HOCKING

Phasec 2200

Technical Reference and Operating Manual

Hocking Phasec 2200
Technical Reference & Operating Manual
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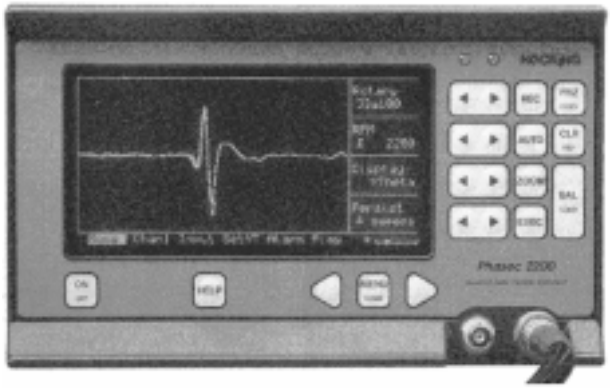
1. Introduction

The Hocking Phasec 2200 is a compact, lightweight, battery operated eddy current flaw detector. It is available in both single and dual frequency versions:



Primary applications of the Phasec 2200 include

- Surface and Subsurface flaw detection in metallic structures such as aircraft.
- Use with a rotating probe drive for inspection of fastener holes
- Conductivity and coating thickness measurement

1.1 How to use this Manual

To get started:
Before using the Phasec 2200 for the first time we strongly advise that you read Chapters 1 and 3 of this manual, The instructions therein will help you to avoid many common operational errors and ensure that the instrument is in a safe and correct condition for use. These instructions deal with essential preparations for use, such as setting the operating voltage and language, and give a general description of the most important functions of the instrument.

To ensure that you have what you need:
Chapter 2 lists necessary and optional accessories for use with the Phasec 2200.

Section 10.4 gives information on common probes which you may wish to use with the Phasec 2200.

To learn more about using the Phasec 2200:
Chapters 4 and 5 give more information about the different controls and methods of use of the instrument.

Section 10.3 gives a number of application examples. These may be used as a tutorial in the practical use of the equipment, or as a basis for developing your own procedures.

To connect the Phasec 2200 to external equipment:
Chapters 6 and 8 detail use of the Phasec 2200 with accessories such as a printer or PC

Help
The Phasec 2200 has an extensive built-in help function, pressing the HELP button gives 'context-sensitive' information on most of the instruments controls and parameters. In addition Section 10.6 gives a troubleshooting guide to help avoid some of the common errors.

If your instrument goes wrong Section 11.1 gives information on servicing facilities.

If you have a special application which you need help with then section 11.4 is an application questionnaire. Please fill this in and mail or Fax it to your representative, or to our Application support department in St. Albans. Their Fax number is +44 (0) 1727 845058

Technical Information
Chapter 9 gives the technical specification of the Phasec 2200 (correct at time of issue) as well as assembly information and a list of 'top level' spare parts.

1.2 Important Notes

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

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

1. Selection of appropriate cables, probes, fixtures, mechanical handling equipment and other accessories.

2. Selection of proper test frequency, test mode and other test parameters.

3. Preparation of the test surface.

4. Characteristics of the test material, for example: conductivity, hardness, permeability, geometry, magnetic properties, heat treatment etc.

5. Environmental factors such as temperature, humidity, dust and electrical interference.

6. Any individual factors that will depend on the particular test object or test being performed.

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

Periodic calibration 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, but if the Handbook recommends a minimum frequency for checks, then this

should be observed. The user should implement a program of periodic calibration, cleaning and maintenance to ensure optimum performance of the equipment. Incidents such as physical shock, immersion in liquid, and exposure to damaging environments such as excessive heat, moisture, dirt, or dust can adversely affect equipment performance. The equipment must be examined for damage and recalibrated after any such incident. Do not use any product which you know or suspect to be faulty.

Reference samples used for calibration should, ideally, have the same material properties as the object to be tested, or a known relationship to it, established by laboratory tests on suitable samples. Equipment calibration should be checked frequently during testing to assure valid test measurements.

As a matter of good practice and wherever possible, suspected defects in critical areas should be cross checked using appropriate alternative indication techniques. Any question about the use, operation specifications or special considerations relative to the particular Hocking NDT product you are using, should be addressed to your local sales representative, the distributor, or Hocking direct.

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

WARNING

1. DANGEROUS VOLTAGES ARE PRESENT IN SOME ELECTRONIC EQUIPMENT. GENERALLY THERE ARE NO USER SERVICEABLE PARTS IN THE ELECTRONIC EQUIPMENT, ADDITIONAL POWER SUPPLIES AND/OR CHARGER UNITS. DISCONNECT ALL POWER SUPPLIES AND REMOVE BATTERIES WHERE POSSIBLE BEFORE REMOVING ANY COVERS.

2. IN THE INTERESTS OF SAFETY IT IS ADVISABLE NOT TO WORK ALONE.

3. THE POWER CABLES CONTAIN AN ELECTRICAL SAFETY GROUND, DO NOT USE WITH AN UN-GROUNDED OUTLET.

DISCLAIMER
Hocking NDT products are sold subject to our standard conditions of sale and warranty. This is in lieu of any other warranty or condition implied by law as to the quality of fitness for any particular purpose. We shall not be liable in contract, tort or otherwise in respect of any claim resulting from the use of or defects in, the goods or from any work done or omitted in connection with the goods.

1.3 Software

Like most current equipment the Phasec 2200 employs a microprocessor based architecture to give great capability in a small, and relatively low-cost, package. While great care is taken over writing the computer programs (software) it is impossible to guarantee that any software will ever be ‘bug-free’ It is the responsibility of the user to ensure that the instrument operates correctly in their chosen application.

During the life of this instrument there will inevitably be software revisions and updates, both to correct such errors and to give performance enhancements or additional functions. In general when software is updated to correct errors then

we will, where practical and appropriate, update user instruments to current software version free of any charge (other than indirect costs such as shipping, handling and customs charges). Where significant improvement of instrument facilities is included an appropriate charge may be made.

In the event of instrument 'lock-up' or erratic operation believed due to software problems, refer to the Starting procedures detailed in Chapter 3.

1.4 Safety Measures

The safety information in this summary is for operating personnel. Warnings and cautions will also be found throughout the manual where they apply.

Power Source
The instrument is intended to operate from either internal batteries or a local AC power supply in the range 100-120 or 200-240 V .R.M.S., 50/60Hz.

The instrument must only be connected to an AC supply using the approved Charger. Use of other chargers may cause damage to the instrument and/or injury to the user. Disconnect the Unit from the Charger (or the Charger from the AC supply) before removing or replacing the battery pack.

Do not use an AC power supply if non-rechargeable cells are fitted without ensuring that the battery selection switch inside the battery compartment is correctly set.

Use only good quality batteries. In General any good quality Alkaline type 'D' cells may be used, e.g. Duracell, Energiser, Rayovac etc. Problems have been experienced when using lower quality or lower capacity rechargeable cells and Hocking would strongly recommend using only types on the list at the end of this section. In particular cells having a capacity less than around 4 Ampere-hours are unlikely to be suitable. If such cells must be used in an 'emergency' situation they should be charged externally in a suitable charger and used as if they were non-rechargeable. Over charging low quality Nicads can result in over heating, evolution of gas and a potentially explosive situation if carried out within an instrument. Hocking and its agents specifically disclaim responsibility for the consequences of such action.

Ensure that the power lead is in good condition. When connected to the local AC supply the protective ground provided by the grounding conductor of the power lead is essential for safe operation.

Do Not Open the Case
There are no user-serviceable parts inside the instrument and it is not necessary to open the case during normal operations. Do not operate the instrument unless it is fully assembled.

Do Not Operate in Wet Conditions
To avoid danger of electric shock and damage to the instrument do not operate or store in environments where ingress of water is possible. The instrument is 'splashproof', but not intended to be fully waterproof. The charger is not intended for outdoor use.

Do Not Operate in an Explosive Atmosphere
To avoid explosion do not operate the instrument in an explosive atmosphere. The instrument is not certified for such operation.

Do Not Incinerate Batteries
Batteries must be disposed of in accordance with local regulations and directives, they must not be incinerated.

Recommended Rechargeable Cells

Sanyo 'Cadnica' 4.4 Ah	KR-4400D
Ever Ready 4.3 Ah	E-4300D
Varta 4.0 Ah	RSH4K
RS Components 4.0 Ah	229-095

2.0 Standard package and accessories

This chapter provides information on the available accessories for the Phasec 2200. It describes:

- The contents of the standard Phasec 2200 package.
- Accessories, not supplied in the standard package, which are required for particular applications.
- Recommended accessories.
- Third-party products such as printers, which are useful in conjunction with the Phasec 2200 and which have been tested for such use by Hocking.
- Recommended kits of probes and related accessories for common applications

2.1 Standard Package

Product Name	Description	Order Code
Phasec 2200	Dual frequency eddy current instrument	33I012
or Phasec 2200	Single frequency eddy current instrument	33I011
Each package includes the following items:		
Cells	Set of six (6) high capacity rechargeable nickel-cadmium 'D' size cells	S33/C789
Operating manual	Phasec 2200 Technical Reference and Operating Manual (English Language) or Technisches Handbuch und Bedienungsanleitung (Deutsch) or Phasec 2200 manual (French) or Phasec 2200 manual (Italian)	33DH11
Charger	Power supply/battery charger for Phasec 2200 (115/230V switchable)	33A110
Power Cord	Power cord, UK (13A plug to BS1363) or Power cord, North America (NEMA plug) or Power cord, European (Schuko plug)	29A095 29A094 29A096
Probe Adapter	Jaeger-Lemo probe adaptor to allow standard Hocking probes (fitted with 6pin Jaeger connector) to be used on the Phasec 2200.	33A12

2.2 Required Accessories

Product Name	Description	Order Code
For conductivity measurement		
Probe	Conductivity probe, AS3000/Phasec 2200, 12.7mm diameter	47P001
Cable	Conductivity probe lead, for Phasec 2200 1.5m long	33A135
Standards	Conductivity reference standard set for Phasec 2200	33A136
For rotating drive fastener hole inspection		
Drive	Standard rotating drive for Phasec 2200 or Miniature rotating drive for Phasec 2200	33A106 33A101
Cable	Rotating drive lead for Phasec 2200, 2m long	33A103
For use with probes fitted with other connectors		
Adaptor	2 x BNC-Lemo adaptor to allow absolute probes with separate balance loads to be used on the Phasec 2200	33A120
Adaptor	8 pin Burndy-Lemo adaptor to allow Nortec probes to be used on the 2200	33A122
Adaptor	3 pin-Cannon Lemo adaptor to allow Nortec probes to be used on the 2200	33A123
Adaptor	Amphenol-Lemo adaptor to allow Zetec bridge probes to be used on the 2200	33A124
Adaptor	Amphenol-Lemo adaptor to allow Zetec reflection probes to be used on the 2200	33A125
Adaptor	Fischer-Lemo adaptor to allow Rohmann reflection probes to be used on the 2200	33A126
Adaptor	DIN-BNC adaptor to allow Rohmann reflection probes to be used on the 2200	29A010
Adaptor	Amphenol-BNC adaptor to allow ED520 probes to be used on the Phasec 2200	29A024

2.3 Recommended Accessories

Product Name	Description	Order Code
Carrying Bag	Carrying bag for Phasec 2200	33A140
Shipping Case	Shipping case for Phasec 2200	33A141
Adaptor	Headphone adaptor (3.5mm fitting) for Phasec 2200	33A148
Printer Lead	Printer lead for Phasec 2200	47A002
Computer Lead	PC interface lead for Phasec 2200	33A146
Battery pack	Spare battery pack/charging frame, holds 6 'D' size NiCad or Alkaline cells	33A114
Charging cable	Cable to connect spare battery pack directly to charger	33A113
Communication software	Communication software package	33A147
Service manual	Service manual	33DSM11

2.4 Recommended Third-Party Products

Product Name	Description
Printer	Kodak Diconix 180si (serial) printer or Canon BJ10sx printer (requires interface converter) or Hewlett Packard or Olivetti JP50 portable inkjet printer (requires interface converter) or Seiko DPU-411 compact thermal printer
Interface converter	Parallel printer to serial interface converter RS 215-167 (uses PC interface cable 33A146 and requires 25-9 pin adaptor, e.g. RS 218-273)

2.5 Recommended Probes

Product Name	Description	Order Code
For surface flaw inspection		
Probe Kit	General purpose probe kit comprising: 121P1A 500kHz unshielded pencil probe 106P4 2MHz shielded pencil probe 107P4 6MHz shielded pencil probe 29A031 Probe tip protectors 29A029 Steel Test Block 29A028 Aluminium Test Block 29A001 1.5m probe cable 29A044 Tool roll	29K5D
For sub-surface flaw inspection		
	33A130 cable for reflection probes 700P001 sprung reflection probe 700P07A 7mm diameter reflection probe 700P24A 32mm diameter reflection probe 33A048 multi-layer sheet test block set	
For use with rotating probe drive		
Probe Kit	615 series probes, steel body 3/16", 1/4", 5/16", 3/8", 7/16", 1/2" or 619 series probes, plastic body 3/16", 1/4", 5/16", 3/8", 7/16", 1/2" 33A150 rotating probe test block	
For weld inspection		
Probe Kit	800P01 WeldScan probe, 9.5mm body diam. 800P04 WeldScan probe, 16mm body diam. 130P3 Wideband pencil probe (for coating thickness estimation on steel) 5A011 Cable 31A008 Test block	
For aircraft fastener inspection		
FastScan probe kit	851P100 FastScan probe for 6-8mm head diameter fasteners 851A004 FastScan Guide with 9mm hole 33A135 Cable 1.5m long for FastScan and conductivity probes 33A094 FastScan training test block.	

3. Preparations for operation

This chapter details the necessary action before the Phasec 2200 is placed in operation for the first time (and subsequent times as appropriate)

Failure to follow these instructions may, in some cases, result in damage to the equipment and/or create a safety hazard.

3.1 Basic knowledge

The Phasec 2200 Has been designed to be as user-friendly and intuitive as possible, however it is a specialised piece of equipment designed for use by appropriately trained and qualified people.

It is generally considered that impedance plane eddy current equipment of this type, unless used purely in accordance with a detailed procedure or on non-safety related work, requires a level of operator training equivalent to SNT-TC-1A Level II or equivalent, operating within an appropriate company Quality system.

As a general rule, effective use of Eddy current equipment requires the following:

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

- An understanding of other, complementary, NDT and inspection techniques which may be more appropriate or which may be required to verify results.

- A knowledge of the application, i.e. the way in which the part being tested is manufactured or stressed in use and the probable defect mechanisms.

Many organisations provide appropriate training, your local representative will normally be in a position to arrange or recommend suitable training courses.

3.2 Positioning the Phasec 2200

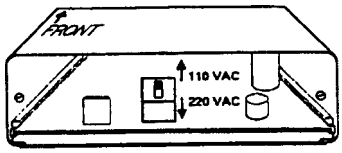
The Phasec 2200 is light enough to be used for long periods of time while suspended from the neck strap supplied as part of the carrying case. When this is used the cover may be positioned so as to act as a “Sunshade” to shield the screen from direct sunlight and improve visibility. Ensure that the Phasec 2200 is securely fastened into the case using the screw fastenings.

When it is not convenient to carry the instrument in this way it should be securely positioned on a suitable flat surface. The case design allows positioning at a convenient angle in most situation.

While robust, the Phasec should not be regarded as ‘drop-proof’

3.3 Power Supply

Setting AC Voltage



Rear view of the battery charger

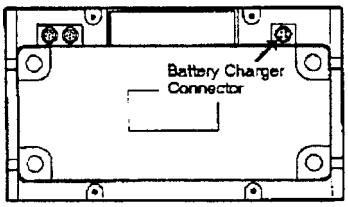
The Phasec 2200 battery charger / power supply will normally have been preset at the factory for 220 V AC operation. 110/220 V AC selection is made via an internal switch on the circuit board. The location of this switch is shown in figure 3.1

Access to the switch may be obtained by removing the two Phillips-head screws on the charger rear panel and carefully removing the panel.

CAUTION:
DO NOT OPEN THE CHARGER WHILE CONNECTED TO AC MAINS POWER

Operating the Battery Charger

The battery charger / power supply connector is located on the rear panel of the Phasec 2200 as shown in the illustration at right.



Rear view of instrument

Batteries may be charged while in the instrument or externally. The Phasec 2200 may be operated on AC voltage while batteries are being charged. The amber LED on the front panel of the charger illuminates while charging.

Normal charge time is 12 to 14 hours. The charger is capable of simultaneous charge and Phasec 2200 operation without increasing charge time. Set the 3 position switch on the front panel according to battery type and operation of the charger:

HI Charging 5 amp hour NiCad batteries and simultaneous instrument operation

O MA Operating the Phasec 2200 on AC power only without charging batteries

STD Charging standard 4.4 amp hour NiCad batteries and simultaneous instrument operation

When charging batteries in the Phasec 2200 the instrument will automatically stop charging when the batteries are fully charged.

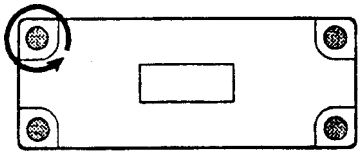
A battery pack may be charged directly from the charger (separate from the instrument) using the optional charging cable (33A113). THE CHARGER SHOULD BE SWITCHED OFF AFTER THE REQUIRED TIME (around 16 hours for fully discharged batteries as above)

Note that the internal protection circuitry of the Phasec 2200 may prevent charging of batteries which have been abnormally discharged (i.e. to less than around 0.5 Volts per cell). Such batteries should be recharged externally using the charging cable above or in a proprietary charger. Note that batteries reaching such a level of discharge may well be permanently damaged.

Installing Batteries

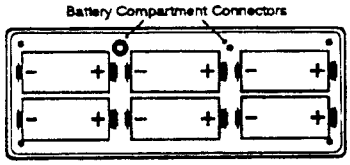
Disconnect the charger before removing the battery pack.

Each cell in the battery pack of the Phasec 2200 is mounted separately in a holder designed to prevent power interruption if the instrument is jolted.



To install cells in the Phasec 2200, lay the instrument face down, loosen the four knobs on the back and lift off the battery pack.

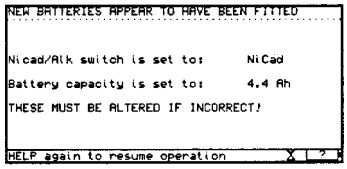
Insert 6 "D" size NiCad or alkaline cells as shown below. Be sure that all cells are firmly seated to assure good contact.



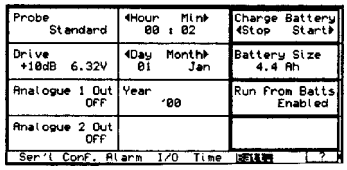
Be sure to set the switch inside the battery compartment for the correct type of cell. For alkaline cells, set the switch to the right. For rechargeable cells, position it to the left.

After the cells have been installed, replace the battery cover and tighten the battery cover knobs.

NOTE: The battery indicator gives an accurate reading of the charge state of the fitted cells. When the battery display begins to flash the instrument has about 10 minutes run time left and the cells should be replaced or recharged as soon as possible. The Phasec 2200 automatically turns off when the battery becomes too weak for reliable operation. Settings are saved and restored when turned on again, after cells have been replaced or recharged. When testing in remote locations, always carry spare cells.



When a new battery pack is fitted and the instrument is first switched on then a warning screen will appear advising the operator of the currently set battery options. Pressing the HELP key takes the operator to the appropriate menu. These should be changed if not correct. Pressing the MENU/HOME key will then return the instrument to normal operation.



Note that on early instruments the real time clock time and date settings will be lost when the battery pack is removed. These should be reset to ensure correct identification of print-outs and stored files.

3.4 Probe Connection

Eddy current probes are connected to the Phasec 2200 either directly with a suitable cable or in conjunction with appropriate adapters.

Directly connected probes include:

Single-coil absolute probes having inductances up to around 200uH fitted with microdot or BNC connectors, and used with a cable terminated in a BNC plug.

Hocking differential and reflection coil probes with a Lemo-terminated cable.

Other probes will require an adapter, e.g. Hocking probes terminated with a Jaeger connector or probes intended for use with instruments from other manufacturers.

Common adapter types are listed in Section 2.

Note that probes connected to the Lemo may be either bridge or reflection type. For absolute or Differential probes intended for bridge operation the

Mode setting should be 'Differential. For driver pickup probes the 'Reflection' setting may be needed.

Note that some special purpose adapters may require the mode set to 'Refl' even when the actual probes are bridge connected.

3.5 Switching on the Phasec 2200

Warm/Cold Start

When the instrument is switched on by pressing the ON/OFF button a 'warm start' sequence is performed.

After a second or two a Logo screen occurs displaying information on the instrument configuration and software version number. This disappears after a further few seconds and the instrument configuration should then be exactly as it was before the instrument was switched off.

To Reset the instrument hold the CLeaR/REFerence key while the instrument is switched on, continue to hold until a continuous tone is heard. A 'cold start' will be performed: the instrument will be reset to its factory default settings. Stored programs will not be deleted

To remove stored programs and completely reset the instrument hold both the top function Softkeys [◄ ►] while switching on, all stored programs and traces will then be deleted.

Language and Measurement Unit Selection

After a "Cold Start" the instrument will be returned to factory default settings as noted above, in particular:

Language is English

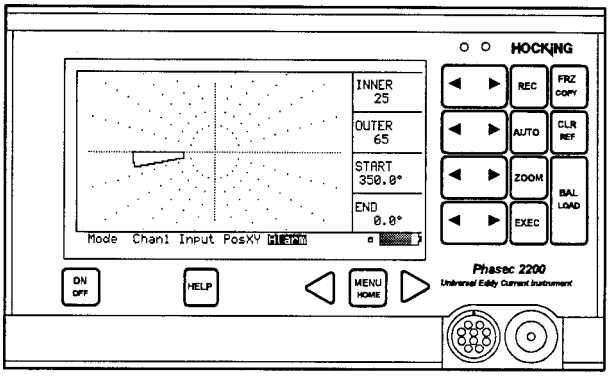
Conductivity measurement in IACS

Coating Thickness measurement in mm

Refer to Chapter 4, Section 4.4 for information on setting the language. Refer to section 5.5 for information on setting the measurement units, These are only applicable when a conductivity probe is connected.

