<tr>
<td>33A121</td>
<td>ADAPTER, (Lemo - Jaeger) 0.24m Hocking probes - PHASEC 2200/D62/PHASEC 2/3</td>
</tr>
<tr>
<td>33A130</td>
<td>ADAPTER,1.5m Lemo/12w-Lemo/4w (PHASEC 2200/Phassec2/3 - reflection probe)</td>
</tr>
<tr>
<td>33A132</td>
<td>ADAPTER,1.5m Lemo/12w-Lemo/4w (PHASEC 2200/Phassec2/3 - bridge/diff prb)</td>
</tr>
<tr>
<td>40A007</td>
<td>ADAPTER Lemo 12 way to DIN 5 way Defectometer prb+lead to Phasec 2/3 0.29m long</td>
</tr>
<tr>
<td>40A010</td>
<td>LEAD, Probe Lemo 12w to Fischer 4w 1.5m Rohmann reflection prb to Phassec2/3</td>
</tr>
</tbody>
</table>

### Adapters Competitors

<table>
<thead>
<tr>
<th>Order number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>40A200</td>
<td>VGA 15 way adaptor</td>
</tr>
<tr>
<td>40A041</td>
<td>Case, splash proof with clear operating window</td>
</tr>
<tr>
<td>39A043</td>
<td>Transit Case with protective foam inserts black Instrument without boot or splash proof case</td>
</tr>
<tr>
<td>Order number</td>
<td>Description</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>40A054</td>
<td>Aluminium desk stand</td>
</tr>
<tr>
<td>39a030</td>
<td>BATTERY PACK, LITHIUM-ION</td>
</tr>
<tr>
<td>39A031</td>
<td>AA BATTERY/ELIMINATOR PACK</td>
</tr>
<tr>
<td>39a035</td>
<td>Charger/Power supply</td>
</tr>
</tbody>
</table>

2.4 Recommended spare parts and consumables

<table>
<thead>
<tr>
<th>Description</th>
<th>Order number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li-ion battery pack assembly</td>
<td>39a030</td>
</tr>
</tbody>
</table>
3 Initial Start Up
3.1 Introduction

GE Inspection Technologies 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 Owners 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 settings.
- 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 eddy current 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,EN 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.

### 3.2 EC Declaration of Conformity

We;

*GE Inspection Technologies, Ltd*

129 – 135 Camp Road

*St Albans Hertfordshire AL1 5HL*

*United Kingdom*

declare under sole responsibility that all production issue versions of the Eddy Current Flaw Detectors Phasec 3, 3s and 3d meet the intent of Directive 89/336/EEC for Electromagnetic Compatibility.

Compliance tested to:

- EN 61000-6-1 2007 Class B
- EN 61000-6-3 2007 Class B

The Phasec 3 has also been tested to DEF STAN 59-411 Part 3 (Jan 2007)
Manufacturer address:
GE Inspection Technologies, Ltd
129-135 Camp Road
St Albans Hertfordshire AL1 5HL
United Kingdom

Phone +44 (0) 1727 795500
Fax +44 (0) 1727 795400

The instruments are 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 conformance of the instrument.

Should you nevertheless detect an error on your instrument, switch the instrument off. Inform your local GE Inspection Technologies Service or Distributor and describe the error in as much detail as possible.

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.
3.3 Checking Supplied Equipment

The instrument is available with a wide range of accessories. Check that the contents of your shipment match all the items listed on the packing note. If any items are missing please contact your supplier immediately.

3.4 Basic Knowledge

As a general rule, effective use of eddy current equipment for new applications requires the following:

An understanding of the principles of eddy current testing, particularly aspects which may limit detectability of flaws such as depth of penetration and the way in which different probe configurations respond to different flaw types.

An understanding of other NDT and inspection procedures which may be appropriate or which may be required to verify results.

Knowledge of the application, i.e. the way in which the part is being tested, manufactured or stressed in use and the probable flaw mechanisms.

Existing applications require a good working knowledge of the equipment to be used plus a written technique to be followed in performing the inspection.
3.5 Key Features of the Instrument

The instrument has been designed to be extremely rugged and robust, whilst also avoiding risk of damage to the surrounding environment. For this reason plastics and rubbers have been used to avoid scratching or denting of precision surfaces, while all connectors are flush with the surface to avoid any scratch hazard. All parts of the unit are secured so as to avoid a Foreign Object Damage (FOD) hazard. For this reason connectors are locked from the inside of the case and there are no parts that can become disconnected.

3.6 Power Sources

Connect the instrument to the power source. This will depend on the configuration of The instrument purchased and can be a lithium-ion battery, an advanced lithium ion battery with internal charger, AA cells or connection to an AC supply via the charger/eliminator unit. For information on these options see Chapter 9, Power Sources and Battery Management.
3.7 Positioning the Instrument

Instrument is a versatile, lightweight unit that is designed for operation in a wide range of environments. A variety of accessories are available for setting the unit in the optimal position for operator use including a protective boot with case prop, tripods and other camera accessories. These can be secured to the instrument using the camera thread provided on the lower edge (see Fig). Ensure any screw is not longer than 8 mm or it may damage the enclosure. The thread type is ¼” BSF.

The instrument has designed to be rugged, splash resistant and also resistant to dirt and dust ingress. The unit is rated to IP64. However, it should not be considered drop proof or waterproof, and care should be taken to position it to prevent damage due to falling or immersion in water.
The instrument has high grip rubber handles on the rear of the unit and these are intended to prevent sliding of the unit when placed on inclined smooth surfaces. Care should be taken to keep the rear of the instrument clean to prevent scratching of the surface. Avoid placing the instrument on contaminated surfaces where it might pick up abrasive particles.

### 3.8 Switching the Instrument On and Off

Once a suitable power source has been connected to the instrument the unit can be switched on by a single press of on/off button.

The unit will then display the welcome screen momentarily, followed by the operating screen.

The unit can be switched off by pressing and holding on/off button for more than 2 seconds.
Introduction to Controls and Basic Operation
4.1 Introduction to Instrument Controls

All operating controls are available on the front panel of the instrument. The most frequently used controls (balance, clear and freeze) are located vertically beside the screen. These buttons are duplicated on either side to allow both left handed and right handed operation.

These keys have two functions. The short press function is as indicated by the light writing on the dark background (i.e. Balance, Clear, Freeze). The second functions are invoked by a long press and are as indicated by the dark writing on the light ellipse (i.e. Automatic Liftoff selection, Clear Reference Trace and Keyboard Lock). These are positioned to be most accessible during operation (see 4.2 for further information).

All the controls required for adjustment of operating settings are based along the lower edge of the screen. Softkeys are engraved with F1 to F6 for ease of reference.

Instrument operating screen

1 ON and Off button
2 Balance Button
3 Clear Button
4 Freeze Button
5 12 Way Connector for Probe Connection
6 7 Way connector for RS232 connection and XY analogue output
7 User Programmable Softkey Button (1 of 6)
8 Menu Screen Button
9 Cursor and OK Buttons for Menu
10 Exec Button
11 USB Connector
12 VGA Output
### Instrument menu screen

**Phasec 3 Common Platform**

#### Table: Instrument Menu Settings

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freq 1</td>
<td>60.6/40.0</td>
</tr>
<tr>
<td>Freq 2</td>
<td>36.6/28.4</td>
</tr>
<tr>
<td>Trace Disp</td>
<td>F1/Mix</td>
</tr>
<tr>
<td>Phase 1</td>
<td>282.0</td>
</tr>
<tr>
<td>Phase 2</td>
<td>312.0</td>
</tr>
<tr>
<td>Filter BP Ratio</td>
<td>36.0</td>
</tr>
<tr>
<td>Filter BP Ratio</td>
<td>25.0</td>
</tr>
<tr>
<td>Input Gain</td>
<td>High</td>
</tr>
<tr>
<td>Input Gain</td>
<td>High</td>
</tr>
<tr>
<td>Display</td>
<td>Spot</td>
</tr>
<tr>
<td>Spot XY</td>
<td>40/0</td>
</tr>
<tr>
<td>Spot Dual</td>
<td>120/0</td>
</tr>
<tr>
<td>Spot Info</td>
<td>None</td>
</tr>
<tr>
<td>Persistence</td>
<td>0.02</td>
</tr>
<tr>
<td>Gain Mix</td>
<td>0.6/0.6</td>
</tr>
<tr>
<td>Alarm</td>
<td>None</td>
</tr>
<tr>
<td>Stretch</td>
<td>60 ms</td>
</tr>
<tr>
<td>Output Shape</td>
<td>Box</td>
</tr>
<tr>
<td>Output Action</td>
<td>On</td>
</tr>
<tr>
<td>Memory</td>
<td>Setup</td>
</tr>
<tr>
<td>Recall</td>
<td>Setup</td>
</tr>
<tr>
<td>Trace Record</td>
<td>Off</td>
</tr>
</tbody>
</table>

---

**GAIN 40.0/10.0**

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**Phasec 3 Common Platform**

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**26**
## 4.2 Overview of button functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>On/off</td>
<td><img src="image1.png" alt="Button Image" /></td>
<td>Short press switches the unit on. Long press switches the unit off. Short presses switch the backlight on and off.</td>
</tr>
<tr>
<td>Balance Lift off</td>
<td><img src="image2.png" alt="Button Image" /></td>
<td>Returns the spot to its set position on the operating screen. A long press automatically sets the phase angle for lift-off. In NormalDual Mode they can be made to Balance both working spots, or can be split to control left and right spots individually (see BAL/CLR Mode).</td>
</tr>
<tr>
<td>Clear</td>
<td><img src="image3.png" alt="Button Image" /></td>
<td>Clears active trace data left on screen as a result of long (or permanent) persistence. A long press will erase traces that have been recalled from memory. In NormalDual Mode they can be made to Clear both working spots, or can be split to control left and right spots individually (see BAL/CLR Mode).</td>
</tr>
<tr>
<td>Function</td>
<td>Button</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>Freeze</td>
<td></td>
<td>Freezes the active trace in its current position (useful for saving traces). A long press locks the keypad</td>
</tr>
<tr>
<td>Lock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Menu</td>
<td></td>
<td>Switches between the operating screen and the menu screen.</td>
</tr>
<tr>
<td>OK</td>
<td></td>
<td>Selects menu items in the menu screen. Switches between softkey items in the operating screen.</td>
</tr>
<tr>
<td>Exec</td>
<td></td>
<td>Toggles the cursor between updating compound variables such as Alarm Boundaries, XY Gain and High Pass and Low Pass Filters. Executes menu actions such as entering Save or Re-call, activates alarm parameters, activates the required menu language, and starts the Trace Recorder. A long press performs the automatic load selection when in absolute mode.</td>
</tr>
</tbody>
</table>
### Function Buttons Description

**Cursors**
- Navigates around the menus and changes values. For some menu items (such as GAIN, ALARM TOP, BOTTOM etc) left and right cursor have large increments, whilst up and down have fine increments.

**Softkeys**
- User Programmable softkeys and utility keys.

### 4.3 Changing Settings using Menus and Cursors

To change settings on the instrument the following general guidelines apply. There are some special cases explained in the relevant sections.

The MENU button switches to the menu screen.

Use cursors to move to the relevant menu field.
The Menu system has 4 columns but only shows three at any one time. The fourth column can be made visible by moving the cursor to the right of the screen and then one more right cursor press swaps the right most menu column with column 4. Pressing the left cursor swaps column 4 with column 3. Pressing the right cursor when in column 4 moves the cursor to column 1 but leaves column 4 visible.

Use OK to highlight the setting.

Use cursors to change the setting.

Note: Press exec to move between overall settings and individual settings for composite variables such as Gain, High and Low Pass filters and Alarm Boundaries.

Alternatively the operator can switch back to the operating screen once pressing MENU has highlighted the menu item. The variable will now be displayed on the operating screen. At this point it can be adjusted using the cursors.

4.4 Setting the Operating Language

The instrument can be set to operate in a range of languages. Available languages are English, French, German, Spanish, Portuguese, Chinese and Japanese. Use the cursor up button to
move through the available languages. When the required language has been selected press exec to activate the selection. This instantly updates the menu in the chosen language. Setting the time and date will enable all stored traces and settings to have accurate date and time information stored with them.

4.5 Setting the Date and Time

To set the time:
- Press MENU to enter the menu screen.
- Using cursors move to the fourth menu column.
- Move to the TIME item.
- Press OK to highlight the menu item.
- Use cursors, left/right to select the time component to change.
- Use cursors, up/down to set the time.
- Once this has been completed press menu to return to the operating screen.

To set the date:
- Press MENU to enter the menu screen.
- Using cursors move to the fourth menu column.
- Move to the DATE item.
- Press OK to highlight the menu item.
- Use cursors, left/right to select the Day, Month or year that requires changing.
- Use cursors, up/down to change the item.
- Press OK to update the DATE item.
4.6 Setting the Automatic Power Down function

The instrument is provided with a selectable power down function. This switches off the unit after a predetermined period of inactivity. Settings are Off, 5, 10, 15 or 20 minutes. This function will preserve battery life in situations when the equipment is not in constant use. To vary this move to the P/DOWN menu item.

Note: When the unit closes down due to the Automatic Power Down function all settings will be preserved and will be restored when the unit is switched back on. However, the mode that the unit starts back up in will depend on the probe leads connected.

4.7 Graticules – Spot Mode

A suitable graticule for the inspection can be selected from a choice of four different types. This applies to spot mode only. If Timebase mode is chosen then an automatic graticule (AUTO) is displayed that resizes relative to the sweep setting.

NONE – A clear graticule with cross-hairs for identifying the origin:
GRID 1 – A square graticule with X and Y positions marked at 20%:

GRID 2 – A square graticule with X and Y positions marked at 10%:
POLAR – a circular style graticule:
4.8 Selecting Graticule Type

Select the GRATICULE menu field. Use the cursors to step through the options. Press OK to select the required option.

4.9 Selecting Key Click

Audio feedback from the unit can be selected so that even when operating the unit in heavy gloves an operator will be able to determine whether a key press has been successful.

Set to KEY CLICK to either ON or OFF.

4.10 Defining User Programmable Softkeys

Each of the six softkeys on the front panel of the instrument can be allocated to any setting as required by the operator.