4. The basics of operation

4.1 Display

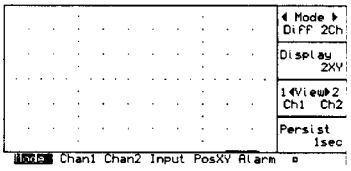


The Phasec 2200 has an Electroluminescent Display, 276 pixels wide by 128 pixels high. This is used in several different ways:

The 'Test' Screen, divided into three sections:

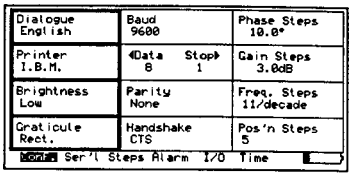
- The Trace area, This may be configured in several different ways: with one or two traces shown, with a timebase or X/Y display. The reference graticule may also be set to Polar, Rectangular, Axes only or Off. See section 5.3

- The right-hand menu area showing the currently active menu selection of four adjustable 'first-level' functions.

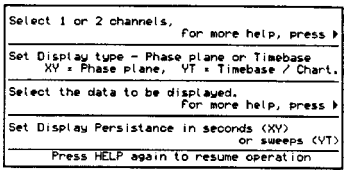


- The status line along the bottom of the display, showing which menu is active along with a number of other indicators, such as battery condition zoom status, freeze etc. This line is also used for displaying a number of warning and information messages.

The 'Setup' screen is accessed by pressing the MENU/HOME key. This gives access to 'second-level' functions, i.e. instrument parameters which will be less frequently changed. Again the status line shows which menu is selected

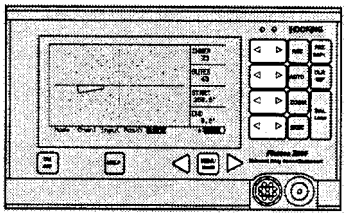


There are a number of other screens, most importantly the help screens (see section 4.3) accessed by pressing the HELP key. Others include the conductivity screen and the program/trace storage screens, more details are given in the appropriate sections.

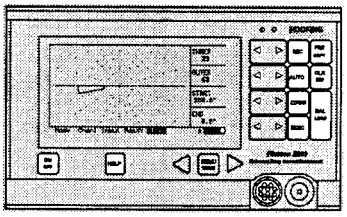


4.2 Keypad

The Phasec 2200 has a sealed membrane keypad, the keys can be divided into two groups.



Keys for selecting functions, and changing the instrument settings.



Special purpose keys for accessing particular instrument functions

Selection/Adjustment keys

MENU/HOME – this key switches between the TEST screen (showing the trace and currently selected first level functions) and the SETUP screen showing the second level functions.

A long (HOME) press switches to the TEST screen and the Mode menu

Function Keys – the left and right function group selection keys allow the operator to select one of the different groups of four functions in each function level.

Softkeys – the four 'Softkeys' change the value of the various functions displayed on the Right Hand Side of the screen

in the case of numeric functions ◄ reduces the value and ► increases it.

Some functions having only a few values, e.g. Units for conductivity and coating thickness, are paired, each side of the softkey steps one of the functions through its allowable values.

In the case of many numeric function pressing both sides of the key simultaneously toggles the function between coarse and fine adjustment steps, Holding one side of the key for more than a few moments will increase the rate of change.

Special Purpose keys

ON/OFF – when the instrument is Off, pressing this key will switch the instrument On.

When the instrument is On, holding this key down for a half-second will switch the instrument Off.

HELP – provides help on currently selected functions, see section 4.3 for more information.

AUTO – If the instrument is in single channel mode and the recording memory is not currently active this key activates the Auto-lift-off function: The instrument will balance and enter a waiting state until the probe is lifted off the surface. When this is detected the phase will be rotated such that the lift-off is horizontal to the left.

If the instrument is in dual channel mode and the recording memory is currently active this button performs the automix sequence. The parameters of channel 2 are adjusted so as to cancel the influence of the selected test condition (e.g. inter-layer spacing variation or a tube support) on the Sum display

BALance/LOAD – a short press initiates the instrument balance sequence. The display spot(s) will return to the zero position, as set in the PosXY

A long press of this button, with ABS mode selected, will cause the balance sequence to be preceded by an 'Automatch' sequence, selecting the most appropriate of the available built in balance loads.

CLeaR/REF – a short press on the CLR key clears the screen of old signal trace data

A long press clears the displayed reference trace.

The CLR key is disabled while 'Freeze' is active

EXECute – the EXEC key is used to initiate a selected action.

Actions requiring EXEC are selected in the Copy Mode and memory function fields. It is also used to exit from editing the print header.

FReeZe/COPY – a short press on the FRZ/COPY key will freeze the current trace, allowing a store or print operation. When pressed a copy control menu pops up allowing the user to specify which (if any) copy operation is required.

If a long (1 second) press is used, the previously selected copy operation will be performed directly.

RECord – controls the signal recording process. The first press clears the store and starts recording, The second press stops recording, retaining the last 32 seconds (16 seconds in dual channel mode) of data. Menu functions allow selection of a portion of the recorded data.

Once a portion has been selected, the operator can press AUTO to initiate automatic mixing and resume normal operation. Or adjust the mixing parameters manually (see section 5.7) then press RECORD a third time to return to normal operation

A long press (approximately 1 second) on the Record key will replay the previously stored data.

ZOOM – successive presses of the ZOOM key set display gain to double, nominal, half, nominal....

This is particularly helpful when looking at signals which are larger/smaller than the current optimum, particularly when mixing is being used so that the setup is not disturbed. Changing the zoom setting does not alter an instrument parameters, and does not change the amplitude of analogue outputs if used.

The ZOOM status is indicated by a square of variable size on the status line next to the battery indicator symbol.

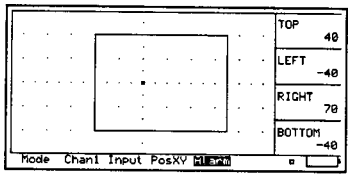
In terms of Analogue outputs:

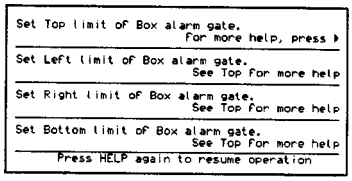
x2 zoom is 0.1 V/Division

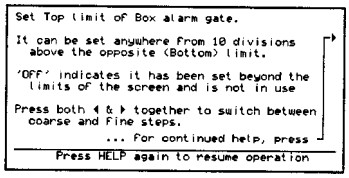
x1 zoom is 0.2 V/Division

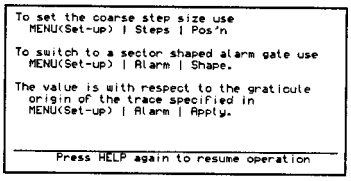
x½ zoom is 0.4 V/Division

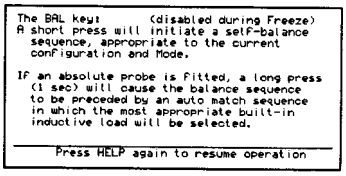
4.3 Help











Pressing the HELP key during operation will display brief information relating to the currently available functions. The illustrations show the help information available for the Alarm (Box) First level function group.

In many cases additional information is available, this is obtained by pressing the relevant ▶ Softkey. Further pages may be obtained by additional key-presses.

A further press of the HELP key returns the instrument to normal operation.

While the Help function is active, pressing one of the direct function keys (e.g BALance/LOAD shown here) will give information about this function.

Again in some cases additional information is available, accessed by pressing the relevant key again.

4.4 Important default settings

Setting the Language

When the Phasec 2200 is fully reset all menus, Help text and printout (hard copy) text will appear in English. It is intended that the following operational languages (and perhaps others) will be available:

- English
- French (Francais)
- German (Deutsch)
- Italian

To select the required language

- Press MENU/HOME to select the second level functions
- Use ◁ and ▷ as necessary to select the Configuration function group
- Use ◀ ▶ in the DIALOG function to select the desired language
- Set other functions as desired.
- Press MENU/HOME again to return to normal operation

Setting the units of measurement

There are three separate units of measurement which can be set on the Phasec 2200

- Unit of measurement (IACS or MS^{-1}) for conductivity testing
- Unit of measurement (Inch or mm) for coating thickness measurement with conductivity probe

- Unit of measurement (Inch or mm) for position readout during bolthole inspection with an incrementing drive unit.

These can be set as follows

Measurement settings with conductivity probe

- Press MENU/HOME to select the second level functions
- Use ◁ and ▷ as necessary to select the Conductivity function group
- Use ◀ in the Units function to select the desired unit for conductivity measurement
- Use ▶ in the Units function to select the desired unit for coating thickness measurement
- Set other functions as desired.
- Press MENU/HOME again to return to normal operation

Setting the Time and Date

The Phasec 2200 contains an internal clock with is used to put the correct date on a screen printout, and to store the time and date with traces and settings in the internal memory

To set the time and date

- Press MENU/HOME to select the second level functions
- Use ◁ and ▷ as necessary to select the Time. function group
- Use ◀ in the Time function to select the current hour.
- Use ▶ in the Time function to select the current minute.
- Use ◀ ▶ in the Day function to select the current day.
- Use ◀ ▶ in the Month function to select the current month.
- Use ◀ ▶ in the Year function to select the current year.
- Set other functions as desired.
- Press MENU/HOME again to return to normal operation

Battery Settings

Charge battery overrides

If required the automatic switching of the battery charging by the instrument can be overridden. This may be necessary if new batteries of indeterminate state have been fitted and it is required to force a charge. It should be

noted that to obtain maximum life from NiCad cells they should always be fully discharged before being recharged. Batteries may be easily discharged by leaving the instrument turned on (Run from Batteries set to enabled), with no mains power connected, until it automatically switches off. Charging on is indicated by the orange LED on the front panel of the PSU unit.

To override battery charging

- Press MENU/HOME to select the second level functions
- Use ◁ and ▷ as necessary to select the Batt. function group
- Use ◀ in the charge battery function to stop charging. The Battery charge monitor will be set to full
- Use ▶ in the charge battery function to start charging. The Battery charge monitor will be set to empty

Battery Size

The battery charging and monitoring circuit relies on 'knowing' the rated battery capacity. This should be set as appropriate. Most Good Quality 'D' size Nicads cells have a rated capacity between 4 and 5 Ampere Hours, while Alkaline are typically 7-8 Ah or so. Separate values are maintained for each type. Note that if the instrument is reset by pressing CLR while switching on these values will be reset to the defaults of 4.4 and 7.5 Ah respectively.

Run from Batteries

This has three possible settings:

Enabled The instrument will run as long as it is connected to an AC supply or is fitted with batteries in an adequate state of charge. If left on It will run until the batteries are discharged.

Disabled The instrument will not run while AC power is not present, If switched on it will start up,balance and then immediately switch off. This is intended where the instrument is always run from AC power and batteries (probably alkalines) are fitted purely to give long-term memory back-up.

N.B. If the instrument is set to this state and it is required to run without AC power then it will be necessary to RESET the instrument completely or remove and replace the battery pack to allow the setting to be changed.

Time Limited On AC power the instrument will run indefinitely, On batteries it will switch off if no key is pressed for around 20 minutes.

Setting Display Brightness

The Phasec 2200 has 2 possible display brightness settings: Low and High; these function as follows:

The Low setting sets both the text and eddy current trace displays to low intensity, this mode gives minimum power consumption.

The high setting sets both trace and text displays to high intensity, this will give the best readability in bright light at the expense of reduced battery life.

To select the required brightness

- Press MENU/HOME to select the second level functions
- Use ◁ and ▷ as necessary to select the Configuration function group
- Use [◂ ▸] in the Brightness function to select the desired intensity
- Set other functions as desired.
- Press MENU/HOME again to return to normal operation

Configuring Analogue Outputs

The Phasec 2200 has 2 analogue outputs which can be used to drive external chart recorders etc.

Connections are made to the rear panel auxiliary Lemo connector.

The outputs are programmable and each one can be selected from the following: Off, X1, Y1, X2, Y2, Sum X, Sum Y. If the instrument is set to single channel mode, only Off, X1 & Y1 are valid. The off position will minimise instrument power consumption and should be selected if analogue outputs are not required.

The variable tone generator for headphones is fed from analogue output 1 thus if this facility is required output 1 should be set as appropriate (usually Y1).

The maximum voltage available from these outputs is +/-2.5V. A voltage of 2.5V corresponds to an X movement right across the screen. Thus if the balanced spot is positioned on the extreme left of the screen using the Xpos/ Ypos shift functions and a defect signal deflects the spot to the extreme right, the corresponding analogue output will change from 0V to +2.5V.

Conversely if the balanced spot is positioned on the extreme right of the screen and a defect signal deflects the spot to the extreme left, the corresponding analogue output will change from 0V to -2.5V.

N.B. The above assume that ZOOM is set to the standard position. Changing the zoom will alter the display but not the output voltage.

To select the required outputs

- Press MENU/HOME to select the second level functions
- Use ◁ and ▷ as necessary to select the I/O function group
- Use ◂▸ in the Analogue 1 function to select the desired signal for output 1and/or Headphones.
- Use ◂▸ in the Analogue 2 function to select the desired signal for output 2.
- Set other functions as desired.
- Press MENU/HOME again to return to normal operation

See section 9.3.5 for details of Auxiliary connector pins

5. Operation

5.1 Adjustment

All Functions are selected as follows:

- Press MENU/HOME to select the first level (displayed with trace) or second level functions
- Use ◁ and ▷ as necessary to select the appropriate function group
- Use the [◄ ►] softkey next to the function to select the desired value.
- Appropriate numerical function values can be adjusted in large and small steps, adjustment in small steps is selected when the function is shown in mixed case (e.g. X-Pos 1).
- By pressing both sides of the [◄ ►] softkey together the function name will be shown in upper case (e.g. XPOS 1) indicating that adjustment will be in large steps. A second press of both sides will return to small step mode.

Function groups menus are arranged as shown below, for more information refer to section 10

First Level Function menus

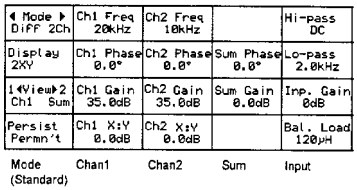
◄ Mode ► DIFF 2Ch	Rotary Mini	◄ Mode ► Conduct	Ch1 Freq 200kHz	Ch2 Freq 1.0kHz		Hi-pass DC	X-pos 1 0	Speed 1s/div	Top OFF	INNER 20	Record Playback
Display 2XY	RPM 300	Freq. 60kHz	Ch1 Phase 0.0°	Ch2 Phase 0.0°	Sum Phase 0.0°	Lo-pass 2.0kHz	Y-pos 1 0		Left OFF	OUTER 40	START 1.00s
1◄View►2 Ch1 Sum	Display W/Fall	Task Measure	Ch1 Gain 35.0dB	Ch2 Gain 35.0dB	Sum Gain 0.0dB	Inp. Gain 0dB	X-pos 2 0	Y-pos 1 0	Right OFF	START 40.0°	LENGTH 0.29s
Persist Permn't	Persist Permn't	◄ Units ► MS/m mm	Ch1 X:Y 0.0dB	Ch2 X:Y 0.0dB		Bal. Load 120µH	Y-pos 2 0		Bottom OFF	END 310.0°	Scroll 0.1 s
Mode (Standard)	Mode (Rotary)	Mode (Conduct.)	Chan1	Chan2	Sum	Input	PosXY	SetYT	Alarm (Box)	Alarm (Sector)	Play

Note that Chan2 and Sum menus are not available on a single frequency instrument.

Second Level Function menus

Baud 9600	Dialogue English	Alarm Stretch 0.2s	Probe Standard	Probe Conduct.	◄Hour Min► 11 : 31	Charge Battery ◄Stop Start►
◄Data Stop► 8 1	Printer I.B.M.	Alarm Shape Box	Drive 0dB 2.0V	Cal. Block 1 57.8 IACS	◄Day Month► 10 Oct	Battery Size 4.4 Ah
Parity None	Brightness Normal	Apply to Trace 1	Analogue 1 Out OFF	Cal. Block 2 8.8 IACS	Year '95	Run from Batts Enabled
Handshake CTS	Graticule Rect.	◄Alarm action► Run Silent	Analogue 2 Out OFF	◄ Units ► IACS in		
Ser'l	Conf.	Alarm	I/O	Cond.	Time	Batt.

5.2 Setting Main Eddy Current Test Parameters



Most of these are set in the Mode, Channel and Input function groups

Mode settings will be determined by the nature of the test to be carried out, for example this may be a single frequency, absolute (single coil) test.

Note that the function of the Abs/Differential/Reflection is to select probe connections and may not always be the same as the probe description, for example an absolute probe with an integral balance load would normally be treated as a Differential connection.

N.B. In this context Diff refers to coils connected using a differential bridge arrangement, Both bridge and Driver-pickup (reflection) coils may have a differential sensing coil configuration.

Frequency for channels 1 and 2 (dual frequency version) is selected in the Chan1 and Chan2 menus.

In single frequency operation the Phasec 2200 will operate from 60Hz to 6MHz, in two-channel mode operation is restricted to the range 100Hz-2MHz.

Note that the maximum frequency ratio between the two channels is 10: 1, e.g. if channel 1 is set to 100kHz, the channel 2 can be adjusted over the range from 10kHz - 1MHz. If channel 1 is adjusted so as to be a greater ratio from channel 2 both will change, e.g. if channel 2 is set to 1MHz reducing channel 1 to 50 kHz will set channel 2 to 500kHz. The instrument will beep to alert the operator.

Typically the low range of frequencies (up to 20KHz or so) are used for subsurface flaw detection, Higher frequencies are used for surface crack detection, conductivity measurement etc. For discussion of two channel operation see section 5.7

Phase rotation is adjustable in steps of 0.1 degree or greater, allowing the trace to be rotated as desired, e.g. to set “lift-off” horizontal

Gain is set in steps of 0.1dB or greater. Gain settings on the Phasec 2200 horizontal and vertical amplifiers are ‘independent but linked’ The Channel gain is set, and then the horizontal or vertical gain may be reduced relative to it. Note that the displayed Gain is the total of set Gain, Input Gain and probe drive Ratio. Thus if input Gain is 0dB and probe drive is -10dB then Gain is adjustable from 0 to 50dB, If input Gain is 20dB and probe drive is +10dB then Gain is adjustable from 40 to 90dB (see below)

For normal operation with Vertical and horizontal gain equal the X:Y ratio is left at 0.0 dB, but this may be adjusted in the range +/- 20 dB, i.e. from 10:1 to 1:10. The table gives common ratios in dB:

1:1	2:1	4:1	5:1	8:1	10:1
0dB	6dB	12dB	14dB	18dB	20dB

Channel 2 and Sum gain and Phase are adjusted in the same way as Channel 1, see section 5.7

High Pass Filtering

The high pass filter is used to reduce or eliminate unwanted signals which vary slowly relative to the defect, such as product vibration or geometry changes, from the displayed trace. If the probe does not traverse a crack quickly, when a high pass filter is being used, the unit will 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. Thus the filter can help to suppress the noise leaving the defect signal undiminished. When using a rotating probe system the high pass filter setting must be chosen carefully to obtain best results at a given rotational speed.

The high pass filter can also be used during hand scanning when there are slowly changing effects, but care should be exercised to move the probe at a constant speed. Settings greater than around 10 Hz are unlikely to be suitable with hand scanning at typical speeds.

Low Pass Filtering

The low pass filter is used for reducing and eliminating rapid signal changes such as electrical interference. If a crack is traversed quickly, with a low pass filter used, the 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 defect signals.

Input Gain

The Input gain function on the Phasec 2200 has two values, 20dB and 0dB. The 20dB setting should be correct for most situations, but if there are problems balancing, or unexpected distortions of the test trace, then the 0dB gain setting should be tried. This may also be useful in applications requiring very low sensitivity, such as demonstration of the full impedance plane for training purposes.

Probe Drive

This is on the second level I/O function menu. Press MENU/HOME to select the second level functions, then use ◁ and ▷ as necessary to select the I/O function group

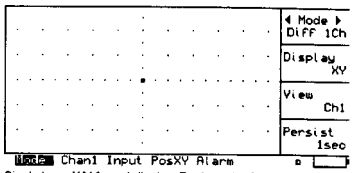
For most applications the probe drive can be left at 0dB, which corresponds to 2 volts peak to peak. For extreme low sensitivity applications, or when inspecting parts which are sensitive to magnetic fields the probe drive may be reduced to -10dB (0.6V peak to peak) The gain settings displayed will be reduced by 10dB For high sensitivity applications, or when driving large coils (for example 'system' type encircling coils and the 'FastScan' probe) the probe drive may be increased to +10dB (6V peak to peak) The gain settings displayed will be increased by 10dB

Optimise

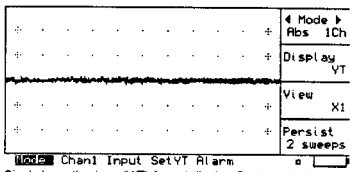
The optimise function occupies the same menu location as balance load. It will be shown in Differential or reflection mode, or may be accessed by pressing both sides of the softkey in absolute mode.

Various offsets throughout the instrument circuitry may combine to cause a change in the balance point when the gain is changed. The optimise sequence measures and eliminates this effect. Once set it should only need further activation if there is a significant temperature change.

5.3 Setting Display Format



Single trace X/Y format display, Rectangular Axes



Single trace timebase(Y/T) format display, Rectangular Axes

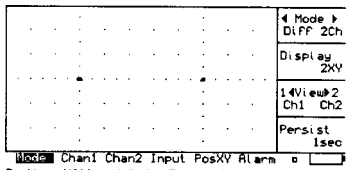
The Display on the Phasec 2200 can be configured in a number of ways to suit the application,

Either one or two signals can be displayed on screen at one time, a timebase (Y/T) or impedance plane display (X/Y) format can be used, and either a polar or rectangular (grid) graticule can be generated.