Press menu to enter the menu screen. Use the cursor buttons to step to the required menu item. When it is highlighted press the OK button to highlight the item value and then hold the required function key.

After 2 seconds the menu field is allocated to the on-screen softkey location.
Press menu to return to the operating screen.

Pressing a softkey will bring up the associated item value for adjustment by the cursor buttons.

To clear a softkey press menu to enter the menu screen and hold the softkey for two seconds whilst on the menu screen, when a menu item is NOT selected.

To use the second set of programmable soft keys (the Utility Set) press F1 when on the menu screen in order to page between the two softkey sets.

4.11 Using Pre-Programmed Softkeys

For three frequently used operations, Spot position, Box Gate Alarm, and Sector Alarm there is easy access to these settings via the pre-programmed softkeys.

There is also two utility sets that may be user programmed (softkeys). When the settings are saved the configuration of the two softkey utility sets are also saved. This enables the instrument to be configured for ease of use according to the test requirements.
Each utility set has a specific icon to enable the operator to easily tell which set is in use. These icons are in the lower left part of the screen.

User definable Softkey 1

The user can program this. As a default these settings are GAIN, PHASE 1, FREQ 1, H/LP 1 (high Pass and Low Pass Filters), TrcRec (Trace Recorder) and DISPL (Display type).

User Definable Softkey 2

Can be programmed by the user as a second set by pressing F1 when in the menu mode. As a default these settings are FREQ1, PROBE (probe type e.g. absolute, bridge etc.) SAVE (for Saving settings) and RECALL (for recalling settings).

Box Alarm

ACTIVE, ACTION, SHAPE, STRETCH, TB (Top and Bottom), LR (Left and Right).

Sector Alarm
ACTIVE, ACTION, SHAPE, STRETCH, SE (Start and End), IO (Inner and Outer).

XY Spot Position ✨

PERS (persistence), SWEEP, GRAT (graticule), DISPL (Display Type) and SPOT (Spot XY position).

To cycle through the above softkey sets repeatedly press OK whilst on the operating screen. An icon on the right hand side of the display indicates which softkey mode the instrument is in.

Note: These settings apply to Normal Single mode only, they are different for Normal Dual Mode, Rotary and Conductivity modes.

Another press on OK will revert to user programmed softkeys and the icon will disappear. A long press on OK at any time will revert to the first set of user programmed keys.

4.12 Keyboard Lock

To prevent accidental key presses changing the settings, the keyboard can be locked. This prevents the operation of all menu keys.

Balance, clear and freeze will continue to remain active when the keyboard is locked.
A long press invokes the keyboard lock on freeze.

A lock icon appears on the display to indicate that the keyboard lock is active.

A long press removes the keyboard lock on freeze.

4.13 On screen icons

In addition to the utility key icons there are several other icons that inform the operator of the status of the instrument.

These icons are in the bottom left of the display control area.

Single frequency mode set

Dual Frequency mode set

Screen display frozen
Recalled trace on screen

These icons are in the bottom right of the display control area.

Alarm Active (may not be visible to view choice)

Keyboard lock active (see 4.12)

4.14 Understanding the Different Modes

The instrument is a multi-capability unit that effectively contains four separate instrument modes. In the menu screen the operator can switch the mode by selecting MODE and changing to the required mode using the cursors.

The modes will also automatically change when either a rotary or conductivity probe is attached using an auto detection function.
The unit defaults to the last mode it was used in, unless a rotary or conductivity probe is attached to
the unit. The user can put the instrument into any mode required by stepping to the MODE item in the
PROBE section of the menu. Select which mode is required with the OK and cursor buttons, and press
exec to switch modes. Pressing OK will escape from the selection process.

4.15 Normal Single Mode (all instruments)

Normal Single mode is effectively the general purpose mode, and covers a wide variety of applica-
tions, from sub-surface corrosion inspection (generally using low frequencies) to surface crack detection and inspection of thin-section items (generally using higher frequencies), with a wide variety of
probes such as Absolute, Bridge, Weld Inspection, Spot Face, Reflection etc. More details can be found in Chapter 5.

4.16 Conductivity and Coating Thickness Mode (all instruments)

The Conductivity mode is used for the conductivity measurement of non-ferrous metals. This measurement can be very useful for detecting heat damage or other material change. Measurement of conductivity is used for the accurate calculation of effective depth of penetration. In addition there is a graph indicating the thickness of non-conductive layers on the top of metal surfaces. This can be used for paint thickness and insulation evaluations etc. This functionality is outlined in Chapter 6.
4.17 Rotary Mode (only Phasec 3s and Phasec 3d)

The Rotary mode is the mode in which the unit supports rotary probe drive units, primarily used for the inspection of holes in structures, such as fastener, cooling or lightening holes. The unit is capable of powering rotary probes from the unit, and can support scanner speeds of up to 3000 RPM. This functionality is outlined in Chapter 7.

4.18 Normal Dual Mode (only Phasec 3d)

The Normal Dual mode is the mode in which the unit is able to drive a single probe at two separate frequencies, or drive a single probe in two modes (e.g. absolute and differential simultaneously). This functionality is described in Chapter 8.

Note: For the following instructions it is assumed that the operator is familiar with the method of changing variables described in 4.3 - Changing Settings using Menus and Cursors.
5 Operation in Normal Single Mode
(Phasec3, Phasec3s, and Phasec3d)
5.1 Connecting a Probe

A very wide range of eddy current probes may be used with the instrument. They may be connected directly by an appropriate cable or via adapters in the case of probes made for other instruments. The primary probe connector on the instrument is the 12 way Lemo connector on the right hand side of the front panel.

For existing absolute probe cables terminated in a BNC cable a Lemo 12 way to BNC adapter is available (PRN 40A002). For other probes, please see 2.3, Accessories.

5.2 Selecting Probe Type

Probe type will depend on the inspection, taking into consideration the flaws that are being inspected for. Flaw geometry, as well as material type and depth of penetration required will determine what kind of probe is required. Once this probe has been selected the instrument can be set to match the connected probe type.

It is important to understand that probes are configured as a choice of EACH of the following elements:
- Absolute or Differential
- Bridge or Reflection
- Shielded or Unshielded

With some eddy current instruments the probe must be hardwired into the configuration required.
However the instrument can drive probes in a variety of ways. For this reason it is often possible to use a differential probe as an absolute probe. This flexibility allows for different configurations with a single probe, however care must be taken to ensure that the operator understands the effects of each configuration.

Probe type can be set to Locator, Absolute, Bridge or Reflection.

Locator mode is a dedicated mode that is designed to match the impedance of all absolute Locator probes at 100 Ohms.

The Absolute mode is for Absolute probes with an impedance of 50 Ohms.

For Absolute or Differential probes intended for bridge operation the setting should be Bridge.

For driver/pick-up probes the Reflection setting probe should be used.

5.3 Frequency

The instrument has a wide range of selectable frequencies between 10 Hz to 10 MHz. Select FREQUENCY from the menu. The frequencies available are in the following ranges:

- Between 10 Hz and 99.5 Hz in 0.5 Hz steps
• Between 100 Hz and 995 Hz in 5 Hz steps
• Between 1 kHz and 9.95 kHz in 50 Hz steps
• Between 10 kHz and 99.5 kHz in 500 Hz steps
• Between 100 kHz and 995 kHz in 5 kHz steps
• Between 1 MHz and 10 MHz in 50 kHz steps

The choice of the correct frequency is critical for a good inspection and is dependent on the flaw type, the probe used and the depth of penetration required.

To rapidly step through the frequency ranges the left and right cursors can be used, by stepping to the right or left end of the frequency and repeating the key press, the frequency will step in orders of magnitude.

Many probes are supplied with a fixed frequency stated as their operating frequency. However it is possible to carry out an effective inspection using a different frequency to the stated nominal. As a rule of thumb the probes can be used up to three times higher or lower than its "center" frequency. However this should be validated by the use of test blocks to ensure the effectiveness of the probe.
5.4 Selecting a Balance Load

Absolute and Locator Probes:
The instrument has a series of internal balance loads to balance Absolute and Locator probes. Attach a suitable probe and go to the operating screen.

Press and hold exec for approximately 2 seconds, until the auto load detect process starts.

The instrument will select a suitable load in order to balance the absolute probe. If the operator wishes to override the selection then this can be performed by going to the Load item on the menu screen.

5.5 Balancing the Probe

All Probe Types:
The probe should be placed on a known good section of material and balance pressed. If the probe cannot be balanced the message BALANCE FAILED will be displayed. A failed balance may be for a variety of reasons:

- Incorrect probe selection (see 5.2)
- Incorrect frequency selection (see 5.3)
- Input Amplifier saturated, i.e. Input Gain too high (see 5.7)
- Incorrect Load selection for absolute probe (see 5.4)
5.6 Automatic Lift-Off Compensation

An automatic facility is provided to rotate the lift-off signal so that it moves from the balance point horizontally to the left of the screen (for most applications this is the accepted position).

To perform this procedure place the probe on an area of known good metal of the type to be inspected.

Press and hold balance for 2 seconds.

The unit will balance. When the unit displays LIFT PROBE the probe should be removed from the surface of the metal. The unit will automatically rotate the phase of the lift-off signal so it is set to the 9 o’clock position.

If the LIFT PROBE message shows for more than 2 seconds after you have lifted the probe then automatic lift-off compensation has failed. If this occurs, please see reasons for balance failure in section 3.5. Also, the gain may need to be increased so that the lift-off signal is greater than one half screen height.
5.7  **GAIN XY**

The instrument has both composite and independent X and Y gain that are controlled from the GAIN XY menu item. This allows fine setting of the impedance plane display. The unit allows simultaneous increase or decrease of the gain setting by using the GAIN XY function and pressing left/right cursors for 10 dB adjustment and up/down for 1 dB adjustment. Pressing the exec button steps from composite setting to setting just the X value. A subsequent press selects the Y value and another press on exec returns it to composite setting.

This independent gain allows extremely fine attenuation of the signals properties to give the best separation of lift-off signal from the flaw signal.

5.8  **Manual Phase Adjustment**

Select PHASE from the menu. Highlight the PHASE setting using OK, and select the required digit using the left/right cursors, and increase or decrease using up/down cursors.

This feature allows rotation of the signal so that flaw indications can be presented in the clearest possible fashion, and is useful for ensuring that non flaw signals do not trigger alarms.
Convention is that the lift-off signal (i.e. the signal that displays when the probe is lifted off the surface of the material) is set in the “9 o’clock” position.

Phase is adjustable from 0 to 359.9 degrees in steps of 0.1, 1, 10 or 100 degrees as required.

5.9 Overview of Filters

Filters are used to reduce or eliminate unwanted signals. High pass filters reduce low frequency components of signals and Low pass filters reduce high frequency components. The frequency of the two sets of filters should not be set so that there is no gap between them or the inspection bandwidth will be reduced to zero (i.e. no signal).

The gap between the filters can be set as a band pass filter. The instrument allows the user to relocate this band in the frequency cutoff spectrum by employing the Band Lock setting feature (see 5.13).

5.10 High Pass Filters

The High Pass filter reduces low frequency components such as product vibration, geometry and temperature drift changes. If the probe does not traverse a crack quickly the unit may treat it as a slowly varying signal and the indication will be reduced.
A typical application for the high pass filter would be to remove low speed rotation signals from a rotating probe system. The frequency of the noise from these sources is lower than the wanted defect signal.

High pass filters can be used effectively during hand scanning where there are slowly changing effects but care should be exercised to move the probe at a constant speed. Settings greater than 10 Hz may be unsuitable for hand scanning. For tests with a rotating component a higher setting may be appropriate.

Select HP/LP from the Menu.

Use exec to select just the High Pass filter setting.

Use cursors to change the value.

The DC setting indicates that no low frequency signals are being filtered.

Standard High Pass filter settings available are (in Hz):
- DC
- Ultra filters 0.01 Hz to 0.5 Hz steps (6 steps)
- 1 Hz to 9.95 Hz in 0.05 Hz steps (180 steps)
- 10 to 99.5 Hz in 0.5 Hz steps (180 steps)
- 100 to 995 Hz in 5 Hz steps (180 steps)
- 1 kHz to 1.2 kHz in 50 Hz steps (4 steps, Normal Mode)
- 1 kHz to 1.95 kHz in 50 Hz steps (20 steps, Rotary Mode)

Ultra filters are special low frequency filters that are controlled by the lift-off signal to give improved signal display and usability.

**Note:** HP settings cannot be moved higher than the currently set LP setting. If it does not appear possible to select some of these settings, check that the LP filter is set to higher than the desired HP filter setting.

### 5.11 Ultra Filters

The Ultra filter is a special form of the High Pass filter. ULTRA is a filter setting that removes the effect of very long time duration signals, such as drift of the balance point caused by temperature or material property changes. This has a range of time constants that it averages over so that different scanning speeds etc. can be compensated.

However, it has been designed so that rapid and/or large movements of the spot from the balance point will not be compensated. This stops the spot from rebalancing to the centre when the probe has been taken off the surface of the metal, for example. Ultra filters are indicated by a U prefix before the value.
5.12 Low Pass Filters

The Low Pass filter reduces and eliminates rapid signal changes such as electrical noise. If a discontinuity or flaw is traversed quickly with a probe, a low pass filter unit will treat it as a rapidly changing signal and the indication will be reduced. The filter setting is sometimes a compromise between acceptable noise and ability to respond to fast flaw signals. Select LOPASS from the Menu.

Use the cursor pad to change the value:
- 3 to 9.95 Hz in 0.05 Hz steps (140 steps)
- 10 to 99.5 Hz in 0.5 Hz steps (180 steps)
- 100 to 995 Hz in 5 Hz steps (180 steps)
- 1 kHz to 1.5 kHz in 50 Hz steps (11 steps, Normal Mode)
- 1 kHz to 2.0 kHz in 50 Hz steps (21 steps, Rotary Mode)

5.13 Filter Setting

Variations in test frequency will result in the operator wanting to move the high and low pass filter settings simultaneously. This can be achieved through the use of the Filter 1 setting. This item has two possible settings, BP RATIO and BP LOCK. This filter function is most useful for rotary inspections where variations in RPM
will require changes to both high and low pass filters.