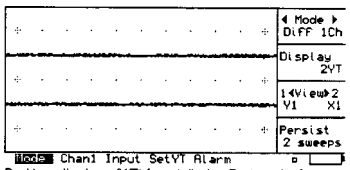
The timebase speed can be adjusted over a wide range, and the display persistence can be set in terms of time (XY) or number of sweeps (YT)

Display

Display type is set on the First-level Mode menu, the following options are available:



Dual trace X/Y format display, Rectangular Axes



Dual trace timebase (Y/T) format display, Rectangular Axes

XY A single impedance plane display, used in the vast majority of applications. Display persistence is adjustable from 0.1 to 20 seconds.

YT A single timebase display. For a static probe the timebase sweep can be adjusted from 0.1 to 20 seconds per division. The display persistence can be adjusted to be one, two, four, eight, 16, 20, 33 or 50 sweeps (but not more than 20 seconds), or permanent. Any of the available channel X or Y signals can be displayed.

2XY A dual (side by side) impedance plane display, used primarily during setup of dual frequency (with mixing) applications. Display persistence is adjustable from 0.1 to 20 seconds.

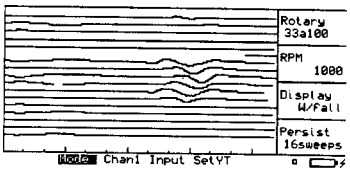
2YT A dual timebase display. For a static probe the timebase sweep can be adjusted from 0.1 to 20 seconds per division. The display persistence can be adjusted as for YT mode

Ytheta (For Rotary Probe drives) Sweep speed is set by the drive RPM and synchronised to display a complete probe revolution accross the screen

2YTheta Timebase as Ytheta, Two traces are shown.

W/fall (Waterfall) This is only available in Rotary probe mode. successive sweeps are retained on the screen to build up a ‘waterfall’

diagram, giving a pseudo-3D image of the bore I.D. The number of scans displayed on screen is controlled by the persistence function.



View

The view function allows selection of one or two signals from those available, In single channel XY mode there is no choice, only Ch1 can be shown, with a timebase display the X or Y component of the channel 1 signal can be shown.

In dual channel mode either channel 1, channel 2 or the Sum can be displayed, in a timebase mode the selection can be made from X1, Y1, X2, Y2, SumX or SumY.

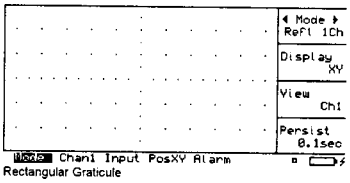
Setting Graticule type

The graticule function in the second level Conf. menu may be set to be either rectangular, polar, axes or off.

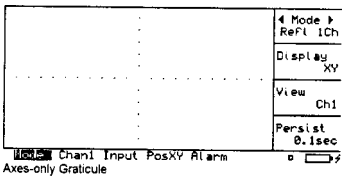
In 2XY mode separate graticules are displayed for each spot.

Normally the graticule will be selected to suit the type of analysis required, i.e. where a defect will be characterized primarily on amplitude a rectangular graticule is most appropriate, whereas when assessment is primarily by phase the polar graticule would be preferable.

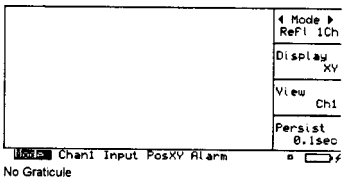
Note that a polar graticule is only displayed in XY modes, in Timebase mode a rectangular graticule will be substituted



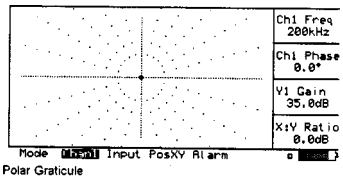
Rectangular Graticule



Axes-only Graticule



No Graticule



Polar Graticule

Spot Position

The Pos.XY function group permits adjustment of the zero position of the displayed spot(s) for the impedance plane (XY) Display

When a single trace is displayed only the X-Pos 1 and Y-Pos 1 functions are shown.

If a timebase display is being used the Y-Pos 1 (and Y-Pos 2 for dual display) functions are accessed from the Set YT function group. This also sets the timebase speed. When using a rotary probe the speed function is not shown as this is set by the probe RPM.

X-pos 1 0	Speed 1s/div
Y-pos 1 0	
X-pos 2 0	Y-pos 1 0
Y-pos 2 0	Y-pos 2 0

5.4 Setting Alarms

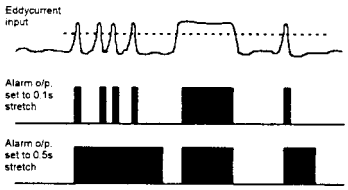
Two menus set the alarm operation. The second level Alarm menu sets the type of alarm and its general configuration. The First level alarm menu allows adjustment of appropriate thresholds

Alarm Stretch 0.2s
Alarm Shape Box
Apply to Trace 1
◂Alarm action▸ Run Silent

Alarm (Box)

Top OFF	INNER 20
Left OFF	OUTER 40
Right OFF	START 40.0°
Bottom OFF	END 310.0°

Alarm (Sector)

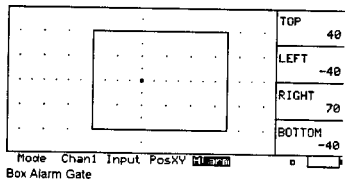


Alarm stretch function

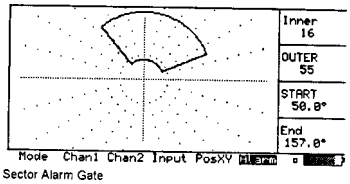
For a given application the options in the second-level menu should be set first:

Alarm stretch controls the minimum on-time for the alarm, i.e. a short alarm condition will be extended to this time, a longer alarm will be on for as long as the alarm condition remains. This is particularly relevant where a visual alarm or some external device is being used and a short alarm may be missed, on the other hand, several defects close together will not be resolved if the alarm stretch is too long.

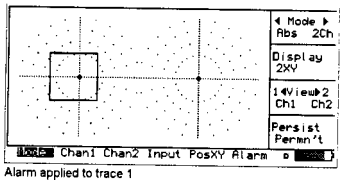
Alarm stretch can be set to zero, 0.1s, 0.2s, 0.5s, or one second



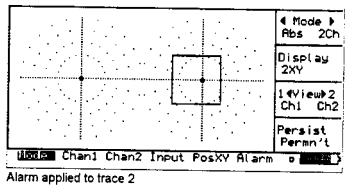
Box Alarm Gate



Sector Alarm Gate



Alarm applied to trace 1



Alarm applied to trace 2

The **Alarm Shape** may be set to either Sector or Box . Most commonly this will match the Graticule , i.e. a Box alarm will be used with a rectangular graticule and a sector alarm with a polar graticule, but either many be used with the other.

The **Alarm action** field contains two independent parts:

The Alarm can be set to give an audible tone, or be silent.

The Freeze option automatically 'freezes' the display ready for printing, data logging or operator scrutiny when an alarm condition occurs.

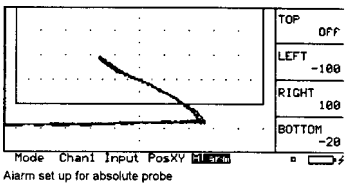
If two traces are displayed the alarm will operate on only one of them. The Apply to option selects which.

Alarm Thresholds

These will be set to suit the exact application, the following guidelines may be useful:

Note that for all Alarm configurations the sense of the alarm relates to the balance position as set by the X-POS and Y-POS functions, If this is inside the set alarm area then an alarm will be generated when the spot leaves the area. If the balance position is outside the alarm area then the alarm will occur when the spot enters the alarm area.

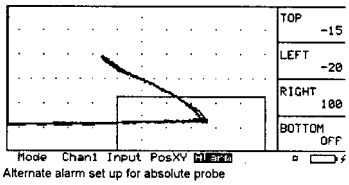
Box Gates



Aiarm set up for absolute probe

For **Absolute probe crack detection** tests a single positive threshold is usually most appropriate, i.e. set Top, Left and Right Threshold OFF and Bottom Threshold as convenient.

To make the most use of the screen area it may be convenient to set the spot zero position to the lower right hand corner (with lift off horizontally to the left) i.e. X-POS set to 80 and Y-POS set to -40 for example.

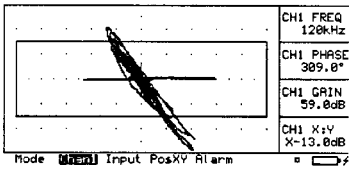


Alternate alarm set up for absolute probe

With an absolute probe the lift-off vector may tend to curve upwards, causing an alarm when the probe is removed from the test piece. To avoid this effect the 'sides' of the box gate may be used as shown.

Alternatively, the sides of the alarm may be used to ensure that the operator is made aware when the lift-off exceeds a certain amount, e.g. where paint is thicker than usual.

Typically **Differential probes** are set up with the 'wobble' signal horizontal and the frequency chosen so that the defect signal has a reasonable phase separation as shown.

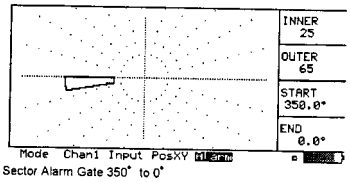


Alarm set up for differential probe

Since defect indications may be positive or negative the spot is centred and the alarms setup symmetrically.

The 'sides' of the alarm box may be used where excessive 'wobble' is required to give an alarm.

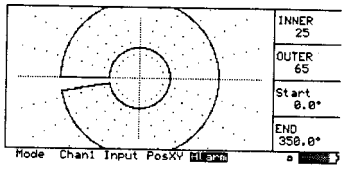
Sector Gates



Sector Alarm Gate 350° to 0°

These are less commonly used than Box gates, but are particularly appropriate when using the FastScan probe (see section 10.11)

Normally Sector Gates will be used with the spot central.

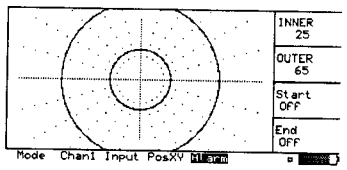


Sector Alarm Gate 0° to 350°

The Minimum value for the Inner radius is 5, i.e. ten small divisions diameter, Below 5 Inner is displayed as 'All Off' and the alarm is inactive

The Outer limit has a maximum value of 125 for a single spot display and 85 for a dual spot display, above these values it is displayed as Off.

The active alarm is measured clockwise from Start to End angles.



Sector Alarm Gate, continuous

When Start and End are the same both display as off and the Alarm region is a complete circle

N.B. To minimise irritating activation of the alarm whilst the limits are being set by the user there is a short delay between setting the alarm and its activation.

5.5 Single frequency operation with standard eddy current probes

Absolute probes, including integral balance and absolute reflection probes

Probe connection

If these are of the single coil type, having an inductance in the range of the internal balance loads (approximately 0-200μH) they may be connected to the BNC connector using a 29A001 cable or equivalent.

In the first level Mode function group set Mode to Abs using the ◄ softkey.

In the first level Input function group set Balance load to the same value as the probe inductance, or, with an appropriate test frequency set, a long push on the BAL key will cause the instrument to select automatically the most appropriate internal balanced load.

If the inductance does not match one of the internal loads then set mode to Diff, Connect the probe cable to the differential (Lemo) connector via an adapter type 33A120 in conjunction with a suitable balance load. It may be

necessary to set input gain to low (0dB) if the impedance mismatch between probe and load is greater than about 20%.

Absolute probes having an integral balance load (for example the Hocking 720P series) and absolute reflection (driver pickup probes such as the Hocking 700P series) probes should be connected to the Lemo connector, via a suitable adapter if required, and the instrument mode set to Differential or Reflection as appropriate for the adapter/probe combination (see section 3.4)

Selection of parameters

Set up First level menu functions as follows

Mode	Chan1	Input	PosXY	Alarm
Diff - 1Ch	Ch1 Freq - A/R	High Pass - DC	X-pos1 - 0	All Off
Display - XY	Ch1 Phase 0	LowPass - 300 Hz	Y-pos1- 0	
View - Ch1	Ch1 Gain 35dB	Inp-Gain +20 dB		
Persist - 0.5 s				

Set up Second level menu functions as follows

Conf.	Alarm	I/O
Dialogue A/R	Stretch - 0.1 s	Probe Type - Standard
Printer A/R	Shape - Box	Drive 0 dB
Bright - Normal	Apply to - Trace 1	Analogue 1 - A/R
Graticule - Rect	Action- Run/Tone	Analogue 2 - A/R

Procedure

Place the probe on the surface of a suitable test block and press and hold BALance/LOAD the instrument will automatically select the optimum load and then balance.

Select the Chan1 menu using the ◁ and ▷ keys as necessary.

Press AUTO and gently lift the probe off the surface, verify that liftoff is horizontal and to the left. or adjust the phase control so that liftoff is horizontal and to the left.

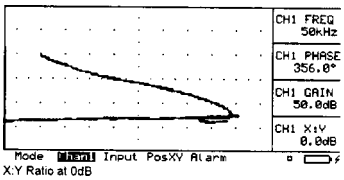
Move the probe over an appropriate notch in the calibration block. Verify that the spot is deflected upwards, adjust Y1-Gain so that the response is of a convenient size.

Select the PosXY menu using the ▷ key.

Set X-Pos 1 to approximately 80, Y-Pos1 to -40, so as to place the spot zero position in the lower right hand corner of the screen, allowing maximum use of the screen area.

Depending on the shape of the defect signals it may be convenient to change the X:Y ratio so that the defect signal shows as near vertical:

Select the Chan1 menu using the ◁ key, adjust X:Y ratio to give a convenient display (see opposite).

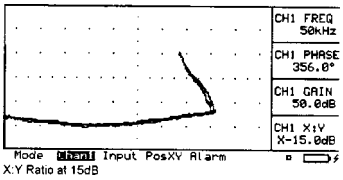


X:Y Ratio at 0dB

Set alarm as follows:

Select the Alarm menu using the ▷ key,

Reduce Top threshold value to approximately -10 (assuming display setup as above) move probe over all relevant notches and ensure that alarm activates.



X:Y Ratio at 15dB

Other Alarm configurations may also be useful, see section 5.2.

The Phasec 2200 is fitted with a variable tone headphone output which may be useful for this kind of test. Connect a pair of standard 'Walkman' style headphones to the auxiliary connector via the appropriate adapter. In the second level menu select Analogue 1 out to CH1 Y.

The tone heard in the headphones will now vary in step with the displacement in the Y axis. The further the spot moves from zero, the higher the frequency of the tone will be.

b) Differential probes

If these are equipped with the correct LEMO connector they may be plugged directly into the instrument, otherwise a suitable adapter should be used as detailed in section 2.2, Some probe adaptors will require the instrument to be set for 'Reflection', others for ' Differential'. When using adaptors this choice is often governed by the adaptor, not the probe.

Selection of parameters

Set up as for absolute probes, except for Mode setting, which should be Diff, 1ch or Refl, 1ch as above

Procedure

Place the probe on the surface of a suitable test block and press BALance/ LOAD

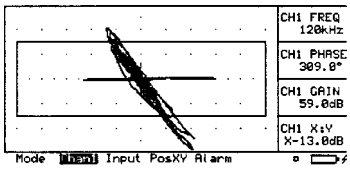
Select the Chan1 menu using the ◁ and ▷ keys as necessary

Move and rock the probe as appropriate over good portions of the test block, a characteristic direction of spot movement will usually be seen (it may be necessary to increase gain) adjust the phase control so that spot movement direction is horizontal

Move the probe over an appropriate notch in the calibration block. Verify that the spot is deflected up and down, adjust Gain so that the response is of a convenient size.

Depending on the shape of the defect signals it may be convenient to change the X:Y ratio so that the defect signal shows as near vertical:

Select the Chan1 menu using the ◁ key, adjust X:Y ratio to give a convenient display as shown



Set alarm as follows:

Select the Alarm menu using the ▷ key,

Reduce Top threshold value to approximately 30, increase Bottom value to -30, reduce Right threshold value to approximately 100 increase Left value to -100 (assuming display setup as above) move probe over all relevant notches and ensure that alarm activates.

A polar graticule and alarm may sometimes be useful with differential probes, Filtering is often used to improve signal to noise ratio when the probe is moving at a defined speed.

5.6 Use with rotating probe drive

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

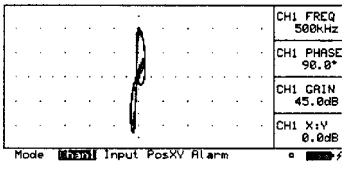
It is recommended that the probe drive is plugged in with the instrument switched off. Connect the drive using a suitable cable and plug in a suitable probe of the correct diameter for the holes to be inspected.

Switch the instrument on again and set parameters as desired. Individual setup preferences will vary but the following is suggested as a guide. The settings are based on a Hocking 615P024 probe in a type 33A100 Minidrive, inspecting a notch in a 0.375" diameter hole in Aluminium.

Initial setup:

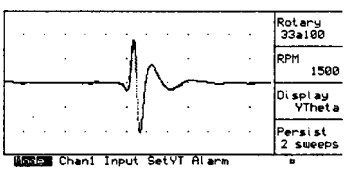
Mode	Chan1	Input	PosXY	Alarm
Rotary	Ch1 Freq - 500 kHz	High Pass - 100	X-pos1 - 0	All Off
RPM - 1500	Ch1 Phase 90	LowPass - 750 Hz	Y-pos1- 0	
Display - XY	Ch1 Gain 45dB	Inp-Gain +20 dB		
Persist - 0.5 s	X:Y 0 dB			

Conf.	Alarm	I/O
Dialogue A/R	Stretch - 0.1 s	Probe Type - Standard
Printer A/R	Shape - Box	Drive 0 dB
Bright - Normal	Apply to - Trace 1	Analogue 1 - A/R
Graticule - Rect	Action- Run/Tone	Analogue 2 - A/R



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. An indication should be seen as shown.

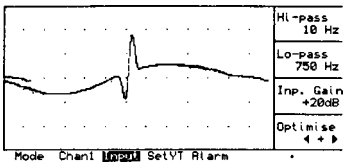


Rotate phase so that the indication from the notch is vertical.

Switch Display to Ytheta in the Mode menu.

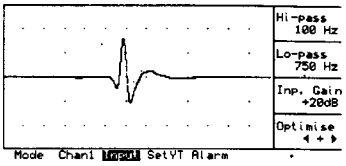
Display will now show an angular representation as shown. The Graticule has major marks at 90° intervals and minor marks at 30°

Select input menu and optimize filters for best signal to noise ratio.



Select alarms if desired (e.g. top 20 and bottom-20)

N.B. Once familiar with instrument operation optimization of phase, gain, filter and alarm settings may be conveniently made while replaying a recorded signal



Points to note about rotating drives

The various types of drives available from Hocking are programmed with relevant parameters, such as type, serial number and allowable speeds

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

For an equivalent situation filter frequencies are directly proportional to speed, e.g. 100Hz and 750Hz at 1500 RPM should give approximately the same results with the same diameter probe as 200Hz and 1.5kHz at 3000 RPM.

5.7 Dual frequency Operation

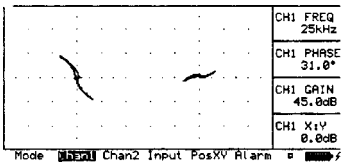
The Phasec 2200 (dual frequency version) is able to test at two simultaneous frequencies, with mixing to suppress an unwanted variable.

This example is based on a standard ID probe (Hocking IDP138L--18k probe with LHC-0C cable or similar and 33A121 adaptor) with an ASME brass tube (Hocking 5A213 with 5A216 steel 'support plate simulator' ring)

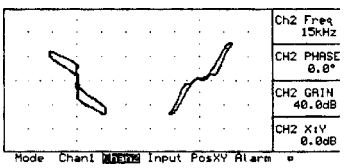
Initial setup:

Mode	Chan1	Chan2	Sum	Input	PosXY	Alarm
Diff - 2Ch	Ch1 Freq - 25 kHz	Ch2 Freq - 15 kHz		High Pass- DC	X-pos1 - 0	All Off
DISPLAY - 2XY	Ch1 Phase 0	Ch2 Phase 0	Sum Phase 0	LowPass - 300 Hz	Y-pos1- 0	
View Ch1, Ch2	Ch1 Gain 45dB	Ch2 Gain 40dB	Sum Gain 3 dB	Inp-Gain +20 dB	X-pos 2 - 0	
Persist - 0.5 s	X:Y 0 dB	X:Y 0 dB			Y-pos2 - 0	

Conf.	Alarm	I/O
Dialogue A/R	Stretch - 0.1 s	Probe Type - Standard
Printer A/R	Shape - Box	Drive 0 dB
Bright - Normal	Apply to - Trace 1	Analogue 1 - A/R
Graticule - Rect	Action- Run/Tone	Analogue 2 - A/R

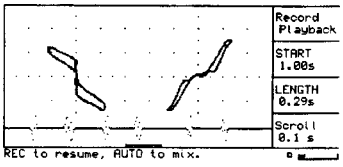


First set the parameters of Channel 1 to give an acceptable signal presentation . For a conventional ASME presentation this means rotating the phase so that the wobble signal is horizontal, adjusting the frequency as necessary so that the angle of the through-wall hole is approximately 40-50°, and the gain so that the signal from the through-wall hole is a convenient amplitude (e.g. around 3 divisions p/p)



Next move the support ring over the tube with the probe inside, and set the gain of Channel 2 so the peak to peak amplitude of the signal on Channel 2 is approximately the same as Channel 1.

Press the record button and move the ring back and forth over the probe a couple of times. Press REC again to stop recording.



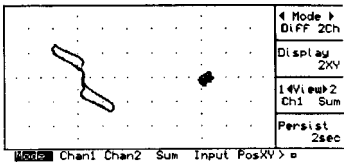
Use the Scroll functions to select an appropriate section of the recorded trace.

The recorded data is displayed in YT form at the bottom of the screen, the displayed cursor selects the area to be mixed.

The last approx. 2 seconds of recorded data are shown on the YT trace, if the recording is longer than this the full data may be scrolled through using the SCROLL setting to display the recorded artefact.

Adjust the LENGTH of the cursor so that it is just long enough to cover one complete cycle of the artefact signal. The position of the cursor on the trace is adjusted using the START setting.

Once the replaying display is showing the desired complete single artefact trace press the AUTO button. Assuming that the recorded signals provide an acceptable mix the processor will then analyse them and determine the optimum settings for Channel 2 Phase gain and X:Y ratio and apply them.



The instrument will then switch display mode to Ch1, Sum and show the result of the mix.

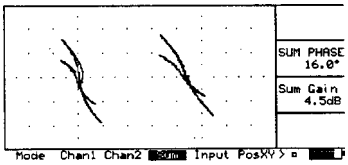
If the mix fails an appropriate message will be displayed, e.g.

"Decrease Gain2 - HELP or REC"

Pressing REC will allow adjustment of parameters,

or pressing HELP will give a further explanation of suggested action.

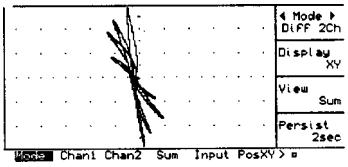
Assuming that the Mix has been carried out successfully pressing the AUTO button will now exit the mix routine.



Move the support ring over the probe a few times and verify that the response is suppressed on the Sum channel.

Press REC again and pull the probe though the tube, press REC again and select appropriate defect responses for replay.

Select the Sum menu and adjust Sum Phase and Sum Gain so as to give the desired response - (normally as close as possible to the response on the unmixed channel 1)



Set Display to XY in the Mode menu and Select the Sum View.

The instrument is now ready to use.

If it is desired to set the Mix manually this may be done following a similar procedure to the above:

Record the 'artefact' (unwanted response) trace, then play it back, With display view set to CH1, CH2 adjust the channel 2 parameters so that the

response is a near a possible identical on screen, then switch view to Ch1, Sum and finally optimize the channel 2 parameters for the minimum mix response.

In two channel mode the 2 analogue outputs can be selected from any of the six possible signals e.g. X1, Y1, X2, Y2, Sum X, Sum Y.

5.8 Conductivity measurement

To use the Phasec 2200 for Conductivity measurement requires the following:

- Phasec 2200 Instrument
- Suitable Probe(type 47P001) and Cable(type 33A135)
- Conductivity standards.(33A136 or equivalent)

It should be noted that the Phasec 2200 does not incorporate temperature compensation as fitted to the AutoSigma range. For most accurate results both the instrument, standards and the items to be tested should be at the same temperature, preferably around 20°C (68°F)

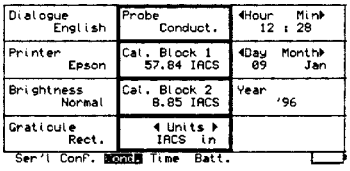
Probe selection Guidelines

For most purposes the 12.7mm probe at 60kHz frequency (47P001) will be adequate

Setting the Phasec 2200 to match the available calibration standards

Connect the probe and cable, and switch the instrument on.

Press MENU/HOME to select the second level functions.



Press ◁ and ▷ as necessary to select the I/O function group. change Probe This will then become the Cond. Function group,

Change the conductivity units to match those in which the blocks are calibrated

Set the value of Cal Block 1 to the higher conductivity standard (e.g. 57.84% IACS) using the ◄ ► keys, note that pressing both keys together will toggle between fine (0.01% IACS) and coarse (1% IACS) steps of adjustment.

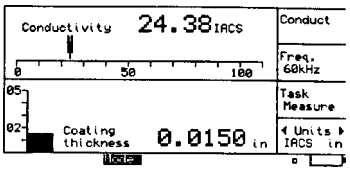
Set the value of Cal Block 2 to the lower conductivity standard (e.g. 8.85% IACS)

Adjust other parameters as desired.

Press menu/home again to return to normal operation.

Calibration of the Phasec 2200 for conductivity measurement

Select the operating frequency, 60kHz.



Press the Task softkey ▶ or BALance/LOAD Task should change to zero.

Hold the probe in air (at least 2cm from any metal) and press BALance/LOAD. Task should change to Calib.1. Hold the probe on the Higher conductivity standard (check that the correct value is displayed) and press BALance/LOAD. Task should change to Calib.2. Hold the probe on the Lower conductivity standard (check that the correct value is displayed) and press BALance/LOAD

Calibration is now complete. Task should change to Measure

The Phasec 2200 is now ready to perform conductivity measurements.

Measuring Conductivity and coating thickness with the Phasec 2200

Hints for successful operation:

For accurate measurement of conductivity the surface coating thickness should not exceed 0.25mm (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 Phasec 2200 does not include temperature compensation, ensure that the calibration standards and the material to be measured are at the same temperature.

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.

Error messages

If the lift-off is greater than 1.250mm (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 '??'

Note that some combinations of magnetic or partially magnetic materials, when tested at high lift-off distance, may give spurious conductivity measurements. If in doubt check with a magnet.

6. Documentation and Data Storage

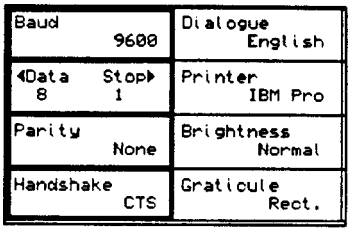
This chapter details the use of the printing and internal memory facilities of the Phasec 2200

6.1 Use with a printer

Setting print parameters on the Phasec 2200

From the normal operating screen

- Press MENU/HOME to select the second level functions
- Select the Conf. function group using ◁ or ▷
- Select the desired printer type, using the [◂ ▸] softkey
- Press ▷ to select the Ser'l function group
- Select the desired interface parameter function values, using the [◂ ▸] softkeys



Printer type should be set to match the printer, or a type it is capable of emulating, The following options are available. Most modes print two traces per page of A4 or letter size paper

IBM Pro — IBM Proprinter mode.

IBM Graphics — IBM Graphics printer N.B. There are significant differences between the two IBM printers, if in doubt try both and choose which works best.

EPSON — FX-80 and compatibles,

OKI — OKI microline 82, 83, 182 and 183, N.B. later OKI's use EPSON or IBM emulation

H.P. PCL — Hewlett Packard printer control language, used by Laser jets, Deskjets and compatible printers, N.B. This mode prints only one trace per page, which is most convenient with laser printers, albeit less economical with paper.

HP PCL (2) — As above, two traces per page.

Seiko DPU — Seiko DPU-411, This is a conveniently sized portable printer using Thermal paper.

Serial transmission parameters set on the Phasec and printer/PC MUST match otherwise communication will not work.

Baud Rate sets the speed of the serial interface in data bits per second (Unformatted) N.B. this is slightly greater than the actual data transmission rate since extra bits are used in the serial data stream.

Data sets the number of data bits in a character and should be set to 7 or 8, Note that if this is set to 7 some graphics functions may not work correctly - 8 should always be used if possible.

Stop sets the number of stop bits in a character, normally set to 1 or 2

Parity sets whether a parity bit is included, and if so whether it is odd or even.

Handshake sets whether Hardware handshake is used via CTS/RTS lines, or whether XON/XOFF characters are sent down the serial line to start and stop data transmission. Normally CTS will be used, however if a 3-wire serial connection is used, or with certain printer or interface converters the hardware lines will not be available and so software handshaking will be needed.

The Default settings of 9600 baud, 8 data bits, 1 stop bit, no parity and CTS (Hardware) handshaking should be suitable for most purposes, however in some circumstances, such as when the printer is also used on another piece of equipment which is less flexible, other parameter settings may be convenient.

Most commonly available printers can be set to emulate one of the indicated printer types, for example the Kodak Diconix operates in EPSON, emulation mode, the Canon BJ10 emulates an IBM graphics printer and the Olivetti JP50 uses Hewlett-Packard PCL (printer control language) codes.

Printing from the Phasec 2200

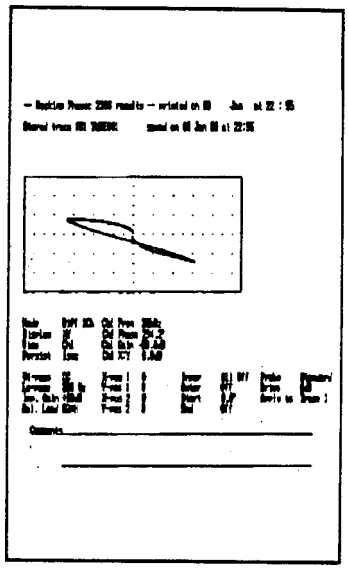
- Create the Desired trace on the Instrument
- Press the FReeZe COPY key to freeze the instrument display
- Ensure that Copy mode is shown as ‘print’
- Press EXECute to print the trace
- Alternatively with trace frozen press the direct print ▶ key

To Print a stored trace

- Press the FReeZe/COPY key to freeze the instrument display
- Ensure that Copy mode is shown as ‘recall’ and Copy Data is shown as ‘trace’
- Press EXECute to enter the file menu
- Select the desired file with Line ◀ ▶ and press ‘Print’ ▶ to print the stored trace

Connection and setting up the Seiko DPU-411 printer for use with the Phasec 2200

The Seiko DUP-411 is a convenient minimum size portable printer, it uses 112 mm wide paper, so the printout format is different from when A4 or letter size paper is used with full-size printers.

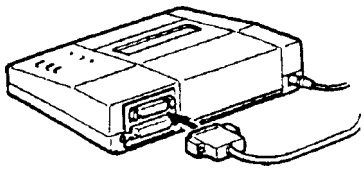


N.B. For full information on using the DPU-411 refer to the appropriate manual.

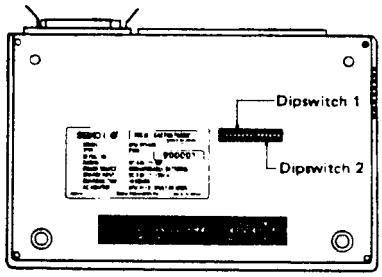
Ensure that the printer is correctly loaded with paper and that it has a battery unless the AC adapter is being used.

Connect the printer serial port to the Phasec 2200 using an appropriate interface adapter. Note that the DPU-411 does not have standard RS-232 pinouts, an additional adapter as shown below must be used with the standard interface cable (part 47A002).

To 47A002	2	>----------> 3 To DPU-411
Cable	3	>----------> 2
	20	>----------> 5
	7	>----------> 7



Set DIP switches, underneath the printer as follows:

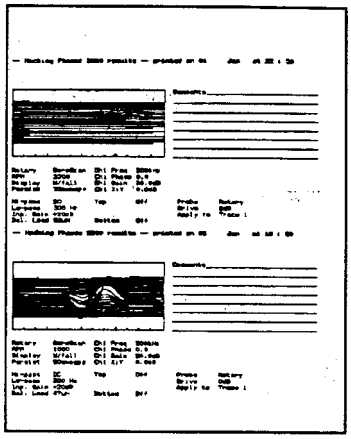


Dipswitch 1		
SW1	OFF	Serial input selected
SW2	OFF	CR only
SW3	OFF	80 characters/line
SW4	ON	Standard characters
SW5	OFF	Slashed zero
SW6	OFF	English character set
SW7	OFF	English character set
SW8	ON	English character set

Dipswitch 2		
SW1	ON	Eight Data Bits
SW2	ON	No Parity
SW3	---	parity setting
SW4	OFF	9600 baud
SW5	OFF	9600 baud
SW6	OFF	9600 baud

Connection and setting up the Kodak Diconix 150/180si printers for use with the Phasec 2200

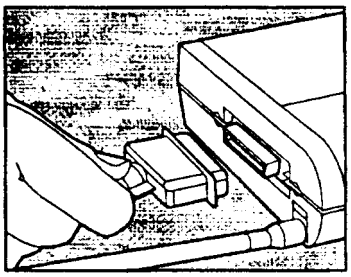
The Kodak Diconix printers are convenient, readily available inkjet printers using single sheet or continuous feed paper. The two printers are operationally similar except that the 150 uses DIP switches to set parameters, while the 180 uses a menu system.



N.B. For full information on using the Diconix printers refer to the appropriate manual

Ensure that the printer is correctly loaded with paper and that it has a fully charged battery unless the AC adapter is being used.

Connect the printer serial port to the Phasec 2200 using the correct interface cable (part 47A002)

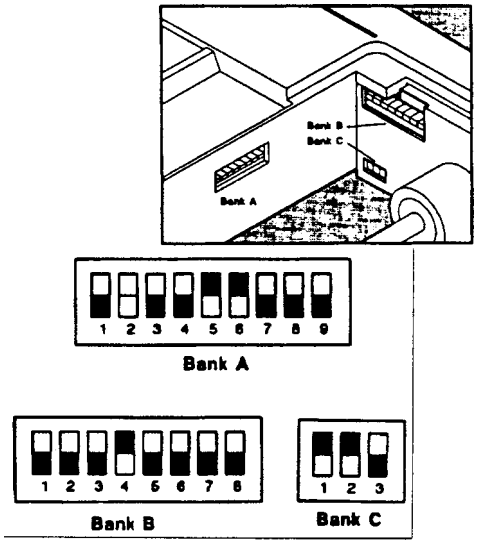


Set up the printers as follows:

Diconix 180si:

Emulation	EPSON
Page Length	As required
Perforation Skip	Off
Character Set	UK
Carriage return	CR only
Line Feed	LF only
Graphics print	Uni-Directional
Graphics Mode	Normal
Protocol	RDY/BUSY
Parity	None
Data length	8 bits
Baud Rate	9600 (1)

Diconix 150



Connection and setting up a parallel printer with an interface converter for use with the Phasec 2200

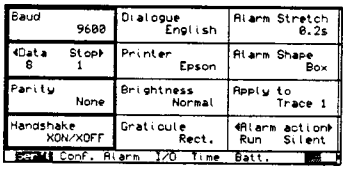
Phasec 2200 Settings

These should be as far as possible identical to the settings for a standard serial printer, i.e. set printer emulation to suit the desired printer type and set serial parameters to 9600 baud 8 data bits and one stop bit. If possible set the handshaking to CTS, i.e. hardware handshaking, but note that some interface converters do not support this, in which case XON/XOF i.e. software handshaking should be used instead.

Printer settings
Parallel printers are generally fairly simple to configure, in most cases the factory default settings should be adequate, Be sure to set the page length as appropriate and set perforation skip off

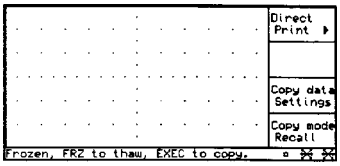
Converter settings
Set the interface converter to match the Phasec 2200 serial communication settings.

The recommended converter (RS 215-167) has fixed settings, The Phasec 2200 should be set to 9600 baud, 8 Data Bits, 1 Stop Bit, No Parity, with XON/XOFF handshaking.

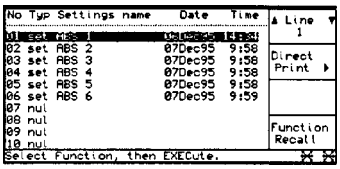


Note that this particular converter uses the PC interface cable (33A146) together with a standard 9-25 pin adapter.

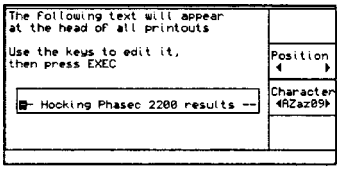
Modifying the Phasec 2200 print header



- Press FReeZe/COPY
- Press the bottom ◄ ► softkey to set Copy Mode to Recall
- Press EXECute to enter the Recall screen
- Set 'Function' to Header
- Press EXECute to enter the Header screen



- Set each character in turn by selecting it with the position ◄ ► softkey, then selecting the desired symbol with the Character ◄ ► softkey
- When the Header line is complete press EXECute to return to the save menu



- Set function to Exit
- Press EXECute to return to the Copy menu
- Set Copy mode to print
- Press FReeZe/COPY to return to normal operation or EXECute to print the current settings and trace

Note that the modified header will printed out in addition to the Standard

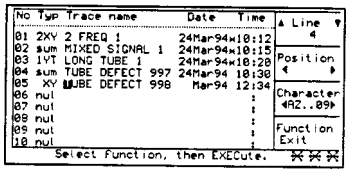
' - Hocking Phasec 2200 results--' header ion all printouts.

This may be used to identify the users organisation, e.g. "General Testing Corporation." , the operators name, or any other text (up to 33 charecters) as required.

6.2 Internal Program/Data store

To save the currently displayed trace

- Create the Desired trace on the Instrument
- Press the FReeZe/COPY key to freeze the instrument display
- Set Copy mode is to 'Save'
- Set 'Copy Data' to 'Trace'



- Press EXECute to enter the Save screen
- The instrument will have saved the trace data in the next available (vacant) storage location. If it should be stored else where use the 'line' [◄ ►] softkey to move it.
- Where the preceding store has been given a name which ends with a number , e.g. DEFECT 997, the new store will be named in sequence (DEFECT 998) . To set a different name set each character of the label in turn by selecting it with the position [◄ ►] softkey, then selecting the desired symbol with the Character [◄ ►] softkey
- When the line is complete set function to Exit and press EXECute to save the trace and return to the normal display

To save the current instrument settings

Proceed as above, but ensure 'Copy Data' is set to 'settings'

To recall traces or settings

- Press the FReeZe/COPY key to freeze the instrument display
- Set Copy mode to 'Recall'
- Set 'Copy Data' to 'Trace' or 'Settings' as required
- Press EXECute to enter the Save/Recall screen
- Function should show 'Recall'
- Use the 'line' [◄ ►] softkey to select the desired stored trace or settings

- Press EXECute to recall the trace or settings and return to the normal display. Note that recalled settings replace the current instrument functions

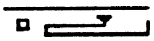
6.3 Instrument internal recording

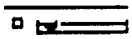
The instrument internal recording function allows up to 16 seconds (32 seconds in single channel mode) of eddy current data to be recorded and then replayed over and over again, allowing instrument parameters to be modified while operating on a constant signal.

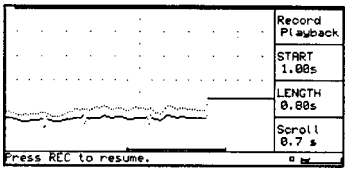
Not all instrument parameters can be changed during replay: Basic test parameters such as Frequency, Probe power, Input gain and Balance load are fixed before the data is collected, but all processing parameters such as filtering, phase, and gain (within a limited range) and display and alarm functions may be changed. Locked function are indicated by a key symbol.

The main purpose of the Record function is for automatic or manual mixing, but it can also be used to advantage in optimising filter and gain settings.

- Set the instrument up as required for the test, Run over the appropriate defect and verify that settings are approximately correct.

- Press the RECord key and rescan the defect. The battery symbol  will be replaced by a recording icon  , which shows how much of the record memory has been used.

- Press the RECord key again to stop recording. The playback icon  will appear. and the 'Play' screen will be displayed .



- Use the Scroll function to position the desired data on screen, and the use the 'length' and 'position' functions to select the required signal. The playback icon shows the position of the sected portion within the whole memory.

- Other functions and menus may be selected using the standard keys and the various functions may then be adjusted while the signal is continuously re-displayed to allow optimisation of the response.

- When using the playback function for manual mixing it is possible to display Ch1 and Ch2 for initial signal matching. Use the View function to show the Sum channel for final optimisation of the mix.

Once the necessary optimisation has been carried out pressing the RECord key again will terminate playback and return the instrument to normal operation.

A further short press on the RECord key will clear the stored data and start a new record sequence, alternatively a long press will resume playback with the previously stored data.

6.4 Use with KK UltraDoc package

The "Ultra Doc" software package, produced by the Krautkramer group for Ultrasonic Instruments, is also suitable, when the appropriate drivers are

installed, for use with the Phasec 2200 and D60, It provides the following facilities:

- Operates under MicroSoft Windows version 3.1 or higher
- Allows screen displays to be downloaded to the PC and transferred via the windows Clipboard to any Windows Wordprocessing or graphics program.
- Acts as a terminal emulation program, allowing the instrument to be remotely controlled by entering suitable commands (see section 8)

  Dump 16 : 32 17 May '96

  Probe PR Standard Mode MO Diff 1Ch
  Display DI XY View VW Ch1
  Ch1 Freq 1F 25kHz Ch2 Freq 2F 200kHz
  Ch1 Gain 1G 37.0dB Ch2 Gain 2G 55.0dB
  Ch1 Phase 1P 15.8° Ch2 Phase 2P 0.0°
  Ch1 X:Y 1R 0.0dB Ch2 X:Y 2R 0.0dB
  Sum Phase SP 0.0° Sum Gain SG 0.0dB
  Hi-pass HP DC Lo-pass LP 200 Hz
  X-pos 1 1H 0 X-pos 2 2H 0
  Y-pos 1 1V 0 Y-pos 2 2V 0
  Alarm Shape AT Off Apply to AA Trace 1
  Alarm Stretch AS 0.2s Persist PE Permn't
  Top TA 30 Left LA Off
  Right RA Off Bottom BA -30
  Inner IA All Off Outer OA Off
  Start SA 0.0° End EA Off
  Analogue 1 Out A1 Off Analogue 2 Out A2 Off
  Sweep SD 0.1sec Zoom ZM Normal
  Drive DR 0dB 2.0V Inp. Gain IP 0dB
  Bal. Load LO — Graticule GR Rect.
  OPERATOR: JMB INSTRUMENT SN:
  CODE: PROBE SN:
  LOCATION: STA CAL BLOCK SN:
  JOB NAME: manual work
  TEST COMMENTS:
  SIGNATURE: _____ DATE: _____

- prints a standard report (as shown) directly to a printer attached to the PC/Network.
- To use the UltraDoc package requires a suitable PC and serial lead.
- Set the Baud rate of the Phasec to 19,200 or slower, Connect up and run the program.
- Select Settings/Auto connect, the program will automatically select the correct serial port and speed.

- Select Data Transfer/Receive. The program will down load the desired information from the Phasec.This may then be printed or copied to the clipboard.

For more information refer to the UltraDoc manual.

7. Maintenance and Care

This chapter details cleaning and preventive maintenance procedures for the Phasec 2200

7.1 Cleaning

The membrane keypad of the Phasec 2200 enables easy cleaning because there are no protruding parts where dirt could gather.