BP LOCK – This maintains the gap between hi and low pass filters as a fixed amount. For example if the low pass is set at 700 Hz and Hi Pass at 400 Hz then incrementing either will always result in a 300 Hz band being maintained between the two. This setting should be used if a specific Band is required for an inspection, irrespective of rotary probe RPM.

RATIO – This maintains a band between Hi Pass and Low Pass filters that is proportional to the original setting position, so as the operator reduces either the Hi or Low Pass setting, the Band Pass will reduce, likewise as the Hi or Low Pass are increased so the size of the band will increase. This mode gives the most consistent filter performance when Rotary probe RPM is varied, as the higher the RPM, the wider a band pass filter needs to be in order to display the same signal characteristics as at lower RPM speeds. The ratio setting removes the need for the operator to manipulate both hi and low pass filters when changing speed.

Note: This setting only applies when both HP and LP filter settings have been highlighted for simultaneous update from the HP/LP menu item. Use exec to select this.

5.14 PROBE

This function allows the selection of the probe configuration. See 5.2 for a full explanation.
5.15 PROBE ID

This allows the user to manually select a rotary probe drive supplied from manufacturers other than GE Inspection Technologies, and will only work when in Rotary mode. Probe drives currently supported are Rohmann and Zetec. See 7.5 for full details.

5.16 LOAD

This allows the manual selection of Load for balancing absolute probe operation. A long press on the exec will automatically select the most appropriate balance load. The following table gives approximate inductances for a range of probes.

<table>
<thead>
<tr>
<th>Load</th>
<th>Description</th>
<th>Example Product Reference Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.2 µH</td>
<td>Locator 2 MHz probes, Defectometer probes with adapter 29A010</td>
<td>122P1A, 352P1A, 106P4, 206P4, 304P24</td>
</tr>
<tr>
<td>22 µH</td>
<td>Broad band and some Phasec probes</td>
<td>130P2, 5P21</td>
</tr>
<tr>
<td>47 µH</td>
<td>Locator 500 kHz probes</td>
<td>121P1A, 351P1A, 105P4</td>
</tr>
</tbody>
</table>
5.17 INPUT GAIN

Switching the INPUT GAIN from Low can increase the sensitivity of the probe (+0 dB) to High (+14 dB). This increases the signal level input from the probe and consequently reduces electronic noise. However for some probe types and materials this may cause problems with balancing (see 5.5). Changing this will affect the overall system gain level (shown by GAIN XY).

Note: If the instrument repeatedly fails to balance set Input Gain to Low.

5.18 Probe Drive

The level at which the probe is driven can also be varied by using the DRIVE dB menu item. This can be set to -8 db, 0 dB and +8 dB. This has significant advantages improving the signal to noise level attainable, but may cause problems in certain setups with saturation. If the unit fails to balance this level should be reduced as a check.
5.19 SAVE function

To save a trace:
- Create the trace on screen.
- Press freeze to freeze the display.
- Go to SAVE and select TRACE.
Press exec to enter the Save screen.
The instrument will move to the next empty storage space.

Note: If a trace or setting has been saved then the instrument will automatically duplicate the previous saved item and add an incremental character to help the operator name subsequent traces rapidly. If the automatic name is not required it can be immediately cleared with a single press of the F2/Clear softkey.

- To move to a new storage space press UP/F5 and DN/F6 to move up and down the list. The operator can name the file using the alphanumeric box.
- Use the cursors to navigate to the correct letter and press OK to accept each letter.
- Any mistakes in the file name can be corrected by moving the cursor to the correct point by using </F3 and >/F4. Once the file has been named press SAVE/F1 to exit the field. To leave the menu without saving back changes, simply press exec.
- To save setups repeat the steps above but ensure SAVE is set to SETUP.
5.20 RECALL function

- To recall a trace move to RECALL menu field, press OK and select TRACE.
- Press exec to enter the Recall screen (see Fig. 4.3).
- To move to the location use DN/F6 to move down and UP/F5 to move up.
- To leave the dialogue without recalling press exec.
- To clear the location without leaving the dialogue press DEL/F2.
- To recall the trace press RECALL/F1. To exit, press exec.
- To recall a SETUP repeat the steps above but ensure RECALL is set to SETUP.
- To clear the reference trace from the screen press and hold clear.

Note: When a trace is recalled, the graticule that was used when the trace was stored will be recalled and displayed for as long as the reference trace is displayed. A flashing icon is used to indicate to the user that other selected graticules cannot be selected whilst this is the case.
Recalled Trace with flashing reference trace icon indicated

RECALL menu

<table>
<thead>
<tr>
<th>No</th>
<th>Type</th>
<th>Name</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>RDL</td>
<td>RRD</td>
<td>RESERVED FOR SETUP</td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>RDL</td>
<td>RRD</td>
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</tr>
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<td>RRD</td>
<td>RESERVED FOR SETUP</td>
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</tr>
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<td>RDL</td>
<td>RRD</td>
<td>RESERVED FOR SETUP</td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>RDL</td>
<td>RRD</td>
<td>RESERVED FOR SETUP</td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>RDL</td>
<td>RRD</td>
<td>RESERVED FOR SETUP</td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>RDL</td>
<td>RRD</td>
<td>RESERVED FOR SETUP</td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>RDL</td>
<td>RRD</td>
<td>RESERVED FOR SETUP</td>
<td></td>
</tr>
<tr>
<td>09</td>
<td>RDL</td>
<td>RRD</td>
<td>RESERVED FOR SETUP</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>RDL</td>
<td>RRD</td>
<td>04 Nov 2002 13:34</td>
<td></td>
</tr>
</tbody>
</table>

Recalled Trace with flashing reference trace icon indicated
5.21 Saving and Recalling in Different Modes

Traces and setups can be stored in Normal Single, Normal Dual or Rotary mode but cannot be recalled in a mode that they were not created in. The Save and Recall dialogs indicate this by the letters under the column MT. If the Trace or Setting has NS: before it then it was created in the Normal Single mode, ND: indicates Normal Dual mode and RS: indicates Rotary Single mode.

Attempting to recall a trace or setting not created in the specific mode will result in the error message MODE INCOMPATIBLE: CANNOT RECALL being displayed.

5.22 Allocating Trace and Setup Permissions

The Trace and Setup Files have four different Type statuses; Empty, Full, Lock and User. To access these settings, select RECALL, Setup/Trace and press exec.

The status can be read from the Type column on the Recall screen (the second column).

‘Empty’ indicates that no data has been stored in the location.

‘Full’ indicates that data has been stored in the location. This is the default data Type.

‘Lock’ prevents the user from accidentally deleting the file when recalling the data.
‘User’ enables an operator to recall the Trace or Setup when in User mode (See 7.12). When the instrument is in User mode no other Traces or Setups can be recalled.

- To change the data type, go to the required data location via the recall screen (see 5.20). Press the OK button. The data type will change to User. A further press will change to Lock.
- To return the Type to Full, go to the setting on the RECALL menu, and make sure the data is showing LOCK. Press the FREEZE button and it will return to FULL.
- Press menu to return to the menu.

Note: When saving large traces the unit may automatically allocate a subsequent Save slot to cope with all the data. In this case the user will see that the type is indicated as Extra. Deleting the saved trace in the slot above can only clear this.
5.23 Trace Recorder

The instrument has the facility to record up to 64 seconds of trace and to play it back when in Normal Single mode, allowing the optimal set-up of gain levels and alarm gates, among other items. In Rotary Single and Normal Dual mode up to 32 seconds of trace can be recorded.

This feature gives the operator the following ease of use features:

- allows the operator to concentrate on the probe and quality of scanning whilst recording and then replay the data afterwards to interpret
- data may be recorded in order to optimize settings of gain, phase and filters e.g. rotary.

- To operate the trace recorder mode move to the TRACE RECORD item in the menu and select On.
- Press exec to activate the recorder. A new set of function keys will appear.

- Pressing OK the operator can move through the Softkeys as before.
The operator must ensure that the correct FREQUENCY, PROBE TYPE, LOAD (if applicable) and INPUT GAIN are selected before starting the recording. These items cannot be changed when playing back as they are fundamental to the data captured. The system indicates that these are locked items (i.e. they cannot be changed) by displaying a key item alongside them in the menu.

When the operator is ready to scan then the RECORD Softkey can be pressed, and the trace recorder will start. The operator can choose to record for the maximum amount of time or can simply press the PLAY/F1 Softkey to start replaying the recorded signal.

During recording, the bar is displayed at the bottom of the screen and the solid area indicates how much of the available storage area has been used. A flashing bar indicates that the storage area is full and only the last 32 seconds (in Normal mode) of data is stored.

When the signal is replayed a bar at the bottom will be displayed, the black area indicating which element of the recorded trace is being displayed.

The operator can focus on a specific area of the replayed trace by pressing START/F3 and moving the point using the cursors to locate the start point for the clip, pressing END/F3 and moving the point using the cursors to locate the end point for the clip, and then pressing ZOOM/F5 to move in. Excessive zoom can be corrected by re-pressing ZOOM/F5 to step back through previous zoom levels. DISP/F6 allows the user to toggle between XY display and YT mode.
In Normal Single mode FFWD/F2 allows the user to play the clip at four times normal speed, pressing F2 again returns the replay speed to normal. In Rotary Single and Normal Dual modes the data will fast forward at two times normal speed.

While in the trace recorder mode, the operator can press OK as normal to scroll through the programmable key sets, and can use menu to access the menu as usual.

To end a trace recorder session, press clear at any stage.

Note: The AUTOMIX function on key A-Mix/F4 can only be operated when the instrument is in Dual mode.

5.24 An Overview of Alarms

To switch on the alarm functions ACTIVE has to be set to a valid setting (F1 for Normal Single and RotarySingle, and F1, F2 or MIX for Normal Dual). The Alarm menu field shows the settings of alarms shapes that are currently selected in the SHAPE dialog.
Alarm Menu showing different Alarm types:

<table>
<thead>
<tr>
<th>ACTIVE</th>
<th>SHAPE</th>
<th>TOP/BTM</th>
<th>LFT/RGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Box</td>
<td>Off/Off</td>
<td>Off/Off</td>
</tr>
<tr>
<td>F1</td>
<td>Box</td>
<td>20/-20</td>
<td>-20/20</td>
</tr>
</tbody>
</table>

Off

Box

Phasec 3 Common Platform
There are two types of alarm: BOX and SECTOR. An alarm condition can be indicated through the LED and Sounder and also by freezing the display. To select which action is required it can be selected from ACTION as None, Tone, Freeze or Tone&Frze. To improve audibility, the Alarm may be stretched to lengthen the audible alert. An alarm can be switched off by setting ACTIVE to None.

Note: Only one type of alarm can be active at a time, and if ACTIVE is set to None no alarms will appear, even if settings appear on the menu screen.

If ACTIVE is set to None it will not be possible to access the ACTION menu item, or TOP/BTM, LFT/RGHT, START/END, IN/OUTER.

In Normal Dual mode the alarm will not be displayed if the display channel that it is active on (F1, F2 or Mix) is not selected for display from the VIEW menu item.
5.25 Box Gate Alarms

To set a box go to SHAPE and select Box.
- Press menu to return to the operating screen.
- Press OK until the BOX Pre-Programmed Softkeys appear (see 2.12).
- Press TB1 to call up the TOP/BTM dialogue.
- Repeat for LR1 and LFT/RGHT.
If the balance point is inside the box then an alarm condition will be created when the working point goes outside the BOX. If the balance point is outside of the BOX alarm then the alarm will indicate when the working point goes inside the BOX.
5.26 Sector Alarms

The sector alarm has the same versatility as the box alarm, and works on a similar principle.
- To set a Sector Alarm go to Alarm Shape on the Menu and select Sector.
- Press menu to return to the operating screen.
- Press OK until the Sector Pre-Programmed Softkeys appear (see 2.12).
- Select IO for Inner/Outer values and SE for Left/Right values.
5.27 Stretch

This setting allows the alarm to be stretched for 50 msecs, 100 msecs, 500 msecs, 1 second, 5 seconds and 10 seconds. This function is relevant where a short alarm might be missed but it is important to note that several flaws close together will not be resolved if the alarm stretch is too long.

5.28 Alarm Action

This setting controls action of the unit upon detecting an alarm condition. The permissible selections are None, Tone, Freeze, and Tone&Frz. Tone emits a beep when the gate is triggered, and Freeze stops the trace at that point. Tone&Frze allows Tone and Freeze to be used at the same time.

5.29 Display

Display type can be selected between SPOT, TIMEBASE, WATERFALL, BAR XY and BAR.

SPOT mode (or XY display) is the display mode used for the majority of non-rotary applications. This displays both the X and Y components of the impedance plane.
TIMEBASE mode (or YT display) is the mode in which the Y component is represented against time. In this mode some of the menu items are not valid, such as X:Y ratio, Graticule, and Sector Alarm. However these items are still displayed and can be modified. The T component (time) can be changed by changing the SWEEP variable below.

WATERFALL mode can be used in either nonor rotary mode. In non-rotary application it can be used as extended Timebase. In rotary mode the Waterfall is synchronized to the rotation of the drive.

BAR XY mode is used for non-rotary applications. In this mode there is a split screen display; one display has a vertical Bar which, shows the Y amplitude of the signal and the other display is SPOT (see above)

BAR mode is used for non-rotary applications. Its display has a vertical Bar which, shows the Y amplitude of the signal.

5.30 Graticule

Depending on how the display mode (above) is set. This gives a choice of Grid 1, Grid 2, Polar or none in Spot display mode, it is fixed when in timebase mode, and fixed when in Waterfall display mode.
5.31 Spot X/Y

The position of the spot can be adjusted to define the origin. This only applies when DISPLAY is set to SPOT. When the spot position is altered the graticules move automatically to indicate the origin point on screen. If the graticule is set to NONE there are cross hairs to indicate the origin. The cross-hairs allow the operator to observe if the balance point has drifted or moved due to an artefact or material condition.
The spot positions are indicated in terms of percentage position, relative to X and Y axes.

Zero X and Zero Y are indicated as the middle of the left hand side of the screen. This allows the user to easily set up the unit in terms of percentage screen deflection relative to the display.

To move spot position whilst on the operating screen use the Spot Position Pre-Programmed Softkeys (see 4.11).