A damp cloth should be used for cleaning the Phasec 2200 and its accessories. Only water or a mild household detergent should be used.

Attention

Application of a solvent can cause brittleness of plastic parts and consequent damage. Under no circumstances should solvents be applied to the keypad.

7.2 Care of Batteries

NiCad cells should be charged:

- before initial operation of the instrument
- after a long storage period (approx. 3 months)
- after frequent partial discharge.

The capacity and life of NiCad cells is dependent on their correct use.

Charging NiCad cells

NiCad cells can be directly charged in the Phasec 2200 when connected to its charger.

NiCad cells should only be recharged when, in normal operation, they have been discharged up to automatic cutoff.

Recharging with a current which is too high for too long can cause capacity losses and possible overheating.

Recharging partially discharged batteries

When NiCad cells are frequently only partially discharged (less than 50% of the operating time) the full capacity will not be reached with normal charging.

You must then proceed as follows:

- The batteries must be fully discharged, e.g. by leaving the instrument switched on overnight. (Ensure that the 'Run from batteries' fuction is set to 'Enabled'
- After this has been done, proceed as described above.

Charging fully discharged batteries

When NiCad cells are fully discharged, e.g. after a long storage period, they should be recharged twice:

- Carry out charging as described above.
- The batteries are to be fully discharged a second time.
- Recharge the batteries then a second time.
- If the batteries have still not reached full capacity you can carry out the discharge and recharge sequence a third time. If the NiCad cells still do not reach full capacity then they are defective.
- Replace the batteries with a new set. Otherwise there is the danger that individual cells will have different capacities and cause reduced instrument operating time when battery driven.

Using NiCad cells which have been stored for long periods

Even fully charged batteries discharge over storage periods. The higher the storage temperature the quicker the discharge.

Batteries which have been stored for long periods should be discharged and recharged once or twice before they are used in the instrument

Using alkaline cells

The batteries should be removed when the instrument is not operated over a longer period.

Leaking batteries can destroy the instrument!

Leakproof batteries should be used (D-cells, IEC R 20) and must be removed from the instrument and discarded (see section 1.4) after the automatic cutoff activates.

8. Interfaces and Peripherals

This chapter details Interfaces and Peripherals for the Phasec 2200

The Phasec 2200 is capable of receiving coded instructions from a personal computer or terminal connected to the RS-232 I/O port. The protocol proposed is similar to that used by KB in USD10, USK7D, USD15, USN50 and the PC support package 'UltraDOC'

8.1 RS232 Data Exchange Format

The 2200 may receive commands and data from the serial port at any time, and responds by echoing them in a modified form and possibly by sending further data. It does not send unsolicited messages or data.

Each command transmitted to the 2200 takes the form of a line of text preceded by an Escape character (ASCII 27, \033 or 0x1B). In a few cases this may be followed by further lines of text containing data. The 2200 also outputs its messages in text form. Note however, some operations normally output binary data (e.g. screen dumps) to the serial port, and where one of these is executed remotely, its binary output will follow the text.

Most of the commands and data are for actions normally executed from the instrument's keypad, but some extra functions are provided for test purposes, and there are also some 'privileged' operations not normally available to the user.

Most commands are associated with a particular variable, e.g. a gain setting or a display type, although some, mainly simulated key presses, are not.

Set command

This may be used to set the value of a parameter or to carry out an operation. the basic format is:

<Esc><Command Code><space><data><CR>

where:

<Command Code> = 1- or 2-character code from the table below

<data> is command dependent, but is usually a numeric value.

The instrument returns ' ' on receiving the Escape character, then echoes the Command Code and data, finishing with the sequence ETX, CR, LF. Some commands (e.g. Direct Print) then output further data, which may be a mixture of ASCII and printer graphics. The Parameter Dump command outputs several lines of additional text before the ETX sequence.

Query (type 1) command

This is used to obtain the current value of a numeric parameter. The format is:

<Esc><Command Code><CR>

The instrument returns ' ' on receiving the Escape character, and echoes the Command Code. It then outputs the current value of the parameter in numeric form, and finishes with the sequence ETX, CR, LF.

Query (type 2) command

This is used to obtain the current value of a parameter in interpreted form. The format is:

<Esc><Command Code><space><?><CR>

The instrument returns ' ' on receiving the Escape character, and echoes the Command Code and space. It then outputs the current value of the parameter in 'clear language' (e.g. quantities scaled and with units), and finishes with the sequence ETX, CR, LF.

8.2 Control Codes

The following table shows the 1- or 2-letter code, the English language menu text,.the range and the resolution of each variable. The numeric value of a variable generally represents a multiple of the resolution, thus a Phase value of 300 represents an angle of 30° (300 × 0.1°), and the numeric value of the input gain may lie between 20 and 120. Exceptions include Frequencies, which are encoded values, and any parameters which are ASCII strings.

Item	Menu text	Code	Range	Resolution (if not 1)	Notes
Freq1	Ch1 Freq	1F	60Hz, 6MHz	See below	
Gain1	Ch1 Gain	1G	0: 10dB.... 500: 60dB	0.1dB	Depends on IP and DR: e.g. with drive -10dB and IP 0 then 0=0dB, with DR+10 and IP+20, 0=40dB
Xpos1	X-pos 1	1H	-50, +50		
Phase1	Ch1 Phase	1P	0: 0° 3599: 359.9°	0.1°	
Ratio1	Ch1 X:Y	1R	-200: X-20.0sB 200: Y-20.0dB	0.1dB	
Ypos1	Y-pos1	1V	-50, +50		
Freq2	Ch2 Freq	2F	60Hz, 6MHz	See below	
Gain2	Ch2 Gain	2G	0-500 = 10, 60dB	0.1dB	As 1G
Xpos2	X-pos 2	2H	-50, +50		
Phase2	Ch2 Phase	2P	0, 359.9°	0.1°	
Ratio2	Ch2 X:Y	2R	-20, +20dB	0.1dB	
Ypos2	Y-pos2	2V	-50, +50		

Item	Menu text	Code	Range	Resolution (if not 1)	Notes
Anlg1	Analogue 1 Out	A1	0: Off 1: Ch1 X 2: Ch1 Y 3: Ch2 X 4: Ch2 Y 5: Sum X 6: Sum Y		
Anlg2	Analogue 2 Out	A2	as A1		
Apply	Apply to	AA	0: Trace 1 1: Trace 2		Apply alarm to selected trace
AFreeze	Alarm action	AF	0: Run, Silent 1: Freeze, Silent 2: Run, Tone 3: Freeze, Tone		On USD15, AF = "TOF A"
Auto_Off	Auto Shut Down	AO	0: Disabled 1: Enabled		Not yet implemented
Stretch	Alarm Stretch	AS	0: Off 1: 0.1s 2: 0.2s 3: 0.5s 4: 1s		
Alarm	Alarm Shape	AT	0: Off 1: Box 2: Sector		On USD15, AT = "Threshold A"
Auto	Auto-Mix	AU	1: Start		Write only. Not yet implemented
Bottom	Bottom	BA	-59, +49 or -100 (Off)		Bottom of alarm box. Also limited to max. of Top-10 (see TA)
Balance	Balance	BL	0: Balance 1: Auto Load 2: Optimise Zero		Write only. Changed.
Baud	Baud	BR	0: Off (reserved) 1: 300 Baud 2: 600 Baud 3: 1200 Baud 4: 2400 Baud 5: 4800 Baud 6: 9600 Baud 7: 19200 Baud 8: 38400 Baud 9: 57600 Baud 10: 115200 Baud		Same as USD15. N.B. Changing this remotely will work, but computer speed then needs to be reset to match in order to continue serial communication
Bright	Brightness	BT	0: Low 1: Normal 2: High		On USD15, BT= "Thresh. B"
Battery	Battery size Ah	BY	40: 4.0 Ah 100: 10.0 Ah	0.1Ah	Limits changed
Block1	Cal. Block 1	C1	0, 31900		Conductivity

Item	Menu text	Code	Range	Resolution (if not 1)	Notes
Block2	Cal. Block 2	C2	0, 31900		Conductivity
CpyDat	Copy data	CD	0: Settings 1: Trace		Was CY.
CFreq	Freq.	CF	0: 60kHz 1: 500kHz (rsvd)		Conductivity
Charge	Charge Battery	CH	0: Start charging 1: Stop charging		Query returns % battery charge remaining
Clear	Clear	CL	0: Clear trace plane 1: Clear ref & hold planes		Write only
CpyMod	Copy mode	CM	0: Print 1: Store 2: Data Output 3: Send 4: Receive		Sames as USD15
CTask	Task	CT	0: Measure 1: Prompt for Zero 2: Prompt for Calibrate 1 3: Prompt for Calibrate 2		Conductivity Read/write. Must work in sequence 1, 2, 3, 0. Check that CT=0 means ok to test. Can also use BL 0 repeatedly
Cunits	Units	CU	Cond/Thickness 0: MS/m mm 1: Ms/m inches 2: IACS mm 3: IACS inches		Conductivity and coating thickness measurement units
Cvalue	Conductivity	CV	-32000, -2, -1 errors 0 to 31900 OK Units of 1/290 IACS = 1/500 MS/m		0 to 31900-Valid -1: Ambiguous material -2: Ferrous material -32000: No reading currently available
SData	Data__Stop	DB	0: 8 Data, 1 Stop 1: 8 Data, 2 Stop 2: 7 Data, 1 Stop 3: 7 Data, 2 Stop		Serial port Bit Counts. On USD15, DB=Gain
Date	Day__Month	DE	(Month-1) x 256 + (Day-1)		Sames as USD15

Item	Menu text	Code	Range	Resolution (if not 1)	Notes
Dilog	Dialogue	DG	0: English 1: German 2: French (reserved: 3: Italian 4: Spanish 5: Portugese 6: Nihongo)		Same as USD15
Disply	Display	DI	0: Off 1: Freq. 1 2: Freq. 2 3: Differential 4: Conductivity 5: Waterfall		Replaces D1, D2
Drive	Drive	DR	0: -10dB 632mV 1: 0dB 2.0V 2: +10dB 6.32V	10dB	
SEnd	End	EA	0, 359.9°	0.1°	End of alarm sector
TPrint	Direct	EL	0: Stop print 1: Start print 2: Full screen dump		Write only
Exec		EX	1: Execute		Write only
Freeze	Freeze	FZ	0: Thaw 1: Freeze		Write only
Grat	Graticule	GR	0: Off 1: Axes only 2: Rectangular 3: Polar		
Handsk	Handshake	HK	0: CTS/RTS 1: Xon/Xoff		
IHelp	Help	HL	0: Normal display 1: 'Help' display		
HPosn	Position	HN	0-31		Header char posn
Hipass	Hi-pass	HP	0, 69 (see below)		
Sinn	Inner	IA	5, sout-10		Alarm Sector inner rad.
Ident	Ident	ID			Software version. Read only.
Input	Inp. Gain	IP	0: 0dB 1: +20dB		On USD15, IP = "Ana_Out I"
IType	Type	IT	0: <blank> 1: Aircraft 2: Tube 3: Naval 4: General		Instrument Type, shows specialised application.

Item	Menu text	Code	Range	Resolution (if not 1)	Notes
Left	Left	LA	-109, 99 or Off=-200		L.H. side of alarm box. Also limited to max. of Right-10 (see RA)
Lconn	Load/Probe 2 Connection (D60 only)	LC	0: None 1: Jaeger 2: BNC		Dual probe on D60 selected by switch.
Load	Bal. Load Optimise	LO	0: open circuit 1: 8.2µH 2: 22µH 3: 47µH 4: 82µH 5: 120µH		Sets balance load
Lopass	Lo-pass	LP	0, 14 (see below)		
HChar	Character AZaz09	MC	0, 68		Header Character
MChar	Character AZ...09	MC	0, 41		Mem Save character
MFunc	Function	NF	0: Exit 1: Clear 2: Recall 3: Lock 4: Unlock 5: Header		
MLine	Line	ML	0, 49		
Mode	Mode	MO	0: 1 Chan Abs. 1: 1 Chan Diff. 2: 1 Chan Refl. 3: 2 Chan Abs. 4: 2 Chan Diff. 5: 2 Chan Refl. 6: Abs/Diff (D60) 7: Conductivity		Values 0-6 only are selectable by this command: value 7 is forced when probe type = conductivity (see command code "PR")
MPosn	Position	MP	0, 13		Mem Save char posn
SOut	Outer	OA	sinn+10, 126 (XY) sinn+10, 86 (2XY)		Alarm sector outer radius. Max value=off
Pconn	Probe (1) Connection (D60 only)	PC	0: Lemo 1: Jaeger 2: BNC (res'd)		
Persis	Persist	PE	0: none 1: 0.1s 2: 0.2s 3: 0.5s 4: 1s 5: 2s 6: 5s 7: 10s 8: 20s 9: Standard		Separate values held for XY and YT display modes

Item	Menu text	Code	Range	Resolution (if not 1)	Notes
Print	Printer	PI	0: IBM Proprinter 1: IBM Graphics 2: Epson 3: OKI Microline 4: HP PCL 5: HP PCL(2) 6: Seiko DPU		
Dump		PM	0: Reloadable 1: Clear language		Write only. Same as USD15.
PType	Probe	PR	0: Unknown 1: Standard 2: Rotary 3: Conductivity		Not alterable if set up from a programmable probe or drive.
Parity	Parity	PY	0: None 1: Even 2: Odd		
Right	Right	RA	-99, 109 or Off=200		R.H. side of alarm box. Also limited to min. of Left+10 (see LA)
Record	Record	RC	0: Erase 1: Record 2: Playback		Data must be sent in sequence 1-2-0. Not yet implemented.
Model	Rotary	RM	Probe Type No.		Read only.
Rpm	RPM	RP	0, (no. of speeds)-1		No. of speeds depends on drive
SStart	Start	SA	0, 359.9°	0.1°	Start of alarm sector
WScrol	Scroll	SC	0, 140		
Speed	Sweep	SD	0: 20sec 1: 10sec 2: 5sec 3: 2sec 4: 1sec 5: 0.5sec 6: 0.2sec 7: 0.1sec 8: .01sec		On USD15, SD= 'Speed'
Gains	Sum Gain	SG	-20, +20dB	0.1dB	
Phases	Sum Phase	SP	0, 359.9°	0.1°	
RTime	Rec. Time	SR	-200, 0		
Top	Top	TA	-49, +59 or Off=100		Top of alarm box. Also limited to min. of Bottom+10 (see BA)
Time	Hour__Min	TI	0, 1439		Minutes after midnight

Item	Menu text	Code	Range	Resolution (if not 1)	Notes
Tvalue	View 1 View 2	VW	XY display 0: Ch 1 1: Ch 2 2: Sum YT display 0: X1 1: Y1 2: X2 3: Y2 4: X 5: Y		For 2-channel displays, combined value is: (value for upper or left display)+6 x (value for lower or right display). "Waterfall" display: codes sames as YT.
WLengt	Length	WL	0, 2.20s - WS	0.01s	Length of replay window
WStart	Start	WS	0, 2.20s	0.01s	Start of replay window
Year	Year	YR	0, 99		
Zoom	Zoom	ZM	-1: Half 0: Nominal 1: Double 2: Nominal		

Notes:

- "Same as USD15" means the same 2-character command code performs corresponding actions on the two instruments. The data values are, however, not necessarily the same
- "Read Only" means the value cannot be set remotely. Any attempt to do so will result in an error message.
- "Write Only" means that the item is intended for use with commands only, no stored value being associated with it. Query (1) will return the value 0 and Query (2) an error message.

Some commands or data values are not always valid. For example, a CH (Charge Battery) command will return an error message if the instrument is fitted with non-rechargeable cells.

There may be additional commands for testing or other purposes, which are not meant to be available to normal users. Their command codes will include punctuation marks or other non-standard characters to avoid clashes with ones used in other instruments.

Signal Frequencies

Frequencies in Hz assigned to Freq1 and Freq2 values:

	0	1	2	3	4	5	6	7	8	9
0	60	61	62	63	64	65	66	67	68	69
10	70	71	72	73	74	75	76	77	78	79
20	80	81	82	83	84	85	86	87	88	89
30	90	91	92	93	94	95	96	97	98	99
40	100	105	110	115	120	125	130	135	140	145
50	150	155	160	165	170	175	180	185	190	195
60	200	210	220	230	240	250	260	270	280	290
70	300	310	320	330	340	350	360	370	380	390
80	400	410	420	430	440	450	460	470	480	490
90	500	510	520	530	540	550	560	570	580	590

Add 100 to these values for each decade increase in frequency. e.g. 1.5MHz = 150 $\times$ 10^4 so value is 50 + 400 = 450. Max. value is 500 representing 6.0MHz.

Note 1
That two specific frequencies: 1.15 MHz and 4.1 MHz are not supported as they have been found to give excessive noise due to 'beating' with the instrument internal clocks.

Note 2
Some values cannot be assigned, unless the item has already been set to fine steps.

Note 3
The range for 2 Channel mode is from 100Hz to 2MHz.

Filter Frequencies

Frequencies in Hz assigned to High Pass values:

	0	1	2	3	4	5	6	7	8	9
00	DC	1	2	5	6	8	10	12	15	17
10	20	25	30	35	40	45	50	55	60	65
20	70	75	80	85	90	95	100	110	120	130
30	140	150	160	170	180	190	200	220	240	260
40	280	300	325	350	375	400	425	450	475	500
50	550	600	650	700	750	800	850	900	950	1000
60	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000

Frequencies in Hz assigned to Low Pass values:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	5	10	20	30	50	75	100	200	300	500	750	1000	1500	2000

There is a restriction that the Low Pass Filter frequency may not be lower than the High Pass Filter frequency.

Error Messages

If an error is detected in the received command, the instrument will echo it as normal, but will then output an error message on a separate line, followed by the ETX sequence.

Err. 01 - Command code must be 1 or 2 characters
The first "word" (sequence of non-space characters) after the "Escape" character is more than 2 chars. long. A common cause is leaving out the space between command code and '?' in a Type 2 Query, e.g. "AF?" instead of "AF ?"

Err. 02 - Unknown command code
The command code is not recognized by the instrument. This error cannot be caused by a command being available under some circumstances but not others — see "Command Not Available", below.

Err. 03 - Invalid command format
Occurs in a Type 2 Query if there are non-space characters after the '?'.

Err. 04 - Invalid parameter format
A command setting an item value had a parameter other than a single numeric value, when one was expected. "Numeric value" means a decimal integer, which may have a sign: it may be followed by spaces before the <CR> but not by anything else.

Err 05 - Invalid parameter value
The numeric parameter defining a new item value was not a legal value, probably because it was out of range, e.g. "BR 1200" ("BR 3" may have been intended). Note that ranges are not always continuous: e.g. "RA 100" and "RA 200" are both valid but not "RA 150". Also, the range of a parameter may change according to other circumstances, e.g. the maximum for RP (RPM) will be one less than the number of speeds available, which will depend on which rotating probe drive is plugged in.

Err. 06 - Command not available
The command to alter a value was recognized and the parameter was a valid one, but the item cannot be changed at present. e.g. PR (Probe Type) may not be altered if it has been set up from a rotating drive or other programmable unit.

Warning - Parameter value modified
Occurs when a command results in an item being set to a value different from that actually specified by the parameter. e.g. "1F 142" is supposed to set the signal frequency to 1.1kHz, but if the frequency resolution is on 'Coarse' (this is controlled from the instrument panel and cannot be altered remotely), it will set it instead to 1.0kHz and this message will be returned.

Use with Windows terminal program

The terminal program, supplied with windows 3.1, can be used as a convenient means of trying out commands.

Connect the instrument using cable 33A146 and adapters as necessary.

Switch on the instrument and start up terminal. Check that the serial parameters set in the Ser'l menu on the Phasec and in the Terminal/ settings/ Communications window are the same. Select a suitable display font in the Settings/Terminal /preferences window.

Hit Escape on the PC, an asterisk '*' should be echoed back from the Phasec.

Try a few commands from the list :

A few typical examples are shown on the right.

```
*ID ? S/W Version /006 14-Nov-95 Developmt
*1F   260
*1F ?   20kHz
*BR ?       19200
*MO ? Diff 2Ch
*MO 3
*MO ? Abs  2Ch
*MO 0
*MO ? Abs  1Ch
```

Note that some functions will not be immediately updated on the Phasec display, e.g. second level functions unless the appropriate display is selected.

8.3 Analogue and Alarm Outputs

Configuring Analogue Outputs

The Phasec 2200 has 2 analogue outputs which can be used to drive external chart recorders etc.

Connections are made to the rear panel auxiliary Lemo connector. (see section 9.3.4 for connection details.)

The outputs are programmable and each one can be selected from the following: Off, X1, Y1, X2, Y2, Sum X, Sum Y. If the instrument is set to single channel mode, only Off, X1 & Y1 are valid. The off position will minimise instrument power consumption and should be selected if analogue outputs are not required.

The variable tone generator for headphones is fed from analogue output 1 thus if this facility is required output 1 should be set as appropriate (usually Y1).

The Voltage output corresponds to 0.2 Volts per division on the XY screen at standard zoom. The maximum voltage available from these outputs is +/-2.5V, where 2.5V approximately corresponds to an X movement right across the screen. Thus if the balanced spot is positioned on the extreme left of the screen using the shift controls and a defect signal deflects the spot to the extreme right, the corresponding analogue output will change from 0V to around +2.5V.

Conversely if the balanced spot is positioned on the extreme right of the screen and a defect signal deflects the spot to the extreme left, the corresponding analogue output will change from 0V to aroun-2.5V.

N.B. The above assume that ZOOM is set to the standard position. Changing the zoom will alter the display but not the output voltage. Output at x2 Zoom is 0.1 V/division, at x½ zoom it is 0.4 V/divisiion

To select the required outputs

- Press MENU/HOME to select the second level functions

- Use ◁ and ▷ as necessary to select the I/O function group
- Use ◂ ▸ in the Analogue 1 function to select the desired signal for output 1and/or Headphones.
- Use ◂ ▸ in the Analogue 2 function to select the desired signal for output 2.
- Set other functions as desired.
- Press MENU/HOME again to return to normal operation

Variable Tone output

The Phasec 2200 is fitted with a variable tone headphone output which can be useful for this kind of test situation. Connect a pair of standard 'personal stereo' style headphones to the auxiliary connector via the headphone adapter 33A148. In the second level menu select Analogue 1 out to CH1 Y.