5.32 Spot Info

The location of the working spot on screen can be displayed by switching the SPOT INFO item to on by selecting it as CH1. This will then display a dialog box on screen that gives a numerical representation of the spot position. This can be useful for metal sorting applications and similar. When the freeze button is hit, the values in the box will also be frozen.
5.33 Persist

This function sets the time for which data is retained on the display before it is refreshed. When set to permanent the data on the screen remains until the Clear button is pressed. The persistence values are set to match the Sweep values above so that the trace can persist for one full traverse of the screen.

Settings available are (in seconds): 0.1, 0.2, 0.5, 1.0, 1.5, 2.0, 5.0, 10.0, 15.0, 20.0,

5.34 Sweep

Sweep applies only when TIMEBASE has been selected. This varies the time that it takes the spot to move across the major division on screen.

Settings available are (in seconds):
0.1, 0.2, 0.5, 1.0, 1.5, 2.0, 5.0, 10.0, 15.0, 20.0, 50.0.
5.35 Colours

Colours allows the colour scheme on the instrument to be changed according to user preference and ambient lighting conditions.

<table>
<thead>
<tr>
<th>Colours</th>
<th>Background</th>
<th>Graticule, text, messages</th>
<th>Trace 1</th>
<th>Trace 2</th>
<th>Trace 1 +graticule</th>
<th>Trace 2 +graticule</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Black</td>
<td>Green</td>
<td>Cyan</td>
<td>Yellow</td>
<td>Green</td>
<td>Blue</td>
</tr>
<tr>
<td>2</td>
<td>Black</td>
<td>White</td>
<td>Magenta</td>
<td>Yellow</td>
<td>Green</td>
<td>Blue</td>
</tr>
<tr>
<td>3</td>
<td>White</td>
<td>Black</td>
<td>Blue</td>
<td>Red</td>
<td>Green</td>
<td>Blue</td>
</tr>
<tr>
<td>4</td>
<td>Yellow</td>
<td>Blue</td>
<td>Red</td>
<td>Black</td>
<td>Green</td>
<td>Blue</td>
</tr>
<tr>
<td>5</td>
<td>White</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
<td>Green</td>
<td>Blue</td>
</tr>
<tr>
<td>6</td>
<td>Black</td>
<td>White</td>
<td>Red</td>
<td>Cyan</td>
<td>Green</td>
<td>Blue</td>
</tr>
<tr>
<td>7</td>
<td>Cyan</td>
<td>Black</td>
<td>Red</td>
<td>Magenta</td>
<td>Green</td>
<td>Blue</td>
</tr>
<tr>
<td>8</td>
<td>Green</td>
<td>White</td>
<td>Red</td>
<td>Magenta</td>
<td>Green</td>
<td>Blue</td>
</tr>
</tbody>
</table>

There are 8 color schemes in total each with its own ID number. There is a feature to automatically highlight when a trace crosses the graticule and/or a recalled trace that turns the color of the trace when crossing to a different color to improve the ability of the operator to discriminate signals.

All the colour schemes used are high contrast. When used in high ambient light conditions then the color schemes with the light background are recommended e.g. 3, 4, 5 and 8. Colors scheme 5 is a monochrome scheme with the highest contrast.
5.36 Output Functions

The instrument has a provision for outputting Analogue X and Y signals, which could be used on an external plotter or data logger. To enable this function the unit should be connected to the external device using the 7 way lemo connector.

The X and Y outputs are always available, so there is no need to configure the device to output them (see chapter 10 for details of pin outs).
Operation in Conductivity Mode
6.1 Basics of Conductivity

Conductivity of metals is commonly measured in two sets of units. In the SI system the unit of conductivity is Mega Siemens per meter (MS/m). A Siemens is the inverse of an ohm. Conductivities of metals at ambient temperature are typically in the range of 1 to 60 MS/m.

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 instrument 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 MS/m, (set this in CONDUCTIVITY on the menu).

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 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 that 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).

6.2 The Effect of Temperature on Conductivity

The conductivity of a material can change with temperature, but is normally specified at 20 degrees Celsius. For the best accuracy, the instrument, material to be tested, probe, and calibration standards should always be at the same temperature, close to 20 °C.
6.3 Lift-off Compensation

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.

6.4 Measurement on Curved Surfaces

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).

6.5 Setting up for Conductivity and Coating Thickness Inspection

To use the instrument for Conductivity measurement requires the following:
  • Instrument
  • Standard 60 kHz Probe (PRN 47P001) and Cable (PRN 33A170)
  • Conductivity standards of known value (PRN 33A136 or equivalent)
Before switching on, plug the lead into the 12 way Lemo socket on the front of the unit. Switch the unit on. The operator should see a splash screen displayed that has the word Conductivity on. After a short pause the Conductivity Operating Screen will be displayed.

The screen above shows the two elements of the Conductivity operating mode.

On the left the screen displays the conductivity reading, in the units as set on the Menu page. An arrow adjacent to the bar indicates the limits set. On the right is the display for Lift-off. Again this bar graph is calibrated in the units set by the operator on the menu screen, in this case under DIMS (an abbreviation for Dimensions).
– Press menu to show the Conductivity Menu Screen.

- Go to the UNITS item in the menu. Using the cursors, change the conductivity units to match those in which the blocks are calibrated. The CAL 1 setting should be the higher value of the two.
- Use the cursors to select the CAL 1 menu item. Adjust the figures to match the value of standard 1 on the Calibration Block set. Recommended value 58 – 59 %IACS.
- Repeat the process to set CAL 2 to the value of standard 2 on the Calibration Block set. Recommended value 8 – 9 %IACS.
- Adjust other parameters as desired.
- Press menu again to return to the Conductivity Operating Screen.
6.6 Calibration for Conductivity Measurement

- Press balance to start the setting process. The following message will appear:

![Image of probe in air]

- Move the probe to a position that is well away from any material (at least 10 cm) and press balance again. The following message will appear:

![Image of probe on 58.9% IACS sample]

Note: 58.9 represents the value for CAL 1.

- Place the probe on the Calibration sample that has been set up as sample 1 and press balance again. The following message should appear:

![Image of probe on 8.6% IACS sample]

Note: 8.6 represents the value for CAL 2.
– Place probe on the calibration sample that has been set up as sample 2 and press balance again. If the calibration has been carried out successfully a message will appear stating Setup successful. The instrument is ready to perform conductivity measurements.

6.7 Measuring Conductivity and Coating Thickness

Guidelines for successful operation:

- For accurate measurement of conductivity the surface coating thickness should not exceed 0.25 mm (0.010 inches).
- The surface to be measured should be flat, or of the same curvature as the calibration standards. Where curved surfaces must be measured, additional error may be introduced.
- Measurement close to edges and on thin materials may give erroneous results.
- Check on a known consistent material to establish the influence of these effects.
- The coating thickness function does not require further calibration, it should be accurate to better than 10% of the displayed value on base materials having a conductivity between approximately 15% and 100% IACS.

6.8 Error messages

If the lift-off is greater than 1.250 mm (0.0500 inches) Coating Thickness will be displayed as “+++” and the conductivity will be shown as zero.
On Ferrous (Magnetic) materials the Conductivity will be displayed as ‘Fe’, on ambiguous materials such as copper coated steel coins, it will be displayed as ‘??’.

VALUE OUT OF RANGE – The instrument is unable to perform a reading within range. This error is usually followed by the message THE SEQUENCE WILL RESTART. This error may occur for a number of reasons:

• If the set values do not correspond with the standards
• If a probe is not attached
• If the cable is damaged
7  Operation in Rotary Single Mode
7.1 Basics of Rotary Inspection

Rotary inspection is a semi-automated form of inspection that gives the operator an increased Probability of Detection (POD) of flaws compared to a manual hole inspection. The reason for this is that in a single insertion and withdrawal of the probe from a hole the scanning element passes over the material surface many more times in comparison.

In addition the instrument has a sampling rate of 16 kHz for Rotary mode, compared to the 4 kHz sample rate in Normal mode.

When one of the recommended GE Inspection Technologies probe drives is plugged in the instrument, software will automatically recognize the type of drive being used, and will set a number of parameters to appropriate values.

In addition the instrument can be connected (via appropriate leads) to competitors equipment. Because often competitor’s equipment does not have enough connections to allow intelligent recognition, the instrument has been designed with the ability to characterize the unit to obtain the best possible performance from the unit. However selection of rotary mode with competitors rotor units connected has to be carried out manually.

The Auto Detection facility of the instrument means that a rotary probe can be attached when the unit is off or on, and the unit will automatically detect its presence and switch to the correct mode. Connect the drive using a suitable cable and plug in a suitable probe of the correct diameter for the holes to be inspected.

*Phas3 Cmmon Platform*
For ease of operator training the Rotary Menu is broadly the same as the Normal Menu (see Chapter 5). However there are several specific differences between this mode and the Normal Menu screen, which are outlined below.

Rotary Mode Menu Screen

7.2 Frequency Range

The frequency range in Rotary Mode is from 10 kHz to 2 MHz, which covers the standard range for Rotary probe inspections.
7.3 RPM Range

The instrument allows instrument based control of suitable rotary probe drive units from 600 to 3000 RPM. Most other eddy current units only allow drive at a single fixed speed, so if the operator is using a legacy probe drive unit, reference should be made to the documentation to obtain the optimum drive speed.

7.4 Initial Setup

- Press the switch on the side of the drive to start rotation.
- Place the probe into a clear area of the test block hole and balance; verify that no significant response is seen on screen.
- Move the probe so that it rotates in the notched region of the hole.
- Rotate phase so that the indication from the notch is vertical.
- Switch DISPLAY to Timebase menu using the cursor keys and OK key as before. Display will now show an angular representation as shown.
- Select the first set of programmable soft keys and optimize filters for best signal to noise ratio.
- Set filters as explained in 7.7. When used with a GE Inspection Technologies probe drive the unit will “learn” to compensate for drag, so when setting up the probe it should be dragged slightly on the test block hole so that the unit can always maintain optimum speed.
- Select alarms if desired (e.g. top 20 and bottom 20).
7.5 PROBE ID

The instrument has the ability to Autodetect when a GE Inspection Technologies rotary drive has been connected and will automatically go to the appropriate settings for that unit. However, when connecting to other manufacturers units there is the option of moving the Probe ID menu item and selecting the correct manufacturers identity. This is then implemented using the exec button.

This is necessary as not all manufacturers support the wide range of rotational speeds and other features of the drive. See Paragraph 7.10 for further details.

7.6 Additional displays for Rotary Mode

Graticules in SPOT are the same as in Normal mode. However there is an extra graticule available in timebase as depicted below.

There is also an additional display mode YT:XY see below:

Timebase with vertical lines at 90 degree intervals

F 1
<NAME> DISPLAY Timebase <NAME>
7.7 Filters in Rotary Mode

The filter functionality of the unit is extended in Rotary mode. For optimum results good filtering is essential in rotary inspection due to the high level of mechanical and electrical noise generated by such an inspection. Conducting such an inspection without filters will result in an extremely noisy trace, and would make the detection of defects very difficult.

The instrument allows independent manipulation of Hi and Low Pass filters, as well as the use of the Band Lock function that allows rapid repositioning of the filter depending on RPM. See 5.8 for further details.

A significant advantage of the GE Inspection Technologies rotary probe drives is that the instrument...
employs a control loop to ensure that the gun is running at the stated RPM. This differs from other systems as a constant voltage or constant current drive will slow down when drag is placed upon the probe (for example from the hole walls). If the drive does slow down then filters that have been optimized for a non-drag environment will now be eliminating useful data.

The filters available in rotary mode are up to 5.0 kHz in Low Pass and 4.95 kHz in High Pass mode. See Chapter 13 for full specifications.

7.8 Guidelines regarding Rotary Inspection

When the drive is switched off the display is instantaneously frozen (before the drive slows down), this allows easy saving of traces.

Filter frequencies are proportional to speed, e.g. 100 Hz and 750 Hz at 1500 RPM will give approximately the same results with the same diameter probe as 200 Hz and 1.5 kHz at 3000 RPM.
7.9 Maximum Probe Sizes for Rotary Inspection

The following table gives an indication for the maximum practical size of probes at different rotary speeds. The information was established by measuring the response on a 14.3 mm diameter hole with a 3000 rpm speed. Using a 1700/1800 Hz HP/LP filter an optimum response was found. This was then scaled up to get the max hole diameter at 5000 Hz.

<table>
<thead>
<tr>
<th>RPM</th>
<th>Max diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3000</td>
<td>39.7</td>
</tr>
<tr>
<td>2500</td>
<td>47.6</td>
</tr>
<tr>
<td>2000</td>
<td>59.5</td>
</tr>
<tr>
<td>1500</td>
<td>79.3</td>
</tr>
<tr>
<td>1000</td>
<td>119.1</td>
</tr>
<tr>
<td>600</td>
<td>198.5</td>
</tr>
</tbody>
</table>

7.10 Rotary Drive Units from Other Manufacturers

The instrument has a facility to support the Rotary Drive units supplied by other manufacturers. Due to the design of these units not all the advanced functions available on the GE Inspection Technologies Rotary Drive units will be available, as some of the units have only a single rotary speed, or no provision for automatic freeze.
The products currently supported are as follows:

- Rohmann Mini and Standard Drive (ID Rohmann1) – requires lead 40A101
- Staveley RA16 Rotary Drive (ID Staveley) – requires lead 40A103
- Zetec Standard Drive (ID Zetec1) – requires lead 40A102
- Zetec Incrementing Drive (ID Zetec 2) – requires lead 40A102

The unit automatically recognizes when a GE Inspection Technologies unit has been connected to it, and will switch to the required mode. However, in order to attach another Manufacturers probe the relevant lead (see above) is required. Once the lead has been attached to the drive, the 12 way Lemo connector end should be inserted into the unit when it is switched on. The instrument will then Autodetect the fact that a rotary drive has been attached and will switch mode to Rotary.

The operator should press menu and select the Probe ID menu item. Use the cursors to move through the options Rohmann1, Zetec1, Zetec2 and Staveley as they correspond with the list above.

Once the desired Rotary Probe drive type has been selected press exec to activate the drive.