The tone heard in the headphones will now vary in step with the displacement in the Y axis. The further the spot moves from zero, the higher the frequency of the tone will be.

9. Technical data

9.1 Phasec 2200 Specification

Control
Multiple processor architecture with membrane keypad and remote control via serial port

Operating Frequency
Single frequency mode: 60Hz - 6MHz
Dual frequency mode: 100Hz - 2MHz,
F1/F2 ratio 10:1 - 1:10 (multiplexed)

Channels
Static probe: 1 or 2 channels
Rotating probe: 1 channel

Probes
Reflection, differential or absolute with built in load via 12-pin lemo connector.
Absolute probes matching internal loads (8.2, 22, 47, 82, and 120 μH) via BNC connector.
Various adaptors available.

Mixing
Manual or automatic mixing available.- Mixing process modifies channel 2 only allowing easy comparison of mixed and unmixed signals.

Gain
Overall adjustment 0-90dB:
Main amplifier adjustable 10-60dB
Input amplifier 0, 20dB
Probe drive -10dB, 0, 10dB
X/Y ratio $\pm$20dB

Noise
Less than one screen division at maximum gain with instrument set to differential mode and LP filter set to 300Hz .

Phase Rotation
0º to 359.9 in 0.1º steps.
Automatic lift-off facility sets phase for absolute probes

Filters
4-pole (slope 24dB/octave)
Low Pass 3, 5, 10, 20, 30, 50, 75, 100, 200, 300, 500, 750, 1k, 1.5k, 2kHz
Switchable highpass 2 Hz to 2kHz in 69 steps.

Alarms
Movable Box Gate (any side can be switched off) or Circular/Sector Gate centred on screen centre.
Upper/lower alarms only in Y/T mode.
Flashing LED's, internal sounder and open collector output.

Internal data storage
Capacity for 50 traces and 50 settings, including preset standard application settings.
14 character file descriptions.

Conductivity measurement
Frequencies 60kHz
1%-110% IACS
Accuracy approx ±1%IACS at 30% IACS, 20°C
No temperature compensation.

Coating thickness measurement
0- 0.050" (1.25mm)
Accuracy approx ± (0.001"+1% of reading)

Inputs/Outputs
Serial interface (RS232 via level converter), supports PC communication or serial printer (Seiko, IBM, EPSON, Diconix or HP compatible)
TTL Open collector Alarm output.
Variable tone Headphone output.
2 selectable Analog outputs for chart recorder or similar, resolution 12bits maximum output level +/-2.5V.

Display
Electroluminescent: 276x128 pixels.
Selectable High/Low brightness.
Persistence 0.1-20 seconds and permanent.
Timebase 0.1-20 seconds or locked to rotating drive.

Power
External power supply/charger: 120/240 VAC 50/60 Hz

Batteries
6x 'D' size Alkaline or NiCad cells. Run time approximately 8 hours from high capacity Nicads. in static mode with low display intensity.

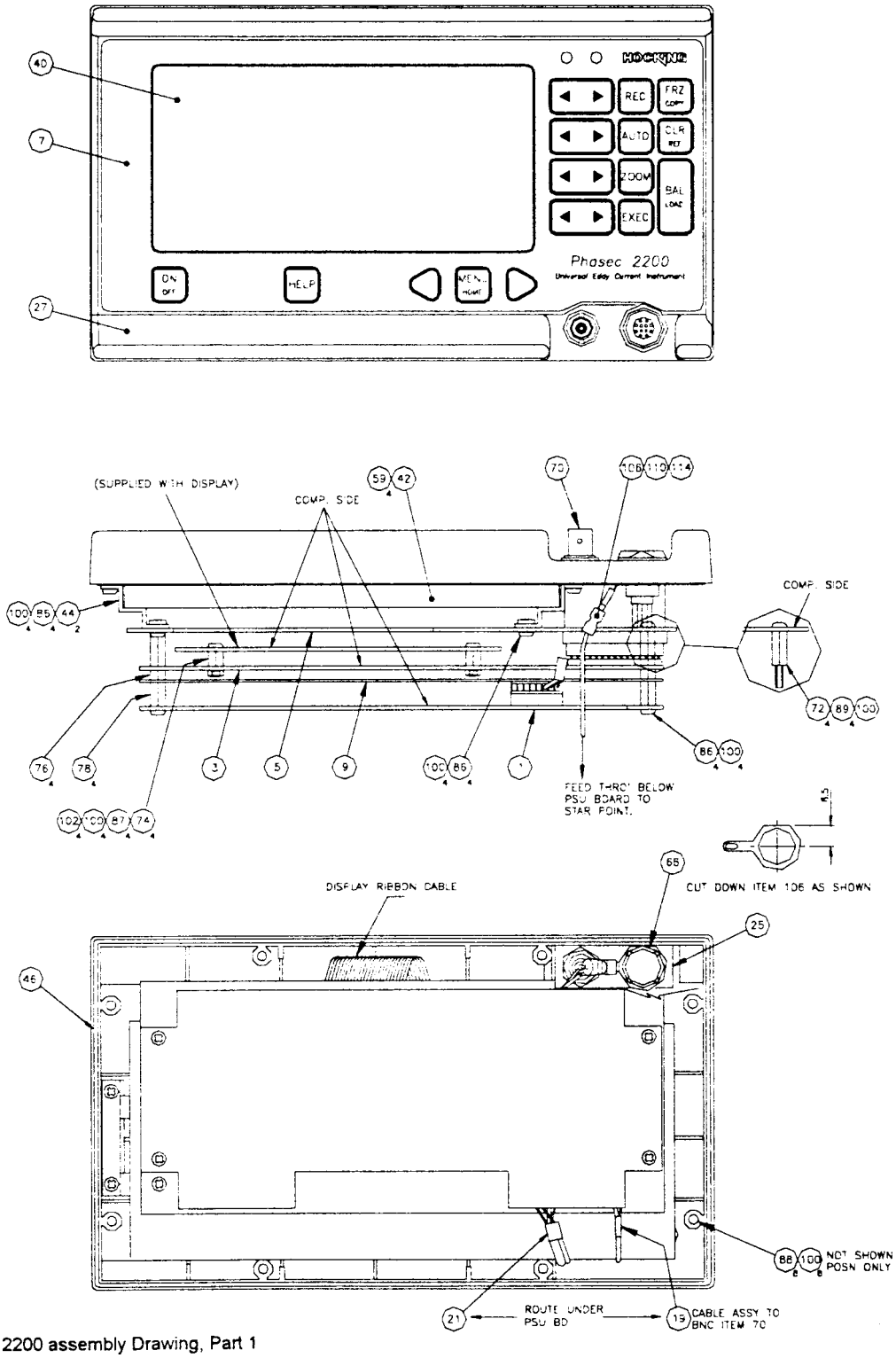
Dimensions
249 x133x146mm (9.8"W x 5.25"D x 5.75"H)

Weight
2.7 kg (6lbs)

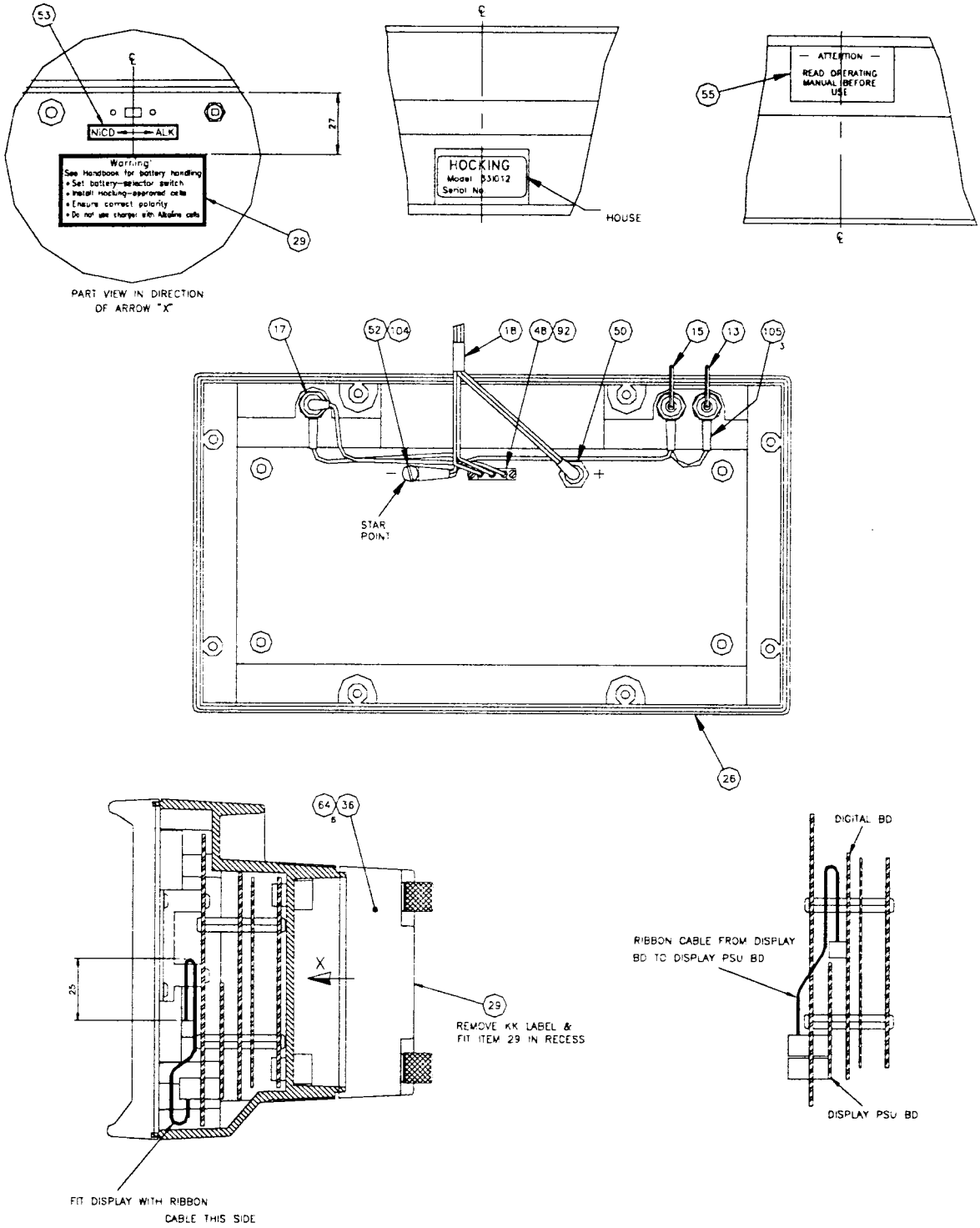
Environment
Operating temperature 0°C to 55 °C
Storage temperature -40°C to +75 °C

Main Accessories
A.C. Power supply/charger (33A110 and cable Included)
Conductivity probe (47P001 + Cable 33A135 + standard 33A136)
Standard Rotating Probe drive (33A106 + cable 33A103)
Miniature Rotating Probe drive (33A100 + cable 33A103)
Carrying Bag (33A140)
Serial printer cable (47A002)
Communication software (33A147 + cable 33A146)

9.2 Parts Lists and assembly Drawings



Phasec 2200 assembly Drawing, Part 1



Phasec 2200 assembly Drawing, Part 2

ItNo	ItRef	DESCRIPTION	QTY	REMARKS	FI
1	10895	ASSEMBLY OF FG/PSD BD PHASEC 2200	1	BLOCK DIA 23427	Y
3	10898	ASSEMBLY DIGITAL BD PHASEC 2200	1		Y
5	10909	POWER SUPPLY BD ASSEMBLY FOR PHASEC 2200	1		Y
7	23418	FRONT PANEL KEYPAD MEMBRANE PHASEC 2200	1		Y
9	33914	SCREEN FOR FG/PSD BD	1		Y
13	33936	CABLE ASSY OUTPUT SOCKET 6 WAY LEMO TO DIGITAL BOARD 6 WAY (PL3)	1		Y
15	33911	CABLE ASSY 7W LEMO TO DIGITAL BD 7W PL5	1		Y
17	33947	CABLE ASSY 4 WAY LEMO (EXT. CHARGER)	1		Y
18	33969	CABLE ASSY BATT. CHARGE 9 WAY MOLEX	1		Y
19	33938	CABLE ASSY ABS BNC TO FG/PSD BD PL2	1		Y
21	33970	CABLE ASSY PROBE FG/PSD BD PL1 TO PSU BD PL2	1		Y
25	44301	LEMO/BNC SUPPORT PLATE FOR PHASEC 2200	1		Y
26	34023	BOX MODIFIED FOR PHASEC 2200 MADE FROM C1098	1		Y
27	34022	BEZEL MODIFIED MADE FROM C1100	1		Y
29	44328	WARNING LABEL BATTERY HANDLING (SEE ALSO ARTWORK DRAWING NUMBER 44329)	2		Y
36	C1099	BATTERY TRAY ASSEMBLY FOR USN50 (METRIC) KRAUTKRAMER PART NO. 022-506-390	1		Y
40	C1101	POLARISING FILTER COMPLETE WITH GASKET KRAUTKRAMER PART NO. 021-608-774 USN 50 MK I FILTER ONLY	1		Y
42	C1102	E.L. DISPLAY WITH ATTACHED PSU PCB (KRAUTKRAMER PART NO. 021-475-101) MANU. PLANAR PART NO. EL4836LP C/W PSU	1		Y
44	A679D	BRACKET METRIC FOR DISPLAY KRAUTKRAMER PART NO. 021-608-935	2		Y
46	A666C	BEZEL "O" RING FOR USN50, KRAUTKRAMER PART NO. 021-608-799	1		Y
48	A653D	SLIDE SWITCH SPDT, KRAUTKRAMER PART NO. 021-385-635	1		Y
50	A632C	BANANA JACK KRAUTKRAMER PART NO. 021-031-018	1		Y
52	A625C	BANANA PLUG KRAUTKRAMER PART NO. 021-031-019	1		Y
53	A625D	LABEL BATTERY SWITCH NICD / ALK KRAUTKRAMER PART NO. 021-608-338	1		Y

ORIGINATED PCD
ENTERED PCD
CHECKED PCD

TITLE **Phasec 2200 dual frequency**

USED ON 33I012

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ItNo	ItRef	DESCRIPTION	QTY	REMARKS	FI
55	C1092	LABEL WARNING "OPERATING MANUAL"	1		Y
		KRAUTKRAMER No 021-608-079			
59	C1224	RUBBER STRIP 1/16" x 0.4" KRAUTKRAMER No 021-342-122 x 15ft LONG (WILL DO 15 UNITS)	4		Y
64	C789	BATTERY NICAD 1.2V 4.4AH TYPE KR4400D SANYO 'D' CELL	6		Y
68	A665D	CONICAL NUT FOR 2B SERIES GEB.2S.240.LN LEMO	1		Y
70	A719B	SOCKET BNC INSULATED(SILVER) TYPE 35049 (GRN-PAR) BULKHEAD (B35M49H999X99)	1		Y
72	A144C	SPCR.14mmLG.TAP.M3 BRASS 87-25980K VERO R6335-02 HARWIN	4		Y
74	A149B	SPCR.6mm LG.TAP M3 BRASS R6372-02 HEX HR	4		Y
76	A679C	SPACER TAP M3 x 4mmLG HEX BRASS NICKEL PLATE G&B REF BS.04-M3	4		Y
78	A661D	SPCR. 10mm LG HEX TAP M3 BRASS NICKEL PLATED A/F 5 ESD 035937A OR RS222-395 (OR MAY USE A/F 5.5)	4		Y
86	B3002S	SCREW M3PAN HD PosiDrv x5LG STL Zn.PLT (MM)	12		Y
87	B3006S	SCREW M3PAN HD.PosiDrv.x12LG.STL.Zn.PLT. 560-603	4		Y
88	B3011S	SCREW M3 x 35 LG PAN HD POSIDRIVE STEEL ZINC PLATE	8		Y
89	B3010S	SCREW M3PAN HD.PosiDrv.x25LG.STL.Zn.PLT. 149-560	4		Y
92	B202S	SCREW S/TAP No2B x 3/16 LG SLOTTED PAN HD STEEL ZINC PLATE	2		Y
100	B3002W	WASHER M3 CRINKLE STAINLESS STEEL 036793G PACK OF 250	28		Y
102	B3002N	NUT FULL M3 ST.STEEL	4		Y
104	B4000T	SLD.TAG M4 S/END.BRS.TN/PL.TUK.TYP.T577 (SOLDER TAG / M4 EYELET TYPE) FARNELL 101-479	1		Y
105	A693E	EARTH TAG 0B SIZE GCA.0S.255.LT LEMO	3		Y
106	A693F	EARTH TAG 2B SIZE GCA.2S.255.LT LEMO	1		Y
110	E1600P	WIRE 16/0.2 PVC DEF61-12 PT6 TY2 BK	A/R		Y
114	A341D	PUSH-ON FEMALE INSULATED CRIMP TERMINAL 4.8 x 0.5 FARNELL 472-542	1		Y
150	C1237	PRE-MOULDED PACKING BOX FOR PHASEC 2200	1		Y
151	44337	HANDBOOK,Operating Phasec 2200 33DH11	1	33DH11	Y

ORIGINATED PCD TITLE **Phasec 2200 dual frequency**
ENTERED PCD
CHECKED PCD USED ON 33I012

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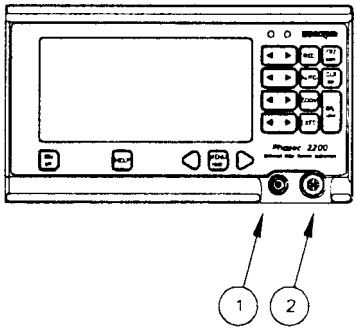
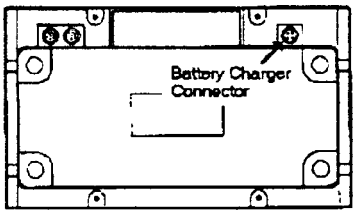
9.3 Connection Information





1. Absolute Probe connector (BNC)

This is for use with Absolute probes fitted with a BNC connector having one of the following (approximate) Inductances.

8.2µH	Locator 2MHz probes, Defectometer probes with adapter 29A010	e.g. 122P1A, 352P1A, 106P4, 206P4, 304P24
22µH	Broad band and older Phasec probes	130P2, 5P21
47µH	Locator 500kHz probes	121P1A, 351P1A, 105P4 etc.
82µH	Broad band and older Phasec probes	5P22, 5P262, 130P3
120µH	Locator 200kHz probes, probes for ED520 and compatibles	120P1A, 350P1A, 104P4, 204P4, 308P24 etc.

The following types of probes should also operate acceptably:

Hocking Locator 6MHz probes (nominal inductance 1.3µH)
Foerster Defectometer probes with suitable adapter (29A010)

2. Lemo connector

This is used for connection of all other probes and rotating drives in conjunction with suitable cables/adapters.

Connections are as follows:

Pin Number	Label	Function
1	FG0V	Fg/Analogue ground
2	FGO/P	Fg output
3	VB+	V batt
4	MOTOR-	Gun motor -ve
5	MOTOR+	Gun motor +ve
6	0VD	V batt (dig) ground
7	DIFF+	+ amplifier input
8	DIFF-	- amplifier input
9	ENC	Encoder input
10	GUNSW/SCK	Motor on/off switch i/p, serial clock
11	GUNSDA	Serial data, rotating gun defect
12	GUNALARM	Flaw led cathode

Note:
The Motor ON/OFF line also acts as the serial clock line. (Wired OR drive). This enables the instrument to communicate with the gun EEPROM.

3. Serial Connector

Note that this does not operate at full RS232 voltage levels, a special cable is required to convert the lines from TTL to bipolar voltages.

Pin Number	Label
1	0VD
2	+5D
3	TX
4	CTS
5	RX
6	0VD
7	EXTREQ

4. Battery Charger Connector

This should only be used with the correct Charger.

Pin Number	Label	Description
1	CHG	Charging power
2	0VCHG	Ground
3	VBEXT+	Instrument power
4	CHGALARM	Charger internal alarm line

5. Auxilliary connector

Pin Number	Label	Description
1	O/P1	Configurable D/A output No 1, ±2.5 Volts
2	O/P2	Configurable D/A output No 2, ±2.5 Volts
3	EXT ALARM	Open collector O/p for LED or Relay
4	0VD	Ground
5	HEADPHONES	Variable pitch audio output
6	0VD	Ground

6. 25 Way 'D' Connector – on printer lead 47A002 or PC lead 33A146

Pin Number	Label (Printer)	Label	Description
1	GND	GND	Protective Ground
2	RxD	RxD	Data to instrument
3	TxD	TxD	Data from instrument
4	-----	RTS	Handshake line to instrument
5	CTS	CTS	Handshake line to instrument
6	DSR	DSR	Handshake line to instrument
7	0V	0V	Signal ground
8	RLSD	RLSD	Handshake line to instrument
20	DTR	-----	Handshake line to instrument

N.B. all handshake lines are connected together

10. Application Examples

These procedures have been developed using, where possible, standard Hocking probes and Test blocks and are designed to approximate calibration procedures which would be used for actual tests.

They are intended primarily for sales demonstration and equipment familiarisation training. While it is anticipated that these procedures may prove useful as a basis for developing actual testing techniques it cannot be over emphasised that the development of any 'real world' testing procedure requires consideration of many factors which are outside the scope of this manual.

Note also that application procedures for Rotating probe bolt-hole testing, Dual frequency tube testing and conductivity testing are given in Chapter 5, along with further guidance on absolute probe crack detection.

It is the responsibility of the operator to ensure that the probe type, instrument parameters and operating procedure used satisfy the requirements of a particular inspection.