Note: If the user subsequently selects another type of Rotary Probe ID with out disconnecting the lead then the instrument will not supply power in order to prevent damage to either the instrument or the Rotary Probe Drive.
Caution

THE OPERATOR IS RESPONSIBLE FOR ENSURING THAT THE ROTARY PROBE DRIVE IS COMPATIBLE WITH THE TYPES LISTED ABOVE. THE DIFFERENT UNITS HAVE SIGNIFICANTLY DIFFERENT POWER SCHEMES AND DAMAGE TO THE UNIT MAY OCCUR IF THE CORRECT SETTING IS NOT SELECTED. IF IN DOUBT, CONTACT YOUR LOCAL DISTRIBUTOR OR GE INSPECTION TECHNOLOGIES DIRECT.
8 Operation in Normal Dual Mode
(Phase 3d only)
8.1 Basics of Dual Frequency Mode Inspection

The Normal Dual mode allows a wide range of inspection that greatly increases the potential of the eddy current unit. On the instrument the dual mode is operated using a single input for the probe, but the eddy current channel can be split in two and manipulated. There are two main ways that the unit can be used.

- As a simultaneous two frequency inspection through a single probe
- Driving a single probe in two different configurations e.g. differential and absolute mode simultaneously.

The instrument allows much more than just setting the frequency to two separate values simultaneously. Once the signal is in the instrument it can be manipulated in a number of ways.
8.2 Switching to Normal Dual Mode

The instrument has been designed so that if an application has been setup in single frequency mode, and then another frequency needs to be added the settings from the single frequency can be instantly transferred.
- In order to do this select the Mode menu item and press OK.
- Select Normal Dual using the cursor keys and press exec.

The unit will switch to Normal dual mode, and a dialog will be presented. This will ask “Copy Current FREQ 1 settings to new mode? Press Exec to accept or OK to decline.”

8.3 Dual Frequency Operation – manual method

The instrument is able to test at two simultaneous frequencies, and provides a mixing channel that allows unwanted variables to be suppressed. Setting up a two frequency test requires a good sample of the product in which the artifact which needs mixing out can be simulated. In this situation the unit should be set up to have the VIEW menu item set to F1:F2. FREQ1 PROBE and FREQ2 PROBE should be set to the same configuration.
FREQ1 and FREQ2 should be set to different frequencies (these frequencies are dependant on the material under test, but a multiple of 1.5 between F1 and F2 is a good general starting point).

The probe should be run over a good section of the material, with the artifact present.
The signal given as a result should be adjusted so that F1 represents F2 as closely as possible by manipulating X Y gain and phase.

Note: The instrument also allows independent manipulation of filters and input gain to give maximum control.

Once the F1 and F2 signals have been mixed, the VIEW should be changed to F1:MIX. When the probe is run over the artifact there should be little or no indication, as the mix of the two channels should eliminate this.

If a flaw is present near or under the artifact it should be visible on the mix channel.

8.4 Dual Frequency Operation – Using Automix

The use of the Automix function requires operation of the Trace Recorder feature (see 5.23). The artifact requiring mixing should be recorded with the FREQ1 and FREQ2 set up as indicated in 8.3 above.

Once a representative trace has been recorded, select a section of the playback in which the trace is shown at its best. Press A-Mix/F4 to invoke the Automix functionality. The best available mix will be represented in the MIX display (see 6.6. below). In some situations the software may not be able to calculate an Automatic mix, and the process should be followed as indicated above.
8.5 Manipulating the Mix Channel

The Gain and Phase of the Mix Channel can be manipulated by using the MIX section of the menu. This allows a standard screen deflection to be applied, or for a flaw indication to be set at, or near, the vertical.

![Image of MIX section with settings GAINMIX 18.0/18.0 and PHASEMIX 220.0]
8.6 Dual Frequency Display

The display options for Dual frequency mode are very similar to Normal Single mode. However if the graticule is set to None in Spot mode, then the location of the two display channel origins are identified by to distinct cursors, as shown below;

These spot positions can be individually manipulated. The left hand cursor is identified as SPOT XY and the right hand position is SPOTF2 XY.
8.7 Balance and Clear Mode

The balance and clear buttons on the front panel of the instrument can be set to operate to both traces, or split so that the left hand balance and clear buttons apply to Spot XY and the right hand balance and clear buttons apply to SpotF2 XY. This is set by the BAL/CLR MODE button being set to either Both or Split. This menu item can be found in the PROBE section.

8.8 Outputs in Dual Frequency Mode

The dual frequency mode allows the user to choose required analog outputs from X1, Y1, X2, Y2, Xmix and Ymix.
9 Example Applications
9.1 Surface defect detection

9.1.1 Aim
The test block contains three differently sized slots (0.2mm, 0.5mm and 1.0mm). The aim of this demonstration is to detect cracks of differing sizes in an aluminium test block, set the sector alarm to detect only the largest crack and save the settings.

9.1.2 Equipment
Probe: 2MHz Locator 106P4
Lead: 40A001
Test block: Aluminium 29A047 or 29A029.

Note: Other probes types and frequencies may be used with this setting procedure. Ensure the correct test frequency is set as appropriate.
9.1.3 Setting Up
Switch to the menu screen and enter the following settings:

In order to change the mode you will first need to enter the menu screen by pressing menu. Then move the cursor to the top right item, press ok then use the up down cursors to select Normal Single and then press EXEC.
To alter dual items then press ok and then pressing exec repeatedly moves the cursor through a sequence of both selected, left item only, right item only, both items thus permitting adjustment of individual items.
Leave remaining items at the default settings at this stage.
9.1.4 Detecting Flaws

Set balance load
Place the probe on the test block. A long press on the EXEC button will activate the automatic load selection. Phassec will select the correct load for the probe and then balances the unit.

Set lift-off angle
It is conventional to set the display such that the lift-off signal is in the horizontal position at the start of the test when the probe is on sound metal. It is then clear which signals are caused by flaws and it is easier to set alarms. To set lift off horizontal keep the probe placed on the test block and use a long press on the 'BALANCE". Then follow the on screen prompts.
Optimising the display
Run the probe over the slots in the test block. All the flaw signals appear in the top left hand quadrant of the screen. The display would be clearer if the size of this quadrant was increased. This can be done, if required, by moving the origin to the right and down.
In the case of routine tests when it is known that all the flaw indications will occur in a particular quadrant of the screen, the origin can be moved to increase the size of this sector by entering suitable settings for ‘Spot X’ and ‘Spot Y’ on the menu screen at the start.

Adjust gain to increase signal size
Run the probe over the slots. The aim here is to alter the gain so that the signal from the 1mm crack fills the screen. Press the F1 ‘Gain’ key on the base function set and adjust the gain until the flaw signal reaches the required size. In this example we use 12dB less gain on the x axis to improve the discrimination between lift off and defect signals.

9.1.5 Setting an Alarm
The aim is to set the alarm so that it is only triggered by the deepest (1mm) slot.

Select the active alarm
Repeatedly press OK until you reach a set of softkeys for the box alarm. Then select F1 ACTIVE and then scroll the item to F1
**Select the Action**
Select F2 ACTION and then set this item to Tone.

**Select the alarm shape**
Select SHAPE and then set this item to Box.

**Setting the size of the Box alarm**
Use the F5 ‘TB1’ key to set the position of the upper boundary of the alarm. Set the first item in the TB (top bottom key) to 50. If this item is set to None then single highlight by repeat pressing of the Exec key and then a long press on the OK key. Long press OK will also switch an alarm box side off.

Return to the menu screen and switch the ‘Alarm tone’ on. You can now demonstrate that the alarm is triggered only by the deepest crack.

**9.1.6 Option**
**Using Alarm Stretch**
Return to the menu screen. Set STRETCH to On. Set ‘Stretch’ to 1 second.

Alarm stretch is used when there is a risk that a short alarm might be missed. When the alarm stretch is on the alarm is triggered when the signal reaches the alarm area on the screen. The alarm sounds for at least the time set under ‘Stretch’ even if the time the signal is in the alarm area is less. The visual alarm shows a red light when the signal is within the alarm area and an orange light for the remainder of the duration of the stretch.
9.1.7 Saving the Settings
Select save by pressing OK until you reach softkey set II Press SAVE'. Select 'Setup' rather than 'Trace' using the cursor button. Press 'exec' and the Save screen will appear. Using the alphanumeric box in the top section of the screen and navigating round it using the cursor buttons, give this demonstration a name e.g. 'LOC'. To save the settings and return to the operating screen, press key F1.

9.1.8 Recall (Optional)
Select recall by pressing OK until you reach softkey set II Press RECALL. Select 'Setup' rather than 'Trace' using the cursor button Select 'Setup' rather than 'Trace' and then press 'exec'. The Save screen will appear. Use the 'Up' and 'Down' function keys to select the required settings. Press F1 'Recall' to activate the required settings. Demonstrate that the original settings have been applied.

The 'Recall' function could be successfully demonstrated at the end of one of the other demonstrations by recalling the settings for this demonstration and showing that the alarm is still triggered as required.
9.2 Weld Inspection

9.2.1 Equipment
WeldScan Probe: 800P04MB1P (other WeldScan probe may be used)
Test Piece: 31A008

9.2.2 Setting-up the Menu
Press the MENU button and set up the screen as shown below ensuring you change the mode first.

9.2.3 Setting-up the Test
- Run probe over test piece and observe signals
- Place one yellow 0.5mm shim on test piece and place probe on top
- See signal on right hand of screen change to indicate an increase in non-conductive coating thickness (e.g. paint)
- Repeat with increasing number of shims
- Note numeric value changing at the same time as thickness,
A typical signal for cracking in a welded piece of material is shown below:

9.3 Subsurface defect detection

9.3.1 Equipment
Probe: 700P24A
Cable: 33A130
Aluminum Reference Standard: 33A048

9.3.2 Setting-up the Test
1. Connect probe to cable and connect to the instrument.
2. Switch instrument on.
3. Press Menu.
4. Use the cursors to scroll around menu until Recall is highlighted, press OK key. Use cursor to select Setup, press exec key to enter Setup menu. Use F5 (Up) or F6 (Down) until 700P24A SLT is highlighted. Press F1 key to Recall Setup.

5. The main Menu Screen will appear as soon as the setup has been recalled. To return to the normal screen press Menu key.

6. From the range of aluminum reference standard sheets in 33A048 select the sheet with the 0.5 mm deep notch and the 2 sheets with thru slots located from one edge to the middle.

7. Arrange the sheets in a stack as:
   - Top Sheet – Notch on upper face to right
   - Middle Sheet – thru slot in the middle
   - Bottom Sheet – thru slot on the left hand side

8. Place the probe on the Reference Standard right of the top EDM slot and close to the same edge as slot. Keep the probe normal (90°) to the surface and carry out Balance/Lift off function, long press of Balance/Lift off key.

9. Scan the probe right to left over the EDM slots, maintaining the same distance from the as edge as when you balanced. Note signal responses.

10. If more or less sensitivity is required, use the Gain (F1 key) to increase or decrease signal amplitude as required.

**9.3.3 Notes**

1. Use your finger as a guide along the edge of the stack. This will help maintain the same probe to edge distance.
2. Always try and keep the probe normal (90°) to the surface of inspection.

9.4 Material Sorting

9.4.1 Equipment
Probe: 700P16A
Cable: 33A130
Test Piece: 33A151
9.4.2 Setting-up the Test
Here two examples are given. The first demonstrates a fairly simple test. The settings used are as follows with the drive set to 0dB.

Balance the probe in air and then place in turn on all the eight samples.
Starting at the extreme anti-clockwise position the lift off line's go from strongly magnetic ferrite through 400 Series Stainless Steel and Carbon Steel then 300 SS, Ni Ag, Al 7075, Al 1200 and finally copper. So approximately the left hand side of the screen is magnetic materials and the right non-magnetic. A Sector gate has been set to give an alarm signal when Al1200 is detected.

A more sensitive way of discriminating variations is to balance on one material and then increase the gain so as to improve the discrimination. Settings used are as below.

Here we see the right hand trace is Copper and the left hand trace is Al7075. The central trace is Al1200. The Phase has been set so lift off is vertical and the gain set to make best use of the screen area. An elongated box alarm has been used to improve the lift off tolerance of the alarm.
9.4.3 Notes
Frequency choice is important. 100Hz – 1kHz has been shown good for ferrous material sorting, 60kHz is a good choice for Aluminium and it’s alloys, considerably higher frequencies can be used for low conductivity material. As usual with eddy current testing frequency choice is also determined by material thickness.
This principle can not only be used for conductivity sorting but also permeability sorting (hardness), thickness measurement, coating thickness determination (both conductive and conductive non-magnetic coatings) and other requirements where there is a change in the conductivity and or permeability of a test piece.

9.5 Rotary Inspection of Holes

9.5.1 Aim
To inspect Fastener Holes using Rotating Eddy Current Probes

9.5.2 Equipment
Probe: 615P016 Rotary Probe (Or any suitable rotary probe)
Rotating Drive: 33A100
Lead: 33A013
Test Blocks: 33AT016 (To match the rotary probe)
9.5.3 Setting Up
Switch to the menu screen and select MODE to Rotary Single.
Wait for the rotary screen to appear and then enter the following settings:

![Rotary settings diagram]

Leave remaining items at the default settings at this stage.
Press 'menu' to return to the operating screen which will now be split into YT:XY.
9.5.4 Setting Up Procedure
Insert Probe in rotor and connect cable to rotor and Phasec 3 d or s.
A short press on the 'Balance' button will balance the system.
Switch on the rotor to drive the probe.
Move the test piece over the probe and observe the indications. They should be very similar to those shown over the page.

The instrument is now set to inspect fastener holes of the size of the probe selected.
9.6 Mixing

9.6.1 Dual Channel Tube Inspection

9.6.2 Equipment

ID Probe: IDP138L—18k
Test Piece: 58213B
Lead: LHC-OC or LMC-1P

9.6.3 Setting-up the Menu

Press the MENU button and set up the screen as shown below ensuring you change the mode first.

![Diagram of menu settings]
9.6.4 Setting-up the Test

- Run the probe through the test-piece
- You will see a signal similar to that shown below
- The figure of eight on the left hand trace is the support plate
- The trace on the right has had the support plate mixed out.
10 Power Sources and Battery Management
10.1 Removing and installing the battery pack

The instrument has a variety of power options. The various choices all use the same method of connecting to the unit as outlined below:
– Place the instrument face down on a soft, clean surface.
– Press down on the battery release clip as indicated above.
– Roll the battery pack away from the unit.
– Installation is the reverse process.

10.2 Battery charger/eliminator

The battery charger/eliminator should be connected an AC supply using an appropriately terminated plug. The adapter is able to switch to power supplies that are in the range of 90 to 264 VAC, and 47 to 440 Hz. Once the unit has been connected the mains switch on the side of the unit should be switched on.

The charger has automatic safety protection to ensure that it will only charge the Lithium-ion battery pack supplied for the instrument, and will not charge the AA/eliminator pack if it is placed on the unit.

Note: The charger/eliminator unit will continue to supply to instrument even when recharging a lithium-ion battery.
To charge the Lithium-ion battery pack place the battery on top of the unit in exactly the same way as described in 9.1.

Different conditions of the battery charger and Lithium-ion battery pack are indicated in the table below.

<table>
<thead>
<tr>
<th>Condition</th>
<th>LED A</th>
<th>LED B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature OK</td>
<td>Solid Green</td>
<td>Flashing Red</td>
</tr>
<tr>
<td>Temperature too high to charge</td>
<td>Solid Red</td>
<td>Flashing Green</td>
</tr>
<tr>
<td>Temperature too low to charge</td>
<td>Solid Orange</td>
<td>Solid Green</td>
</tr>
<tr>
<td>Incorrect Battery Type</td>
<td></td>
<td>Solid Red</td>
</tr>
<tr>
<td>Battery charging</td>
<td></td>
<td>Solid Orange</td>
</tr>
<tr>
<td>Battery charged</td>
<td></td>
<td>No light</td>
</tr>
<tr>
<td>Battery not full after 3 hours</td>
<td></td>
<td>Flashing Red/Orange</td>
</tr>
<tr>
<td>Pre-Charge failed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battery not detected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown battery, pre-charging for 1 minute</td>
<td>Flashing Orange</td>
<td>Flashing Orange</td>
</tr>
<tr>
<td>Problem with power supply</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The charger/eliminator pack has two modes of operation, Pre-charge and fast charge which are determined automatically depending on battery condition and are not user selectable.
The unit interrogates Lithium-ion packs when they are placed on the unit. If the unit has discharged to a very low level then the unit initiates a pre-charge routine that trickle charges the pack until it is ready to accept the fast charge. In the case of extremely discharged packs this process can take up to 90 minutes.

If LED A is not green then the battery will not be charging. LED B may still flash green to indicate it is in the battery charge cycle, but the unit will wait for the pack and charger to stabilize before starting to charge.

For packs in normal use the pre-charge is not necessary and the unit can start on a fast charge routine immediately.

Using the fast charge the pack can be supplied with enough charge in 30 minutes to provide over 3 hours of operation. If the battery illuminates LED B as a solid red, see section 9.4 “Battery Not Full” Indication.
CAUTIONS

AS THE UNIT USES HIGH CURRENTS WHEN IN FAST CHARGE MODE THE UNIT WILL GET WARM. IT IS IMPORTANT THAT THE COOLING SLOTS IN THE SIDE OF THE BATTERY CHARGER/ELIMINATOR UNIT ARE KEPT CLEAR FROM OBSTRUCTION.

ENSURE THAT THE UNIT IS NOT EXPOSED TO DIRT OR FLUID AS THIS MAY DAMAGE THE UNIT.

HIGH VOLTAGES ARE PRESENT INSIDE THE UNIT. AS WITH ALL POWER SUPPLIES CARE MUST BE TAKEN IN HANDLING AND THE UNITS MUST NEVER BE OPENED BY NON-AUTHORISED PERSONNEL.

10.3 Lithium-ion battery pack

A Lithium-ion battery pack is available for the instrument. The fully sealed design means that there are no user serviceable parts.

Lithium-ion batteries offer the highest possible energy density for the minimum size and weight. The fully charged cells provide sufficient energy for 4 hours continuous use, without the backlight or 4 hours with backlight on.
A significant advantage of this technology over other secondary battery technologies is that unlike NiCad or NiMH cells there is no requirement for cycling or deep discharging the batteries. Lithium-ion does not suffer from memory effects; therefore it is possible to top up batteries as required without losing battery capacity.

This battery technology has several levels of protection to ensure safety for the operator and equipment. However as with all forms of battery power care must be taken in handling these units.

**Note:** The contacts are contained in a molded feature on the pack providing barriers between the contacts and reducing the likelihood of inadvertent short circuit. Nevertheless the batteries should be handled with care, shorting the contacts may cause the cell protection to operate and render the pack useless. If it is suspected that the battery contacts have been shorted then the pack must be returned to a battery charger/eliminator unit. Placing the pack on the unit will allow the intelligent management system to establish whether the pack is useable or not.

The battery charge indicator on the screen will only work with the Lithium ion pack. If the AA/eliminator pack is attached then the battery charge indicator will not display a remaining charge indicator.

Charging of the Lithium-ion battery pack should only be performed using the instrument battery charger eliminator (39a005).
10.4  “Battery Not Full” Indication

A solid red LED B indicates that the battery has not fully charged in three hours. This may have happened for a number of valid reasons, such as requiring a lengthy pre-charging routine due to deep discharge or high ambient temperatures. In nearly all cases the battery will be OK to operate. To validate this, place the battery on the instrument and switch on. If the battery charge indicator shows full, or nearly full, then the battery is fine. However if the instrument battery charge indicator shows a low charge level even after two hours on the battery charger then the Lithium-ion unit should be returned for service at the next convenient time.

10.5  Battery charge indicator (Lithium-ion only)

The instrument indicates the battery charge of Lithium-ion packs when they are operated on the unit. The indication of charge remaining can alter with change in ambient temperature, use of backlight and inspection frequency, amongst others. This indication will not work with the AA pack. The unit will give a fill on the battery graphic on screen to indicate approximate remaining charge. When the battery charge icon approaches the empty state the operator is advised to save the settings and replace/recharge the battery.
10.6 AA battery/eliminator pack

The AA battery/eliminator pack has two functions.
- It is able to take standard dry cell AA batteries when required. The operator can use rechargeable technology AA cells such as NiCd or NiMH and recharge on a battery charger for these types of cells.

- It connects the charger/eliminator unit to the instrument by the Power Output lead as illustrated.
Note: Under no circumstances attempt to charge cells other than the GE Inspection Technologies appropriate Li-Ion battery pack.
10.7 Placing cells in the AA battery/eliminator pack

- Remove the AA battery eliminator pack from the instrument.
- Remove the pack cover by gently pulling the tabs located at the middle of the pack on either side.

- Place 8 AA cells in the polarity indicated by the pack.
- Replace cover by snap-fitting over the base.

**CAUTION**
DO NOT MIX CELLS OF DIFFERENT CHARGE LEVELS.
DO NOT USE A MIXTURE OF RECHARGEABLE AND ALKALINE CELLS.
DO NOT USE CELLS THAT HAVE DIFFERENT AMP HOUR RATINGS.
DO NOT MIX CELLS OF DIFFERENT CHARGE LEVELS.
10.8 Resetting the Instrument

The instrument may be reset when powered up by selecting the menu item RESET, and then pressing OK followed by pressing exec. Alternatively reset may be initiated at power up by holding down the fF5 key and then pressing the Power key and then releasing both.

Caution
THESE ACTIONS MAY RESULT IN DAMAGE TO THE SOFTWARE OF THE UNIT

A dialogue box will appear as illustrated below;
- Total Reset F1
- Default F2
- Continue F3

TOTAL RESET reboots the unit and takes unit back to factory settings, losing all traces, settings and other setup data.

DEFAULT will reset standard factory settings but will attempt to maintain traces and settings if possible.

CONTINUE maintains stored locations and unit settings.
Press CONTINUE/F3 to continue. This will start the unit in a normal manner without resetting any of the variables in the unit. However the user must check both the settings menu, and the stored traces and settings to check for evidence of corruption, which would invalidate further operations. This will be evident by file locations reported as full that have no apparent data, and corrupted data labels etc.

If data corruption is evident then the unit should be switched off.

When the unit is switched back on the operator should press and hold the F5 button.

This will bring up the reset menu, and depending on the perceived level of corruption either TOTAL RESET or DEFAULT should be implemented.

Removal of the battery and replacement whilst the instrument is powered up will cause the instrument to revert to the settings prior to the last correct power down.
11 Supervisor PC
11.1 Overview of Supervisor PC

The instrument is supplied with Supervisor PC. This is a program that is capable of uploading and downloading traces and settings and documenting inspections. It can also be used for remote control of the unit via serial commands. Full details and the USB drivers required for the operation of this software are available on the CD ROM supplied with the instrument.
12 Routine Care and Maintenance
12.1 Care and maintenance

The instrument is a product of superior design requiring minimum user maintenance.

The suggestions below will help you fulfill any warranty obligations and will keep the instrument fully functional for many years.

- Keep it dry. Precipitation, humidity and most liquids contain minerals that will damage electronic circuits.
- Do not store in hot or extremely cold areas. Extreme temperatures can shorten the life of electronic devices, damage batteries and warp or melt plastics.
- Do not attempt to open it. Non-expert handling of the device may damage it.
- Do not drop, knock or shake it. Rough handling could break internal circuit boards.
- Do not use harsh chemicals, cleaning solvents or strong detergents to clean it. Wipe it with a soft cloth slightly dampened in a mild soap-and-water solution.
- Do not paint it. Paint can clog the keypad, connectors and battery latching. This will prevent proper operation.
12.2 Long term storage

As with all battery technologies the lithium-ion battery pack has a shelf life. This means that if the battery pack is left for a long period (greater than 12 months) there is a risk that the voltages inside the unit may drop to a level at which permanent damage to the pack may occur, thus rendering it inoperable.

If the unit is to be left in long term storage the following precautions should be followed:

- Ensure that the storage area is clean and dry. For optimum protection it is recommended that the instrument is stored at Room Temperature (i.e. 20° C).
- Make sure that the battery is fully charged and place the battery on the rear of Instrument.
- It is recommended that all settings and traces are saved and archived on computer using the Supervisor PC program as described in Chapter 11.
- Ensure that the instrument is switched off.
- Visually inspect all items for signs of physical damage.
- Pack the instrument and accessories in a protective case and place the Instrument kit in a location where it will not be subjected to physical shock or exposed to potentially damaging substances.
- Every 3 months the instrument should be removed from storage. The lithium-ion battery pack should be removed and charged.
- When the battery is fully charged place the lithium-ion back on the instrument.
12.3 Recycling

12.3.1 General view of the device
The following section contains an overview of the instrument and guidelines and notes for recycling and waste disposal of the components.

<table>
<thead>
<tr>
<th>No.</th>
<th>Recycling/material code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lithium-ion battery</td>
<td>Lithium-ion battery externally mounted at rear</td>
</tr>
<tr>
<td>2</td>
<td>Liquid Crystal Display</td>
<td>With LED backlight</td>
</tr>
<tr>
<td>3</td>
<td>ABS + PC Flame retardant housing</td>
<td>Housing</td>
</tr>
<tr>
<td></td>
<td>without chlorinated or brominated additives with rear half silicone rubber grips</td>
<td>Key Pad Mat</td>
</tr>
<tr>
<td>4</td>
<td>Silicone Rubber</td>
<td>Instrument window</td>
</tr>
<tr>
<td>5</td>
<td>Acrylic</td>
<td></td>
</tr>
</tbody>
</table>
12.3.2 Materials for separate disposal
This section contains guidelines and notes on how to remove materials and components that must be treated separately.

<table>
<thead>
<tr>
<th>No.</th>
<th>Recycling/material code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lithium-ion battery</td>
<td>Lithium-ion battery attached to rear of instrument removable by releasing grey clip at top of battery.</td>
</tr>
<tr>
<td>2</td>
<td>LC display</td>
<td>LED backlight Accessed by opening case.</td>
</tr>
</tbody>
</table>

12.3.3 Further materials and components
This section contains guidelines and notes on how to remove materials and components that can be difficult to treat in some recycling processes or can be beneficial to remove and recycle separately.

<table>
<thead>
<tr>
<th>No.</th>
<th>Recycling/material code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Circuit boards</td>
<td>Contained inside instrument housing</td>
</tr>
<tr>
<td>2</td>
<td>ABS + PC with Brass Inserts</td>
<td>Case Front</td>
</tr>
<tr>
<td>3</td>
<td>ABS + PC with Brass Inserts</td>
<td>Case Rear</td>
</tr>
</tbody>
</table>

These components are within the case and are positioned as shown in the picture.
### 12.3.4 Recycling data for whole instrument
(Materials/components that must be removed and treated separately)

<table>
<thead>
<tr>
<th>Recycling/material code</th>
<th>Weight approx (kg)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lithium Ion battery</td>
<td>0.2748</td>
<td>Located at rear of instrument</td>
</tr>
<tr>
<td>LC Display</td>
<td>0.2207</td>
<td>Located inside instrument case</td>
</tr>
</tbody>
</table>

(Materials/components that should be removed because they are difficult to treat in some recycling processes)

<table>
<thead>
<tr>
<th>Recycling/material code</th>
<th>Weight approx (kg)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS with brass inserts</td>
<td>0.1428</td>
<td>Case Front</td>
</tr>
<tr>
<td>ABS with brass inserts</td>
<td>0.1883</td>
<td>Case Rear</td>
</tr>
<tr>
<td>Main circuit board</td>
<td>0.1656</td>
<td>Inside case</td>
</tr>
<tr>
<td>Keyapd Circuit Board</td>
<td>0.050</td>
<td>Inside case</td>
</tr>
</tbody>
</table>

(Materials/components that it is beneficial to remove and recycle separately)

<table>
<thead>
<tr>
<th>Recycling/material code</th>
<th>Weight approx (kg)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe</td>
<td>0.0423</td>
<td>Screws</td>
</tr>
<tr>
<td>Silicone Rubber</td>
<td>0.0186</td>
<td>Keypad mat</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1.1031</strong></td>
<td></td>
</tr>
</tbody>
</table>

Phasec 3 Commom Platform 140
13.1 Manufacturer’s details

The Phasec 3 is manufactured by:

GE Inspection Technologies Ltd
Inspec House
129 – 135 Camp Road
St Albans
Hertfordshire
AL1 5HL
United Kingdom
Tel:  +44 (0) 1727 795 500
Fax:  +44 (0) 1727 795 400

13.2 Service details

The Phasec 3 contains no user serviceable parts. Should you detect an error on your instrument, switch it off and remove any batteries. Inform your nearest GE Inspection Technologies service centre, describing the error.