10.1 Standard instrument settings

Unless otherwise stated, the following settings should be assumed at the start of each application procedure:

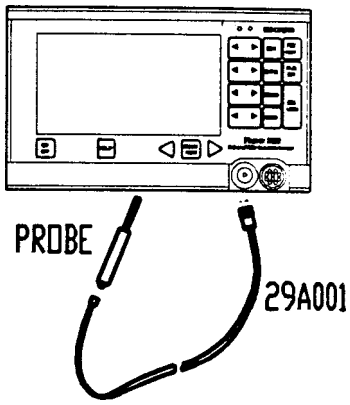
Set up First level menu functions as follows

Mode	**Chan1**	**Input**	**PosXY**	**Alarm**
Diff - 1Ch	Ch1 Freq - 10 kHz	High Pass - DC	X-pos1 - 0	All Off
Display - XY	Ch1 Phase 0	LowPass - 300 Hz	Y-pos1- 0	
View - Ch1	Ch1 Gain 30dB	Inp-Gain +20 dB		
Persist - 0.5 s				

Set up Second level menu functions as follows

Conf.	Alarm	I/O
Dialogue A/R	Stretch - 0.1 s	Probe Type - Standard
Printer A/R	Shape - Box	Drive 0 dB
Bright - Normal	Apply to - Trace 1	Analogue 1 - A/R
Graticule - Rect	Action- Run/Tone	Analogue 2 - A/R

10.2 High-frequency surface crack detection



Items required:

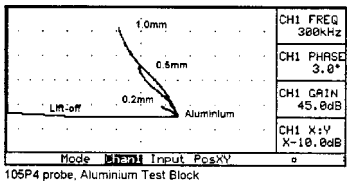
Phasec 2200 instrument
105P4 '500kHz' shielded pencil probe
29A001 BNC-microdot cable
29A028 Steel test block
29A029 Aluminium test block
Plastic shim, 0.010 inch (0.25mm) thick

Initial Settings:

Mode: Abs
Frequency: 500kHz
Vertical Shift: -30,
Horizontal Shift: 30
X-10dB,

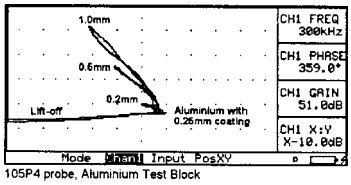
Procedure:

a. Connect as shown, Place probe vertically on a portion of the aluminium test block between notches and balance instrument using a long press so as to select the correct load.



105P4 probe, Aluminium Test Block

b. Tap probe on surface gently and rotate phase control so that spot moves horizontally to the left when probe is lifted. Or use Auto lift-off function.

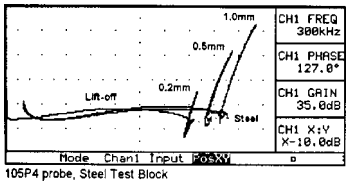


105P4 probe, Aluminium Test Block

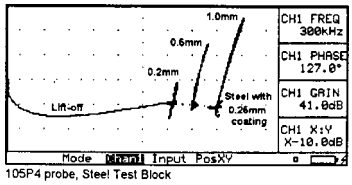
c. Move probe across notches in test block. Adjust gain so that the spot deflection on the deepest notch is approximately 1 division less than full screen height. Adjust the horizontal spot position as convenient to keep the display on screen.

d. Repeat using the 0.25mm coating to show the increase in gain required

e. Repeat using the steel test block (N.B. spot moved to separate indications)



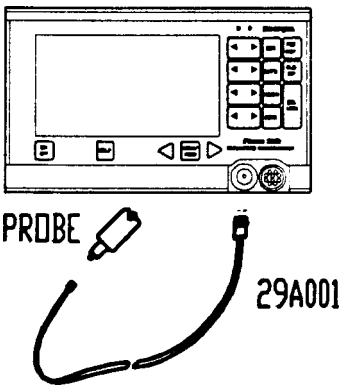
105P4 probe, Steel Test Block



105P4 probe, Steel Test Block

10.3 Surface coating thickness measurement

Items Required:



Phasec 2200 instrument
808P1 metal sorting probe
29A001 BNC- microdot cable
29A029 Aluminium test block
Plastic shims, 0.010, 0.020, 0.040 inch (0.25, 0.5, 1.0mm) thick - included in 33A048 Test block set

Initial Settings:

Mode: Abs
Frequency: 80kHz,
Input Gain: 0dB,
Gain: 30dB
Vertical Shift: -40.

Procedure:

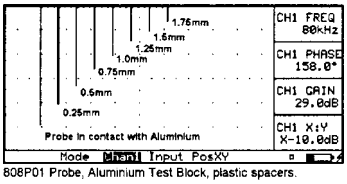
a. Connect as shown, Place probe directly on the rear surface of the test block and balance instrument using a long press so as to select the correct load.

b. Tap probe on surface gently and rotate phase control so that spot moves upwards when probe is lifted.

c. Place all shims on test block. Place probe on top. Adjust gain as necessary to give an indication near the top of the screen. To set the gain accurately it may be necessary to re-balance on the bare metal after adjusting the gain/phase.

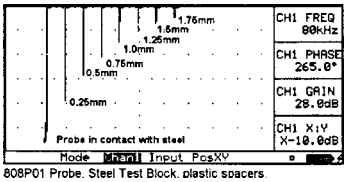
d. Use the various combinations of plastic shims to demonstrate the coating thickness response. The screen display shown was created by adjusting the horizontal position between readings. As can be seen, the response is acceptably linear up to about 0.070 inches (1.75 mm)

Notes:
Frequency selected here is lower than the centre frequency of the specified probe. This is done to reduce sensitivity and give a reasonably linear response for the thickness range selected. The greater the coating thickness to be measured the lower the frequency should be to give good results.

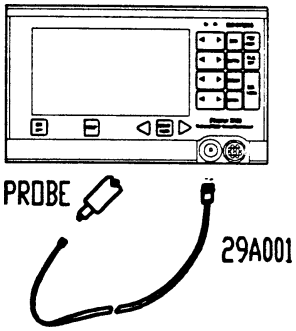


808P01 Probe, Aluminium Test Block, plastic spacers.

A similar technique may be used on the ferrous test block but the linearity of thickness measurement with this probe will be reduced. Note that material variations throughout a steel may give large indications, and that eddy current is not recommended for high accuracy coating thickness measurements on steel. It is however more than adequate for establishing coating thickness to allow sensitivity compensation when performing eddy current inspection using the WeldScan probe (see section 8).



808P01 Probe. Steel Test Block. plastic spacers.



10.4 Metal sorting

Items Required:

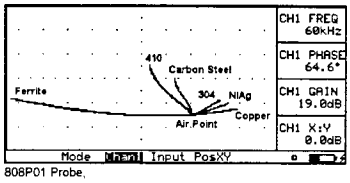
Phasec 2200 instrument
808P1 metal sorting probe
29A001 BNC-microdot cable
33A151 Set of metal samples: Copper, Nickel-Silver, 300 Stainless steel, carbon steel, 400 Stainless Steel, ferrite, Other metals also useful.

Initial Settings:

Mode: Abs
Frequency: 60kHz
Input Gain: 0dB
Gain: 20dB
Horizontal Shift: -30

Procedures:

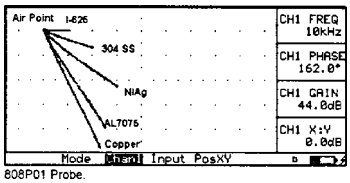
Basic sorting of ferrous and non-ferrous metals



808P01 Probe.

a. Connect as shown, hold probe in air and balance the instrument using a long press so as to select the correct load.

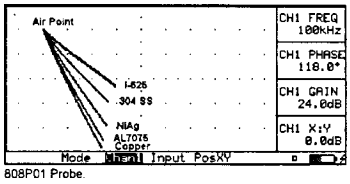
b. Place probe on ferrite sample and rotate phase so that spot moves to the left, N.B. this is done to make best use of the screen area, in the 'conventional' impedance plane setup the spot would be set to move upwards.



808P01 Probe.

c. Place probe on the various metal samples and observe the differing phase and amplitude response. Adjust gain and spot position as necessary to make best use of the display area.

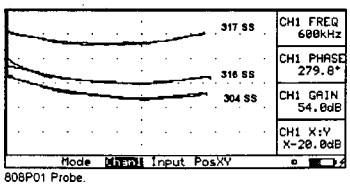
Effect of frequency on nonferrous metal sorting



808P01 Probe.

d. Set Frequency to 10 kHz, Set Horizontal position to -40, Vertical position to 30. Balance instrument with probe in air. Place on the copper standard and adjust gain and phase so that the spot moves down and to the right. Place the probe on the other samples and observe the relative angles

e. Repeat at 100 kHz. Note that the lower conductivity metals are more separated at the higher frequency.

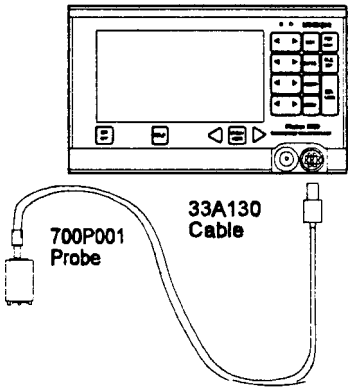


808P01 Probe.

Sorting of "similar" metals

Example using stainless steel alloys:
304, 316 and 317. Spot set to 50 horizontal and balanced on 316. Gain and phase set to give good display spread.

10.5 Measurement of thickness of aluminium on steel substrate



Items required:

Phasec 2200 instrument
33A130 Lemo to Lemo cable
700P001 sprung reflection probe
33A048 test block set

Initial settings:

Mode: Reflection
Frequency: 1kHz
Input Gain: 0dB
Vertical Shift: -30
Low Pass Filter: 50Hz

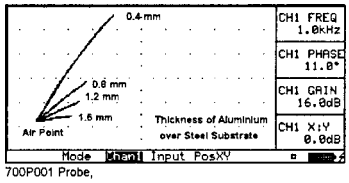
Procedure:

a. Connect as shown, Place counter-bored aluminium strip 'F' on plain steel sheet 'G'. Hold probe in air and balance instrument .

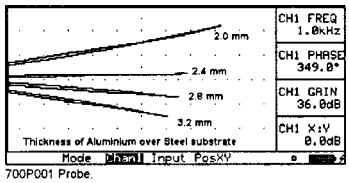
b. Tap the probe gently on surface of the thinnest section (i.e. in deepest recess) and rotate the phase so that the spot moves up and to the right when the probe is placed on the metal.

c. Place the probe in each recess of the test strip to show the response obtained

d. Repeat using the blank Aluminium sheet 'A' between 'F' and 'G' to cover the range from 2.0 to 3.2 mm coating thickness over steel. It will be necessary to adjust the gain and phase to obtain a satisfactory display

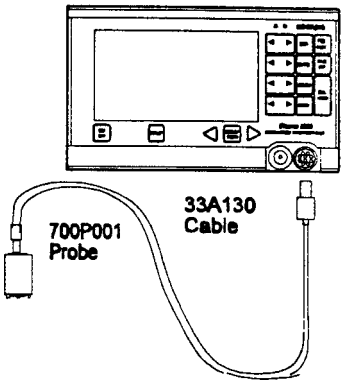


700P001 Probe,



700P001 Probe.

10.6 Metal thickness measurement (corrosion monitoring)



Items required:

Phasec 2200 instrument
33A130 Lemo to Lemo cable
700P001 sprung reflection probe
33A048 test block set

Initial settings:

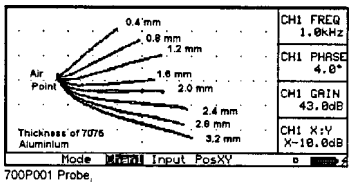
Mode: Reflection
Frequency: 1kHz
Input Gain: Low
Horiz. Shift: 40
Low Pass Filter: 50Hz

Procedure:

a. Connect as shown, place probe on the thickest section (ie shallowest recess) of the counterbored aluminium strip 'F' , and balance the instrument .

b. Lift probe off the surface and rotate phase control so that spot moves horizontally to the left.

c. Place the probe in each recess of the test strip to show the response obtained.

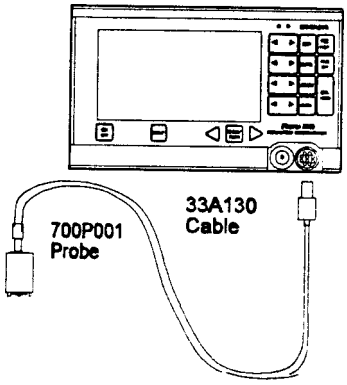


700P001 Probe

d. Repeat adding the blank Aluminium sheet 'A' to cover the range from 2.0 to 3.2 mm thickness.

It may be necessary to adjust the gain and phase to obtain a satisfactory display.

10.7 Single frequency interlayer spacing/corrosion measurement



Items Required:

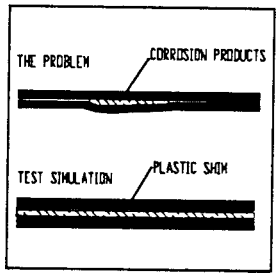
Phasec 2200 instrument
33A130 Lemo to Lemo cable
700P001 sprung reflection probe
33A048 Aluminium test block set, preferably with additional plastic shim, 0.005", (0.12 mm) thick

Initial Settings:

Mode: Reflection
Frequency: 3kHz
Input Gain: 0dB
Vertical Shift: -30
X-14dB (5:1)

Introductory Notes

A common problem in aircraft and other multi-layer structures is corrosion between layers, this can be detected by the formation of insulating corrosion products, which tend to force the layers apart. To demonstrate or calibrate the equipment this can be simulated by using a plastic shim between two sheets of aluminium.



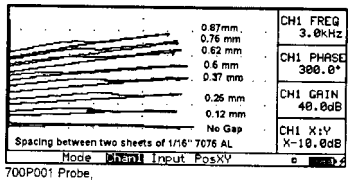
Procedure:

a. Connect as shown, Place two aluminium sheets 'A' and 'B' together, hold probe vertically on a portion of sheet away from notches and balance instrument.

b. Rotate phase control so that spot moves horizontally to the left when probe is lifted.

c. Lift the probe away from the test block. Place the 0.020 inch (0.5mm) shim between the two sheets, place the probe back on the surface, adjust the gain so that the spot is around 3 divisions above the balance position

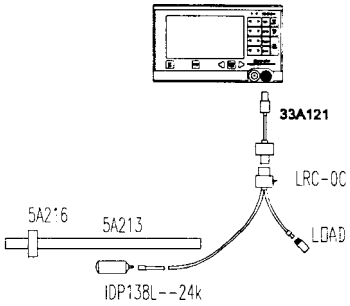
d. Repeat using the other thicknesses of spacing material to show the response obtained



700P001 Probe,

Note:- in some situations it is desirable to distinguish between the effects of interlayer spacing variations and 2nd layer thinning, for this a dual frequency technique is necessary.

10.8 Inner diameter tube testing



Items required:

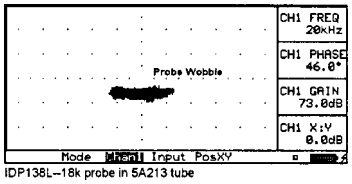
Phasec 2200 instrument
33A121 Jaeger to Lemo Adapter
LRC-0C Jaeger to I.D. probe demo cable with Abs/Diff switch, or LHC-0C with 5A072 Abs/Diff adapter
IDP138L—18k Demo I.D. probe
5A137 470mH balance load
5A213 Brass demonstration tube standard (as ASME V)
5A216 Steel support ring for 5A213

Initial settings:

Frequency: 20kHz

Introductory Notes

Eddy current is the standard method for inspection of Non Ferrous heat exchanger tube bundles .By pulling an eddy current probe through the tubes a typical 20m long heat exchanger can be inspected at a rate of up to about 100 tubes/hour. Internal or external pitting, cracking, thinning, denting and other damage mechanisms can be detected and evaluated.

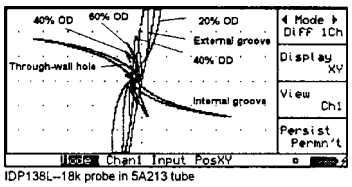


IDP138L–18k probe in 5A213 tube

Procedure:

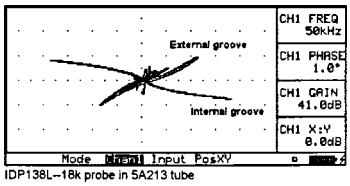
a. Connect as shown, set switch on cable to 'D' (Differential)

b. Set gain to 70 dB. Wobble probe in tube and rotate phase so that deflection is horizontal.



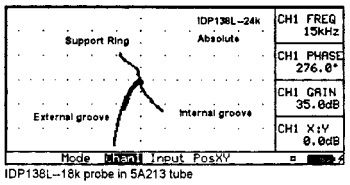
IDP138L–18k probe in 5A213 tube

c. Reduce gain to 35 dB. Pull probe through tube, note the different angle of the response for the different depths of defect



IDP138L–18k probe in 5A213 tube

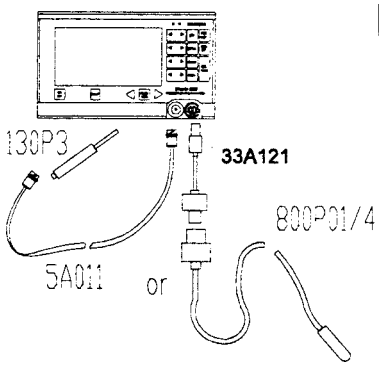
d. Vary the frequency to say 10kHz and 50 kHz, note that as the frequency is increased the phase spread increases and the response from the support ring and the external defects decrease. The opposite occurs as the frequency is reduced.



IDP138L–18k probe in 5A213 tube

e. Switch probe cable/adapter to Absolute mode. Set the frequency to 15 kHz to reduce the phase spread. Rotate the phase to give a response similar to that shown Note that here just the internal and external grooves are shown.

10.9 Inspection of ferrous metal welds



Items required:

Phasec 2200 instrument
33A121 Jaeger to Lemo adapter
130P3 rugged pencil probe
5A011 BNC-BNC cable
800P01 and/or 800P04 weld inspection probe
31A008 Test Block.

Introductory Notes

Eddy current testing is a suitable method for detecting of in service cracking on welded steel structures such as bridges, cranes and oil platforms.

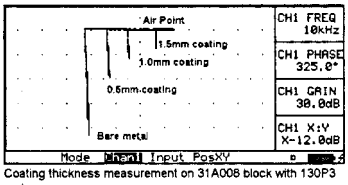
These structures are normally covered with thick anti-corrosion coatings that may include an aluminium or zinc based primer. With suitable measurement of coating thickness the calibration sensitivity may be adjusted to compensate for this by placing a plastic shim of appropriate thickness over the test block. Block type 31A008 includes three 0.5mm shims.

The 800 series Weld probes have been designed to be insensitive to changes in liftoff, geometry and material property changes caused by heat during the welding process,

Procedure:

1. Coating thickness measurement

Initial settings:



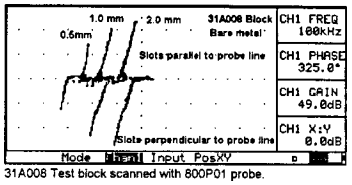
Coating thickness measurement on 31A008 block with 130P3 probe

Mode: Abs
Balance Load: 82uH
Frequency: 10kHz
Gain: 30dB
X:Y 10dB
Vertical pos: 40

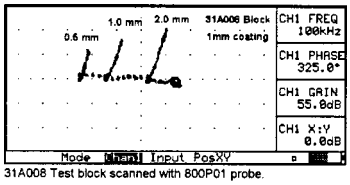
a. Connect 5A011 and 130P3 as shown. It is recommended that a layer of thick tape be used over the 130P3 probe to protect the probe from wear and reduce the eddy current indication on the bare metal.

b. Balance the probe in air and rotate phase so that the spot moves down as the probe is placed on the metal.

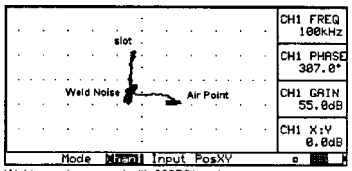
c. Adjust gain so that the movement between air and bare metal fits on screen as shown. By measuring the spot movement for various thicknesses a calibration curve can be drawn or comparisons made allowing estimation of the thickness of a paint layer on steel. The following sensitivity calibration for the weld probe can then be made using an appropriate plastic shim over the calibration block.



31A008 Test block scanned with 800P01 probe.



31A008 Test block scanned with 800P01 probe.



Weld sample scanned with 800P01 probe.

2. Weld Test

Initial settings:

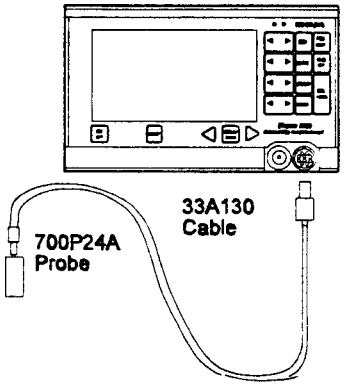
Mode: Diff
Frequency: 100kHz
Gain: 50dB
X:Y 10dB
Vertical pos: 0

a. Connect weld probe. Set frequency to 100 kHz, and X:Y ratio to 0dB. Scan over slots in test block. Adjust gain as necessary, and adjust phase for vertical deflection, up when slots are parallel to weld axis. Direction of deflection shows crack orientation.

b. Repeat with 1mm coating (i.e. 2 shims as fitted to 31A008) Note that increased gain is required to give the same indication size.

c. The final trace shows results from a 'real' weld sample, Note that there is a significant amount of noise which limits the minimum defect size which can be reliably detected.

10.10 Dual frequency second layer thickness measurement



Items required:

Phasec 2200 instrument (dual frequency)
33A130 Lemo to Lemo cable
700P24A reflection probe
33A048 test block set

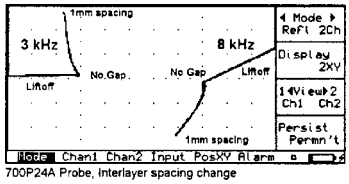
Initial settings:

Mode: Reflection, 2 Ch
Ch1 Frequency: 3.0kHz
Ch1 Gain: 26dB
Ch2 Frequency: 8.0kHz
Ch2 Gain: 30dB
Sum Gain: 12dB
Sum Phase: 270
Probe Drive: +10dB
Input Gain: Low
Low Pass Filter: 200Hz
Display: 2XY
View: Ch1, Ch2

Procedure:

a. Connect as shown, Place two plain aluminium sheets together with one end separated by the 1mm plastic shim:

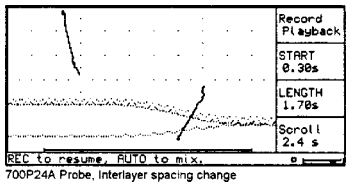
b. Place probe on end with two sheets touching and balance instrument.