*Keep the shipping container in case the instrument needs to be returned to the service center.*

If you need any advice on the use, handling, operation or specifications of the instrument, please contact your nearest GE Inspection Technologies representative or one of the service centers.
14 Specifications
Specifications

Probe Compatibility
Absolute Locator (100ohm impedance)
Absolute standard (50ohm impedance)
Bridge
Reflection
Hocking, Staveley, Zetec & Rohmann Rotary drives
Hocking Conductivity probes
Probe Connector
12 way Lemo 1 series socket
Balance Load
Internal manual or automatic. Selection from 1.3, 8.2, 22, 47, 82 or 120 H

Operating Frequency
Normal: 10Hz to 10MHz
Dual: 2 * 10Hz to 10MHz (multiplexed) Phasec 3d only
Rotary: 10kHz to 2MHz Phasec 3s and 3d only
Conductivity: 60kHz

Display
LCD with LED backlight
Protected by hard coated acrylic window
Color Active Matrix 5.7"
320 x 240 pixel resolution
117.2x 88.4 mm viewable area

Trace Persistence
Selectable – 0.1, 0.2, 0.5, 1.0, 1.5, 2.0, 5.0, 10.0, 15.0 and 20.0 s and permanent.

Display Modes
Selectable – Spot (X, Y), Timebase (Y/T), XY and Y/T (Rotary only), Waterfall, Bar, Bar:XY
Timebase Sweep (Normal Mode Only)
Selectable – 0.1, 0.2, 0.5, 1.0, 1.5, 2.0, 5.0, 10.0, 15.0, 20.0 and 50.0 s.

Note: In Rotary mode the sweep of the screen corresponds to a full 360 rotation of the probe.
Gain
Adjustable together or as independent X and Y control for ultra precise setting
Overall gain -8dB to 96dB
Input Gain selectable 0dB or 14dB
Probe Drive -8dB, 0dB & +8dB
Fine adjustment 0-74dB in 0.1 dB steps

Phase
0° to 359.9° in 0.1° steps

Low and High Pass Filters
High Pass DC
Ultra filters 0.01 Hz to 0.5 Hz steps (6 steps)
1 Hz to 9.95 Hz in 0.05 Hz steps (180 steps)
10 to 99.5 Hz in 0.5 Hz steps (180 steps)
100 to 995 Hz in 5 Hz steps (180 steps)
1 kHz to 1.2 kHz in 50 Hz steps (4 steps, Normal Mode)
1 kHz to 4.95 kHz in 50 Hz steps (80 steps, Rotary Mode only)
Low Pass 3 to 9.95 Hz in 0.05 Hz steps (140 steps)
10 to 99.5 Hz in 0.5 Hz steps (180 steps)
100 to 995 Hz in 5 Hz steps (180 steps)
1 kHz to 1.5 kHz in 50 Hz steps (11 steps, Normal Mode)
1 kHz to 5.0 kHz in 50 Hz steps (81 steps, Rotary Mode only)

Lift-off Compensation
Automatic, with Phase rotation to 9 o’clock position, or manual

Alarm Type
X and Y levels Adjustable from 0 to 100% full screen height.
Box Adjustable – Left, Right, Top, Bottom
Sector Adjustable – Start, End, Inner, Outer

Alarm Signals
Audio Tone
Virtual on screen flashing LED
Freeze signal on alarm.
Digital output on auxiliary connector
**Alarm Tone**
Selectable on/off using Alarm Action menu item.

**Alarm Stretch**
Selectable – 50 ms, 100 ms, 500 ms, 1s, 5s, 10s.

**Internal Data Storage**
Capacity for up to 200 traces and 200 settings. 28 character alphanumeric names, plus time and date stamps. Settings held in non-volatile memory so are not lost if backup battery fails. In addition, slot 0 is reserved for default settings that will be restored when the instrument is reset.

**Conductivity and Coating Thickness Measurement**
Capable of measuring electrical conductivity of materials in the range from 0.8 to 110% IACS (0.5 - 63.8MSm⁻¹)
Non-conductive coating thickness 0 to 50 thou 0.5 thou resolution or 0 to 1mm to 0.1 mm resolution.

**Outputs**
Selectable X and Y analogue outputs
Alarm output
USB

**PC Connectivity**
Dedicated Windows software allows easy reporting and printing

**Languages**
English, French, German, Spanish, Portuguese, Japanese, Chinese

**Weight**
1.1kg including batteries

**Dimensions**
192 W x 139 H x 57 L mm

**Temperature Range**
Operation from 0 °C to +40 °C
Storage from −33 °C to +71 °C
Note: Prolonged exposure to temperatures over 50 °C will reduce battery life.

Enclosure
Rated to IP 54, Resistant to short term immersion and/or splash or wipe contact with a wide range of substances including:
Avtur/FSII (F34), Avcat (F44), JP8+100 Avgas, 100LL, F18, Diesel, Petrol, Synthetic and mineral based oils, Lotoxane
Tactile molded rubber grips for non-slip on smooth angled surfaces
Tripod Mount
The enclosure features a standard camera tripod mounting point.
An optional detachable rubber boot with integral stand is available.

Conformance
CE marked. The instrument and accessories conform to appropriate Standards, including EEC Directive 89/336/EEC and 73/23/EEC.
Flaw Detectors Phasec 3, 3s and 3d meet the intent of Directive
Compliance tested to:
EN 61000-6-1 2007 Class B
EN 61000-6-3 2007 Class B
The Phasec 3 has also been tested to DEF STAN 59-411 Part 3 (Jan 2007) and
Random Vibration to EN 60068-2-64:1995 Test Fh
Freq (Hz) ASD (m2/s3)
5-20Hz 0.96
20-500Hz -3dB
Duration: 30min/axis
Bump - BSEN 60068-2-29: 1993
Pulse shape: Half Sine
Amplitude: 40g
Pulse duration: 6ms
Number of bumps: 500 in each direction
Degrees of protection provided by enclosures (IP code)BS EN 60529:1992 IP54 cat 2
Battery Charger/Eliminator
90 to 264 VAC, 47 to 440Hz
Off instrument charging only

Connectors
Probe – 12 way fixed socket, Lemo Size 2B
Auxiliary – 7 way fixed socket, Lemo Size 1B

Note: Sockets are different sizes to prohibit incorrect connection of cables. Sockets are secured from rear to reduce risk of Foreign Object Damage.

Probe (12 way Lemo) connections

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FG0V</td>
</tr>
<tr>
<td>2</td>
<td>FG0/P</td>
</tr>
<tr>
<td>3</td>
<td>+VB</td>
</tr>
<tr>
<td>4</td>
<td>Motor–</td>
</tr>
<tr>
<td>5</td>
<td>Motor+</td>
</tr>
<tr>
<td>6</td>
<td>0VD</td>
</tr>
<tr>
<td>7</td>
<td>Diff+</td>
</tr>
<tr>
<td>8</td>
<td>Diff–</td>
</tr>
<tr>
<td>9</td>
<td>ENC</td>
</tr>
<tr>
<td>10</td>
<td>Gunsw/sck</td>
</tr>
<tr>
<td>11</td>
<td>Gun sda</td>
</tr>
<tr>
<td>12</td>
<td>Gunalarm</td>
</tr>
<tr>
<td></td>
<td>0V</td>
</tr>
</tbody>
</table>
Auxiliary (7 way Lemo) connections

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0v</td>
</tr>
<tr>
<td>2</td>
<td>Analog O/P 1 (X)</td>
</tr>
<tr>
<td>3</td>
<td>Analog O/P 2 (Y)</td>
</tr>
<tr>
<td>4</td>
<td>Alarm</td>
</tr>
<tr>
<td>5</td>
<td>Not Used</td>
</tr>
<tr>
<td>6</td>
<td>Not Used</td>
</tr>
<tr>
<td>7</td>
<td>Not Used</td>
</tr>
</tbody>
</table>

![Diagram of 7 way Lemo connections]
ABSOLUTE PROBE
A probe where only one coil is used to test the material. A balancing coil may be present in the instrument or within the probe body. For the instrument the nominal impedance is 50 ohms. Also see Locator.

AC
An abbreviation for alternating current as used in the domestic power supply and eddy current probe excitation.

ALPHANUMERIC
Indicating either alphabetic letters or numerals.

AMPLIFICATION
This is a measure of the increase in level of the probe signal before a representation of it appears on the display. On the menu, it is also described as Gain and is usually measured in dB. E.g. +6 dB = 2x gain, –6 dB = 1/2x gain, +20 dB = 10x gain and –20 dB = 1/10x gain.
BALANCE LOAD
An inductance added to the instruments input circuit to allow the use of absolute single coil probes. The value of the inductance should equal that of the absolute probe. Also see HENRY and INDUCTANCE.

BALANCING
This facility allows steady or dc signals from a probe, or probe/material combination, to be cancelled out. The visual effect is that after balancing has occurred the display is set at zero or a preset reference point.

BAUD
Baud Rate is the number of bits of information transmitted in one second.

BRIDGE
A probe connection where there are two coils connected so that the signal is compared between them.

CURRENT
Is the measure of the amount of electrical charge flowing in a conductor in unit time.
Unit of measurement the Ampere (A)
dB
An abbreviation for decibels, a logarithmic measure of gain or attenuation. See AMPLIFICATION.

DC
An abbreviation for direct current as supplied by a battery.

DEFECT
An imperfection in material composition.

DIFFERENTIAL
A differential probe is one that has two detection coils arranged such that equal signals detected by both coils are cancelled out. This gives much less drift and noise than an absolute probe. May be Bridge or Reflection connected.

DIGITAL
Digital or logic circuitry operates in incremental steps and switches between two voltage levels (commonly 0 V and +5 V). A microprocessor consists of digital circuitry.
DSP
Digital Signal Processor. A specialised type of microprocessor, it is optimized for high speed processing of digitized signals, used for phase rotation, filtering, mixing etc.

E

EARTH
A local connection between a circuit or device and the earth, that is at zero potential.

EDDY CURRENT
These are the currents that are created in a conductive material when changing magnetic fields intersect the conductor e.g. by bringing a coil carrying an alternating current near to the conductive material. Commonly used to describe the Non-Destructive testing method exploiting this phenomenon.

EC
An abbreviation for Eddy Current.

ET
Electro-magnetic testing. An alternative term used in the USA for Eddy Current Testing.
F

f, Freq.
Abbreviation for Frequency. Unit Hertz (Hz).

FILTER
Is an electronic device for limiting frequency range. Filters are often described as high, low or band pass.

FLAW
An imperfection in material composition e.g. a crack.

FREQUENCY
For an alternating current signal, frequency is a measure of the number of full cycles occurring every second (measured in Hertz).

G

GAIN
See AMPLIFICATION

GROUND
An alternative word for EARTH, a local connection between a circuit or device and the earth which is at zero potential.

157
GROUNDING
The act of connecting to ground/0v potential.

H

HERTZ
Unit of frequency. Abbreviated to Hz.

Hz
Abbreviation for Hertz. 1 kHz = one thousand Hz and 1 MHz = one million Hz.

I

IMPEDEANCE
Circuits that have resistive and reactive components (capacitance and inductance are reactive components) are said to give an impedance to the flow of current. Impedance is normally dependent on frequency.

INDUCTANCE
Inductance is a measure of the voltage required to cause current to change at a given rate in a coil of wire. Measured in Henrys. Usually in micro-henries (millionths of a Henry) = µH.
**LED**
Abbreviation for light emitting diode.

**LCD**
Abbreviation for Liquid Crystal Display.

**Li-Ion**
Abbreviation for Lithium Ion battery technology. Offering high charge density, zero memory effect and greater charge cycle life. Also see NiMH and NiCd. State of the art technology.

**LIFT-OFF**
The signal caused when a probe is lifted from the test specimen surface. Can refer to movement or the actual spacing.

**LIFT-OFF COMPENSATION**
Setting the phase of the signal caused by lift-off to the 9 o’clock direction from the balance point in order to ensure that defect signals in the Y axis are relatively free of this effect.
LOCATOR PROBE
As in Locator Probe. This is an absolute probe but to be compatible with the Locator UH the nominal impedance is 100 ohm. This means that the operating frequency for a Locator Probe when set to Absolute Probe Mode is half that when set to Locator Probe Mode e.g. a 2 MHz probe may be used at 1 MHz in absolute probe mode. See Absolute Probe.

N
NDE
Abbreviation for NON DESTRUCTIVE EVALUATION.

NDT
Abbreviation for NON DESTRUCTIVE TESTING.

NiCd or NICAD
Abbreviation for Nickel-Cadmium technology batteries. Well known for suffering from the memory effect, where the energy storage capability is reduced if the battery is not discharged fully before recharging. Oldest of battery technology used in portable equipment.
NiMH
Abbreviation for Nickel Metal Hydride battery technology. Successor to NiCd giving no memory effect at the cost of a higher self discharge rate.

NOISE
Unwanted signals which appear on the display. Much of the design work for an eddy current instrument is involved with minimising electronic noise (both external and internal) in order to improve the signal to noise ratio.

P

PROBE
This is the name given to hand held eddy current sensors. See also ABSOLUTE, LOCATOR, DIFFERENTIAL, BRIDGE and REFLECTION.

R

REFLECTION
A probe connection where there is a primary and secondary windings. The secondary output is connected so as to give a small output. May be differential or absolute.
RS232
A serial communications protocol for transferring data between computers and other devices.

S
SKIN EFFECT
The tendency for alternating current to flow near the surface of a conductor.
SKIN DEPTH
The average depth at which an eddy current is considered to flow (37% of the current density at the surface) and decreases exponentially with depth. Higher frequencies, relative permeability (magnetism) and conductivity result in less skin depth.

T
THRESHOLD
A limit, which indicates that the signal from a defect is sufficient to cause concern.
TRAIN
To train an instrument is to set the phase angle for lift off automatically to give a minimum response. Thus improving the detection ability. Equivalent to the auto lift off function
16 Serial Commands
Serial Commands

Syntax
Set = Set parameter value
Inq= Inquire parameter value returns instrument native value as used in set
Ask = Ask parameter returns verbose human readable version of parameter.
Range= Valid range of parameters.

Channel 1 Gain
set xy1 123 456 Gain1X = 12.3 dB, Gain1Y = 45.6 dB
inq xy1 123 456
ask xy1 X 12.3 dB : Y 45.6 dB
Range: 0 to 74.0

Note: Gains are set by entering the required value multiplied by 10. Thus to set 30.0 db a number of 300 is used.

Channel 2 Gain
set xy2 123 456 Gain2X = 12.3 dB, Gain2Y = 45.6 dB
inq xy2 123 456
ask xy2 X 12.3 dB : Y 45.6 dB
Range: 0 to 74.0

Note: Gains are set by entering the required value multiplied by 10. Thus to set 30.0 db a number of 300 is used.

Channel 1 Phase
set phase1 123.4 123.4 degrees
inq phase1 1234
ask phase1 123.4 deg
Range: 0 to 359.9

Channel 2 Phase
set phase2 123.4 123.4 degrees
inq phase2 1234
ask phase2 123.4 deg
**Phase 3 Common Platform**

**Channel 1 Frequency**
set freq1 10.5 KHz 10.5 KHz
inq freq1 8297
ask freq1 10.5 KHz

Notes: Frequency is set by entering the required value including the decimal place and the range, e.g. set freq1 23.0 KHz = 23.0 KHz.

The 8297 response from “inq” is due to the number being in the following format:
8297 decimal is 0x2069 hex
The top 4 bits – represented by ‘3’ – is the range.
The remaining bits represent the frequency.
Range: 10.0 Hz – 10 MHz

**Channel 2 Frequency**
set freq2 10.5 KHz 10.5 KHz
inq freq2 8297
ask freq2 10.5 KHz

Note: See notes for Channel 1.
Range: 10 Hz – 10 MHz

**Channel 1 Filter (frequencies)**
set h/lp:1 u.05 1000
inq h/lp:1 0.03 1000.00
ask h/lp:1 HP u.05 Hz : LP 1000.00 Hz
set h/lp:1 10.0 300
inq h/lp:1 10.00 300.00
ask h/lp:1 HP 10.00 Hz : LP 300.00 Hz
set h/lp:1 DC 300
inq h/lp:1 0.00 300.00
ask h/lp:1 HP DC Hz : LP 300.00 Hz
Range: dc, u.01, u.02, u.05 u.10, u.20, u.50, 1.0 to (Low Pass – 1 least significant digit)
Note: The final version will incorporate a flexible token interpretation that can parse the decimal point and non-significant zeros and characters within the set process.

E.g. set h/lp:1 U.05 1000.56 0.03 1000.56
The ultra ranges are represented in the inq query in the following manner:
U.01 : 0.01
U.02 : 0.02
U.05 : 0.03
U.10 : 0.04
U.20 : 0.05
U.50 : 0.06

Channel 2 Filter (frequencies)
set h/lp:2 U.05 1000
inq h/lp:1 0.03 1000.00
ask h/lp:1 HP U.05 Hz : LP 1000.00 Hz
set h/lp:2 10 300
inq h/lp:1 10.00 300.00
ask h/lp:1 HP 10.00 Hz : LP 300.00 Hz
set h/lp:2 DC 300
inq h/lp:2 0.00 300.00
ask h/lp:2 HP DC Hz : LP 300.00 Hz
Range: dc, u.01, u.02, u.05 u.10, u.20, u.50, 1.0 to 1000 Hz
(High Pass + 1 least significant digit)

Note: See note for Channel 1 Filter (frequencies).

set filt1 bp ratio
inq filt1 0
ask filt1 BP RATIO
Range: bp ratio, bp lock

Channel 2 Filter (type)
set filt2 bp lock
inq filt2 1
ask filt2 BP LOCK
Range: bp ratio, bp lock
Probe ID
set id 0
inq id 0
ask id unknown

Channel 1 Probe
set probe1 reflection
inq probe1 2
ask probe1 Reflection
Range: absolute, bridge, reflection, locator

Channel 2 Probe
set probe2 bridge
inq probe2 1
ask probe2 Bridge
Range: absolute, bridge, reflection, locator

Gain Mix
set gainmx 10.1 18.0
inq gainmx 101 180
ask gainmx X 10.1 dB : Y 18.0 dB
Range: –180 to +180

Phase Mix
set phasem 234.1
inq phasem 2341
ask phasem 234.1 deg
Range: 0 to 359.9

Analog O/P 1
set op:1 X1
inq op:1 0
ask op:1 X1
Range: x1, y1, x2, y2, xmix, ymix

Analog O/P 2
set op:2 ymix
inq op:2 5
ask op:2 Ymix
Range: x1, y1, x2, y2, xmix, ymix

Note: See note for Channel 1 Gain.

Note: See note for Channel 1 Phase.
**Active**
set active f1
inq active 1
ask active F1
Range: none, f1, f2, mix

**Alarm box top/bottom**
set tb1 10 20
ask tb1 T1 10 : B1 20
inq tb1 10 20

**Alarm box left/right**
set lr1 10 20
ask lr1 L1 10 : R1 20
inq lr1 58 68

**Alarm sector start/end**
set se1 0 60
ask se1 S1 0 : E1 60
inq tb1 0 60

**Alarm sector inner/outer**
set io1 7 20
ask io1 I1 7 : O1 20
inq tb1 7 20

**Action**
set action tone
inq action 2
ask action Tone

Note: Action cannot be set if Active is set to “None”.

Range: Tone&frze, none, tone, freeze

**Stretch**
set strch 500 ms
inq strch 2
ask strch 500 ms
Range: 50 ms, 100 ms, 500 ms, 1 s, 5 s, 10 s
Channel 1 Input Gain
set igain1 low
inq igain1 0
ask igain1 low
Range: low, high

Note: See note for Channel 1 Gain.

Channel 2 Input Gain
set igain2 high
inq igain2 1
ask igain2 high
Range: low, high

Note: See note for Channel 1 Gain.

Shape
set shape1 sector
inq shape1 1
ask shape1 sector
Range: box, sector

View
set view f2
inq view 1
ask view F2
Range: f1, f2, mix, f1:f2, f1:mix, mix:f2

Display
set display spot
inq display 0
ask display Spot
Range: spot, timebase, waterfall, yt:xy

Graticule
set grat polar
inq grat 2
ask grat polar
Range: grid 1, grid 2, grid 3 (rotary timebase only), polar, none

Spot XY
set spot 23 -10
inq spot 23 -10
ask spot X 23 : Y -10
Range: X 0 to 177, Y -50 to 50

SpotDual
set spotd 23 -10
inq spotd 23 -10
ask spotd X 23 : Y -10
Range: X 0 to 177, Y -50 to 50

Spot information
set spinfo CH1
ask spinfo CH1
inq spinfo 1

Software version
inq softver 165= 1.00,prb=00.13,kyd=00.03,dsp=01.00,enc=00.00
ask softver 165= 1.00,prb=00.13,kyd=00.03,dsp=01.00,enc=00.00

Spot Info
set spotinfo none
inq spotinfo 0

Persistenc
set pers permanent
inq pers 6
ask pers permanent
Range: 0.1s, 0.2 s, 0.5 s, 1.0 s, 5.0 s, 10.0 s, 15.0 s, permanent

Sweep
set sweep 1.0 s
inq sweep 3
ask sweep 1.0 s
Range: 0.1s, 0.2 s, 0.5 s, 1.0 s, 2.0 s, 5.0 s, 10 s, 20 s, 50 s

Save
set save setup
inq save 0
ask save setup
Range: Setup, trace

Phasor 3 Common Platform
Recall
set recall setup
inq recall 0
ask recall setup
Range: Setup, trace

Mode
set mode Normal dual
inq mode 1
ask mode normal dual
Range: normal single, normal dual, rotary single, conductivity

Load
set load 8.2
inq load 1
ask load 8.2
Range: 1.3, 8.2, 22, 47, 82, 120

Drive
set fgdrive +8
inq fgdrive 2
ask fgdrive +8
Range: -8, 0, +8

Balance/Clear
set balclr both
inq balclr 0
ask balclr both
Range: both, split, single

Power Down
set p/down off
inq p/down 0
ask p/down off
Range: off, 5 min, 10 min, 15 min, 20 min

Key Click
set keyclk on
inq keyclk 0
ask keyclk on
Range: on, off
Language
set lang English
ask lang English
inq lang 0
Range: English, French, German, Spanish, Portugués, Chinese, Japanese

Rotary Frequency
set freq1 10 khz
ask freq1 10 KHz
inq freq1 8292
Range: 10 kHz to 2 MHz

Rotary RPM
set rpm 1500
inq rpm 2
ask rpm 1500
Range: 600, 1000, 1500, 2000, 2500, 3000
Calibration Block 1
set cal1 59.65
ask cal1 59.65
inq cal1 172985
Note: The return from Inq has to be divided by 2900 to get the value in %IACS.
Range: 40.00 to 110.0

Time
set hm 10:25
inq hm 10 25
ask hm 10:25

Date
set date 12 aug 03
inq date 12 7 3
ask date 12 Aug 3
Calibration Block 2
set cal2 8.88
ask cal2 8.88
inq cal2 25752

Note: The return from Inq has to be divided by 2900 to get the value in %IACS.

Range: 1.00 to 30.00

Conductivity High Alarm
set hialm 50
ask hialm 50
inq hialm 50
Range: (Low Alarm + 2) to 110

Conductivity Low Alarm
set loalm 40
ask loalm 40
inq loalm 40
Range: 0 to (High Alarm – 2)

Conductivity Coating Thickness Alarm
set ctalm 25
ask ctalm 25
inq ctalm 25
Range: 5 to 100

Conductivity Units
set cond %iacs
ask cond %IACS
inq cond 0
Range: %iacs, ms/m

Conductivity Dimensions
set ctunit imperial
ask ctunit imperial
inq ctunit 0
Range: imperial, metric

Remote Key Responses
This is the serial support for key presses. In other words the UP, DOWN, LEFT, RIGHT, MENU etc keys can now be simulated from the serial port.
ext scrnxy<CR> = Read spot position x, y for
Channel 1
ext scrnxy2<CR> = Read spot position x, y for
Channel 2

Conductivity
In conductivity mode the displayed conductivity
may be read using the command
ext condom<CR>

Coating Thickness
In conductivity mode the displayed coating
thickness may be read using the command ext
condtm<CR>
<table>
<thead>
<tr>
<th>Serial commands</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>„key up“</td>
<td>Up arrow</td>
</tr>
<tr>
<td>„key down“</td>
<td>Down arrow</td>
</tr>
<tr>
<td>„key left“</td>
<td>Left arrow</td>
</tr>
<tr>
<td>„key right“</td>
<td>Right arrow</td>
</tr>
<tr>
<td>„key menu“</td>
<td>menu key</td>
</tr>
<tr>
<td>„key ok“</td>
<td>OK key</td>
</tr>
<tr>
<td>„key exec“</td>
<td>exec key</td>
</tr>
<tr>
<td>„key f1“</td>
<td>F1 key</td>
</tr>
<tr>
<td>„key f2“</td>
<td>F2 key</td>
</tr>
<tr>
<td>„key f3“</td>
<td>F3 key</td>
</tr>
<tr>
<td>„key f4“</td>
<td>F4 key</td>
</tr>
<tr>
<td>„key f5“</td>
<td>F5 key</td>
</tr>
<tr>
<td>„key f6“</td>
<td>F6 key</td>
</tr>
<tr>
<td>„key bal“</td>
<td>Left balance key</td>
</tr>
<tr>
<td>„key clr“</td>
<td>Left clear key</td>
</tr>
<tr>
<td>„key frz“</td>
<td>Left freeze key</td>
</tr>
<tr>
<td>„key lbal“</td>
<td>Long left balance key</td>
</tr>
<tr>
<td>„key lclr“</td>
<td>Long left clear key</td>
</tr>
<tr>
<td>„key lfrz“</td>
<td>Long left freeze key</td>
</tr>
<tr>
<td>„key lf1“</td>
<td>Long F1 key</td>
</tr>
<tr>
<td>„key lf2“</td>
<td>Long F2 key</td>
</tr>
<tr>
<td>„key lf3“</td>
<td>Long F3 key</td>
</tr>
<tr>
<td>„key lf4“</td>
<td>Long F4 key</td>
</tr>
<tr>
<td>„key lf5“</td>
<td>Long F5 key</td>
</tr>
<tr>
<td>„key lf6“</td>
<td>Long F6 key</td>
</tr>
<tr>
<td>„key lexec“</td>
<td>Long exec key</td>
</tr>
<tr>
<td>„key rbal“</td>
<td>Right balance key</td>
</tr>
<tr>
<td>„key rclr“</td>
<td>Right clear key</td>
</tr>
<tr>
<td>„key rfrez“</td>
<td>Right freeze key</td>
</tr>
<tr>
<td>„key lrbal“</td>
<td>Long right balance key</td>
</tr>
<tr>
<td>„key lrclr“</td>
<td>Long right clear key</td>
</tr>
<tr>
<td>„key lrfrz“</td>
<td>Long right freeze key</td>
</tr>
<tr>
<td>„key lok“</td>
<td>Long OK key</td>
</tr>
</tbody>
</table>

**External Data Reading**

**Spot position**
Spot position for both the currently displayed spot positions may be read using the following commands.
The equipment that you bought has required the extraction and use of natural resources for its production. It may contain hazardous substances that could impact health and the environment.

In order to avoid the dissemination of those substances in our environment and to diminish the pressure on the natural resources, we encourage you to use the appropriate take-back systems. Those systems will reuse or recycle most of the materials of your end life equipment in a sound way.

The crossed-out wheeled bin symbol invites you to use those systems.

If you need more information on the collection, reuse and recycling systems, please contact your local or regional waste administration.

Visit [www.ge.com/inspectiontechnologies](http://www.ge.com/inspectiontechnologies) for take-back instructions and more information about this initiative.
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