700P24A Probe, interlayer spacing change

c. Rock probe and rotate Ch1 Phase so that liftoff is horizontally to the left

d. Slide probe along sheets as shown noting spot movement on both channels, Adjust Ch2 Gain as necessary so that amplitude is approximately the same.

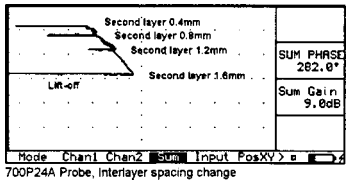


700P24A Probe, interlayer spacing change

e. Press REC and record a few seconds of moving the Probe back and forth smoothly. Press REC again and use the scroll function to select an appropriate portion of the signal Press AUTO to mix. Then REC to return to normal operation.

f. Scan along the sheet again and verify that the spot movement due to the spacing change has been eliminated.

g. Change Display to XY and View to Sum. Rotate Sum Phase to that liftoff signal from probe movement is horizontally to the left as for channel 1

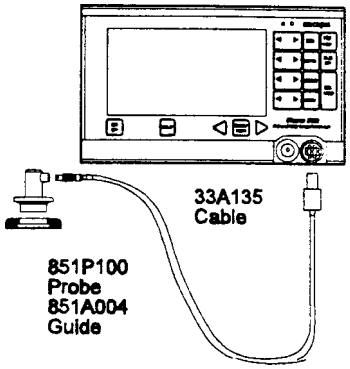


700P24A Probe, interlayer spacing change

h. Replace the lower sheet by the stepped sheet and scan along, adjust sum gain and spot position as desired. Verify that similar results are obtained with and without the spacer.

10.11 Dual frequency FastScan inspection

Items required:

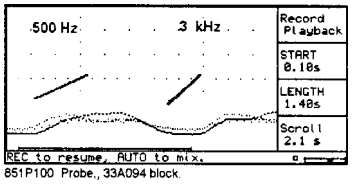


Phasec 2200 instrument (dual frequency)
33A135 Lemo to Lemo cable
851P100 FastScan probe
851A004 FastScan probe guide
33A094 test block set

Initial settings:

Mode: Reflection, 2 Ch
Ch1 Freq: 500Hz
Ch1: Gain 72dB
Ch2 Frequency: 3kHz
Ch2 Gain: 65dB
Sum Gain: 9dB
Probe Drive: +10dB
Input Gain: 20dB
Low Pass Filter 30Hz
Display: 2XY
View: Ch1, Ch2

Procedure:



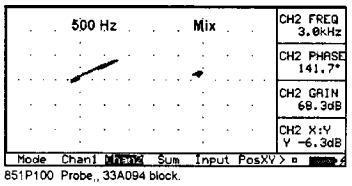
851P100 Probe,, 33A094 block.

a. Connect as shown, fit the Aluminium fasteners into the test block. Centre the Guide over the 'Good' fastener hole in the block (second hole from the left)

b. Place the probe in the guide, balance, and rotate though 90 degrees. A signal with amplitude around 2 divisions pk/pk should be seen on each channel Adjust Gains as necessary.

c. Record the signals from repeated 90 degree and back rotation of the probe.

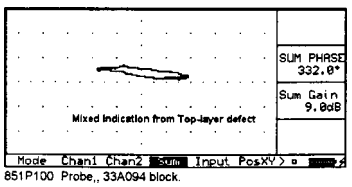
d. Replay the signals and select a complete 'rotate and back' section of data.



851P100 Probe,, 33A094 block.

e. Press AUTO To Mix. Assuming a successful mix is achieved press REC again to return to normal operation. Rotate the probe over the 'good' hole and verify that only a small residual mix signal is obtained as shown

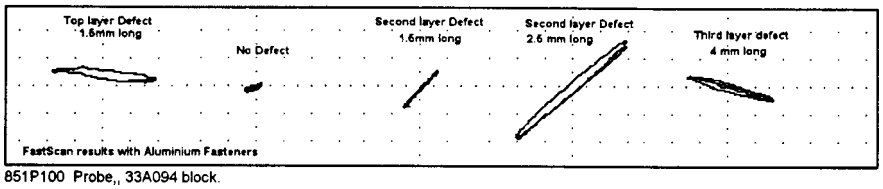
f. In the mode Menu change Display to XY and view to Sum.



851P100 Probe,, 33A094 block.

g. Centre the probe over the left-hand hole (top-layer defect). In the Sum menu rotate Sum Phase so that the indication from this defect is horizontal

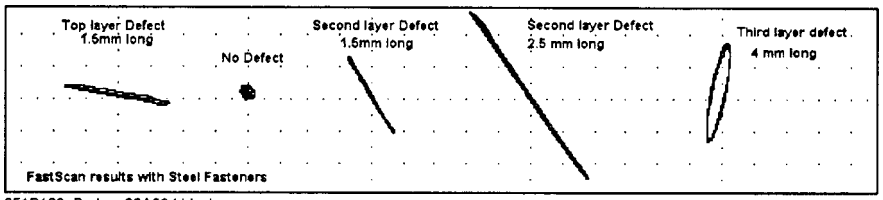
h. Repeat for the other fastener holes, noting the different phase and amplitude of the response from defects of different length and depth.



851P100 Probe,, 33A094 block.

i. Repeat the test if desired using the Steel Fasteners. Initial settings as above, with Ch1 Gain 70dB, Ch2 Gain 70dB, Sum Gain 3dB.

j. Results should be approximately as shown below, Note that the signal amplitude is significantly greater and the phase change with depth is less.



851P100 Probe,, 33A094 block.

k. Low conductivity fasteners (Titanium or Stainless steel) have very little effect on the eddy current field, and may be simulated by removing the fasteners completely. Starting settings may be the same as for Aluminium, and results are similar.

10.12 Probes and accessories referred in this application note

For general surface probe test tests:

105P4 '500 kHz' shielded pencil probe
29A001 BNC- microdot cable
29A028 Steel test block
29A029 Aluminium test block
808P1 Metal sorting probe
33A151 Set of metal samples: including Copper, 7075 Aluminium, Nickel Silver, 300 series Stainless steel, Carbon steel, 400 series Stainless steel, ferrite. Other metals also useful, e.g. Inconel 625 and a selection of 300 series steels as used in application example.
33A130 Lemo to Lemo cable.
700P001 Sprung reflection probe, other 700 series probes should give similar results.
33A048 Test block set, including plastic shims, 0.005, 0.010, 0.020 inch (0.12, 0.25, 0.5mm) thick

For I.D. tubing test

33A121 Jaeger to Lemo adapter
LRC-0C Jaeger to I.D. probe demo cable with Abs/Diff switch, or LHC- 0C with 5A072 Abs/Diff adapter.
IDP138L—24k Demo I.D. probe.
5A137 470mH balance load.
5A213 Brass demonstration tube standard (as ASME V).
5A216 Steel support ring for 5A213.

For ferrous weld probe tests

33A121 Jaeger to Lemo adapter
130P3 Rugged pencil probe
5A011 BNC-BNC cable
800P01 and/or 800P04 weld inspection probe
31A008 Test Block.

For dual frequency second layer thickness measurement

700P24A Large diameter reflection probe.

For FastScan inspection

33A135 Lemo(12way) -Lemo(5way) cable
851P100 FastScan probe
851A004 FastScan probe guide
33A094 FastScan test block with steel and aluminium fasteners.

11. Appendices

11.1 Calibration and servicing

The Phasec 2200 has been designed and manufactured using the most modern methods and highest quality parts in accordance with a strict quality assurance system. It should give many years of reliable operation in normal use.

It is recommended that the instrument be calibrated annually or otherwise as required by the customers quality system. Calibration or repair should be carried out only by a trained service technician working with the appropriate service documentation. It is recommended that this be done by the factory or an appropriate Hocking NDT approved servicing distributor.

Should you require calibration services or experience any problems with the instrument please contact the appropriate office to obtain an appropriate return authorisation reference number before returning the instrument. To expedite the required service please ensure that this number is clearly identified when the instrument is returned and that the following information is enclosed:

Description of Service required (repair calibration etc)
Detailed description of any fault.
Purchase order number when work is not covered by warranty or a service contract.

The following are Authorised Phasec 2200 service centres:

UK/Worldwide
Hocking NDT Ltd
Service Department
Inspec House,
129-135 Camp Road
St. Albans, Herts,
AL1 5HP, UK
Tel +44 (0)1727 840321
Fax +44 (0)1727 845058

North America
Krautkramer-Branson
Service Department
50 Industrial Park Road
P.O. Box 350
Lewistown, PA 17044
USA
Tel: +1 717 242 0327
Fax +1 717 242 2606

Germany
Krautkrämer GmbH & Co.
Service Centre
Robert-Bosch-Straße 3
P.O. Box 1363
D- 50354 Hurth (Koln)
GERMANY
Tel +49 2233 601 111
Fax +49 2233 601 402

Japan
Nippon Hocking kk
Juko Building
9-15, 1-Chome Edobori
Nishi-Ku, Osaka
JAPAN
Tel +81 6 445 5190
Fax +81 6 445 5191

11.2 Glossary

- A -

ABSOLUTE PROBES
These, as opposed to differential probes, have only one active coil and are used, for example, for hand scanning or where long slowly developing defects may occur.

AC
Abbreviation for alternating current. Normally used with respect to the mains supply e.g. 220V, 50Hz a.c.

ALARM
The alarm mode of the instrument is used to indicate when signals (flaws) have exceeded some predetermined limit. Visual and audible warnings may occur when this happens.

ALKALINE BATTERIES
Non rechargeable chemical batteries with alkaline electrolyte giving approx. 1.5V per cell when new.

ALPHA NUMERIC
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 +6dB = 2x gain

- B -

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.

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.

BIT
The smallest unit of information used in a binary system to indicate the state of the system.

BLANKING
The cancelling of unwanted voltages or signals.

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

- C -

CTS
The RS232 signal for "Clear To Send"

CURRENT
Is the measure of the amount of electrical charge flowing in a conductor in unit time.

- D -

dB
Is an abbreviation for decibels, a logarithmic measure of gain or attenuation.

DC
Is an abbreviation for direct current as supplied by a battery.

DCD
The RS232 signal for "Data Carrier Detect" signal

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.

DIGITAL
Digital or logic circuitry operates in incremental steps and switches between two voltage levels (commonly 0V and +5V). A microprocessor consists of digital circuitry.

DIGITIZE
The process of converting an analogue signal into a digital form so that it can be processed by computing techniques.

DSP
Digital Signal Processor. This is a specialised type of microprocessor, optimized for high speed processing of digitized signals, used for phase rotation, filtering, mixing etc.

DTR
The RS232 signal for "Data Terminal Ready"

- E -

EDDY CURRENTS
These are the currents that are created in a conductor when changing magnetic fields intersect the conductor. e.g. by bringing a coil carrying an A.C. current near to the conductor.

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

- F -

F, Freq
Abbreviation for Frequency

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 eg. a crack.

FREQUENCY
For an a.c. 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.

GROUNDING
The act of connecting to ground.

- H -

HERTZ
Unit of frequency.

HI-P
Abbreviation for High Pass Filter.

Hz
Abbreviation for Hertz.

HANDSHAKE
A means of ensuring that the devices at either end of a communications link (e.g a serial cable) do not get 'out of step' due to one sending data faster than the other can handle it

- I -

IMPEDANCE
Circuits that have resistive and reactive components (capacitance and inductance are reactive components) are said to offer 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.

- L -

LATCH
A locking switch. or electronic storage device

LED
Abbreviation for light emitting diode

LIFT OFF
Lift Off of probe from the test specimen surface.

LIFT OFF COMPENSATION
The setting of the instrument so as to make it least sensitive to variations of probe distance from surface of the test specimen.

LO-P
Abbreviation for Low Pass Filter.

- M -

MEMORY (of Computers)
A storage device to hold programs and data.

MICROCONTROLLER
A specialist type of microprocessor, optimized for small programs. may be capable of operation with very low power consumption, allowing it to run continuously, even while the instrument is switched off.

MICROPROCESSOR
Essentially the principal components of a computer integrated into a small package . It is normally used in conjunction with memory (Ref MEMORY).

MOTHER BOARD or MOTHER CARD
A PCB to which other PCB's (daughters) plug in.

- N -

NDT
Abbreviation for NON DESTRUCTIVE TESTING

NICAD
Abbreviation for Nicad-Cadmium based batteries (rechargeable)

NOISE
This is a blanket word for all unwanted signals which may appear on the display if special precautions are not taken. Much of the design work for an NDT instrument is involved with minimising noise. and improving the signal to noise ratio.

- P -

PARITY
A parity 'bit' can optionally be included in RS232 character data, so that the total of all the bits in the character is either an odd or even number, This acts as a simple error check.

PASSIVE
A passive circuit is one that does not use amplifiers, transistors etc, and requires no external power to operate. It normally consists of a combination of resistors, capacitors and inductors.

POLE (as of a switch)
The common terminal of the moving part of a switch.

PROBE
This is the name given to (generally) hand held eddy current sensors.

PROGRAM
A sequence of instructions to a computer.

PSD
Abbreviation for PHASE SENSITIVE DETECTOR

PSU
Abbreviation for POWER SUPPLY UNIT

- R -

RAM
An abbreviation for a Random Access Memory of a computer.

RESOLUTION
Is indicative of the smallest change in signal that can be seen on the display.

RS232
A Communications protocol standard

RTS
The RS232 signal for "Request To Send"

- S -

SEMICONDUCTOR
A semiconductor is an element whose electrical properties lie between that of a conductor, like copper, and an insulator, like sulphur. Semiconductors form the basis of all microchip technology, a silicon base being the most commonly used.

SOFTWARE
General name for the set of instructions held in memory which controls the sequence of operations of a microprocessor.

STOPBIT
Part of the RS232 serial pulse train format, indicating the end of the transmitted character. May be 1, 1.5 or 2x the basic pulse length

STORE
Send to the computers memory

STORED
Recorded in memory

SURFACE EFFECT
(Skin Effect) The tendency for current to flow near the surface of a conductor, which increases with frequency.

SYNCHRONISED
Held in step.

- T -

THRESHOLD
A limit which indicates that the signal from a defect is sufficient to cause concern.

TOGGLE
To alternate between two states or conditions.

TRAIN
To train an instrument is to set the phase angle to optimum for the sample under test.

- V -

VAC
The voltage of an a.c. source

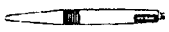
11.3 Probe information

For full information on probes refer to the Hocking probe catalogue, however the following probes, most of which are in the preferred range, may be appropriate for many common applications.

Absolute probes

Connect to the BNC connector via a single Coaxial cable. Use the internal balance load.

Unshielded Pencil Probes

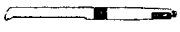


General purpose probe for crack detection on simple geometry

All are 100mm long, and use 29A001 cable or equivalent::

120P1A	120uH, 200kHz
121P1A	47uH, 500kHz
122P1A	8.2uH, 2MHz
124P1A	1.3uH, 6MHz

Unshielded Angle Tip probes



Useful where access or 'headroom' is restricted.

All are 133mm long, and use 29A001 cable or equivalent::

350P1A	120uH, 200kHz
351P1A	47uH, 500kHz
352P1A	8.2uH, 2MHz

Shielded Pencil Probes

Shielded tip gives better resolution of defects close to edges or changes in geometry

All are 114mm long, and use 29A001 cable or equivalent::

104P4	120uH, 200kHz
105P4	47uH, 500kHz
106P4	8.2uH, 2MHz
107P4	1.3uH, 6MHz

Shielded 45° cranked pencil probes

All are 114mm long, and use 29A001 cable or equivalent::

204P4	120uH, 200kHz
205P4	47uH, 500kHz
206P4	8.2uH, 2MHz
207P4	1.3uH, 6MHz

Shielded 15° cranked pencil probes with 90° tip

All are 116mm long, with 6mm tip length and use 29A001 cable:

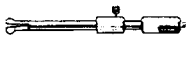
312P24	120uH, 200kHz
313P24	47uH, 500kHz
314P24	8.2uH, 2MHz
315P24	1.3uH, 6MHz

Shielded 90° tip pencil probes

All are 116mm long, with 6mm tip length and use 29A001 cable

308P24	120uH, 200kHz
309P24	47uH, 500kHz
310P24	8.2uH, 2MHz
311P24	1.3uH, 6MHz

Manual Bolt hole probes

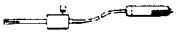


Use for 'low volume' bolthole inspection when drive unit not justified

Standard working length 76mm
Use 29A001 or R/A cable

501P16	1/4"	200kHz
504P12	3/16"	2MHz
504P16	1/4"	2MHz
504P20	5/16"	2MHz
504P24	3/8"	2MHz
504P32	1/2"	2MHz
504P40	5/8"	2MHz

Flexi-lead bolthole probes

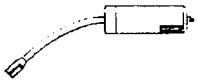


Very low headroom for use where access is severely restricted

Working length 38mm
Use 29A001 cable

514P12	3/16"	2MHz
514P16	1/4"	2MHz

Flexible Bolthole probes



Working length 102mm
Use 29A001 cable

524P12	3/16"	2MHz
524P16	1/4"	2MHz

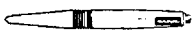
Internal thread inspection probes

Used for inspection of nuts and threaded holes

All are 131mm long, and use 29A001 cable or equivalent::

819P1B	120uH, 200kHz
821P1B	47uH, 500kHz
822P1B	8.2uH, 2MHz

External Thread Inspection probes



For Inspection of Bolts and Studs

All are 131mm long, and use 29A001 cable or equivalent::

819P1A	120uH, 200kHz
821P1A	47uH, 500kHz
822P1A	8.2uH, 2MHz

Metal sorting probes

Sprung coil with V-Grooves for flat or curved surfaces

All have 19mm body diameter, and use 29A001 cable.

807P1	120uH, 200kHz, NFe
808P2	47uH, 500kHz, Fe
809P1	8.2uH, 2MHz, NFe

Rugged Broad-band pencil probes

General purpose, particularly used for coating thickness measurement in weld inspection

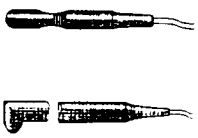
100mm long, fitted with BNC connector - Use Cable type 5A011 or similar.

130P1	5.6uH, 500kHz-4MHz
130P3	82uH, 35kHz-250kHz
130P1	390uH, 7kHz-60kHz

Standard Hocking probes, fitted with Jaeger connector

Connect to the Lemo connector of the Phasec 2200. Use adapter type 33A121.

Weld Inspection Probes



For in-service inspection of ferrous steel welds for surface breaking cracks

Use at 100kHz, fitted with 5m integral cable

800P01	9.5dia.,straight
800P04	16dia.,straight
800P06	32dia.,straight
801P01	9.5dia.,90° inline
801P02	9.5dia.,90° R/A
801P04	16dia.,90° inline, long body

Flat Surface probes

Absolute probes with integral balance load and 1.5m cable

720P1F3	12.7 dia, 50kHz -400kHz
720P2F2	19 dia, 250kHz-2MHz
720P2F3	19 dia, 50kHz -400kHz
720P2F5	19 dia, 1.5kHz -10kHz

Rotating drive bolt-hole probes

Used with Rotating probe Mini drive and standard drive. Wide bandwidth 200kHz-2MHz, various working lengths available.

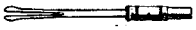
Metal body rotating probes

Available from 3/32" to 1" diameter in working lengths from 35mm to 150mm, preferred sizes:

615P012	3/16", 35mm w/l
615P016	1/4", 35mm w/l
615P020	5/16", 35mm w/l
615P024	3/8", 35mm w/l
615P032	1/2", 35mm w/l

Used for high sensitivity inspection of round holes at high speed.

Plastic body rotating probes



Available from 5/32" to 1.5" diameter in working lengths from 51mm to 100mm, preferred sizes:

619P012	3/16", 51mm w/l
619P016	1/4", 51mm w/l
619P020	5/16", 51mm w/l
619P024	3/8", 51mm w/l
619P032	1/2", 51mm w/l

Used for general purpose inspection of holes subject to elongation or wear

Differential and reflection probes

Spot face probes

Driver/pickup design giving good field projection and low frequency operation allowing detection of subsurface defects.Use cable 33A130 or 33A131

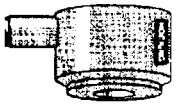
700P07A	7mm, 1kHz-100kHz
700P11A	11mm,300Hz-100kHz
700P24A	24mm, 80Hz-60kHz

Sprung Spot face probe

Mounted in a spung assembly fitted with a three-point contact for flat and curved surfaces, and a V-groove for round products

700P001	13mm, 200Hz-200kHz

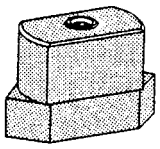
Ring probes



Designed for detection of surface and subsurface defects around airframe fasteners without fastener removal. Use cable 33A130 or 33A131

702P10A	10mm ID, 22mm OD 250Hz-40kHz
702P16A	16mm ID, 29mm OD 80Hz-50kHz

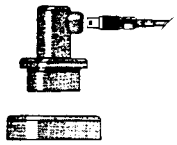
Sliding Probes for aircraft fastener inspection.



Designed to slide along rows of fasteners, can fine surface and subsurface cracks and corrosion. Use cable 33A130 or 33A131

851P001	50 x 20 x 34mm 400Hz - 50kHz

FastScan Probes



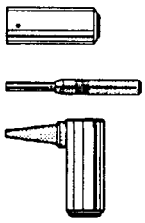
Designed for dual frequency detection of small cracks in deep layers of aircraft structures.

Need Probe and Guide to suit fastener diameter, e.g. for 10mm fastener head:

851P101 Probe (9-13mm)
851A005 Guide (10mm)

33A135 Cable

Differential Probes



Normally used for detection of small flaws where material changes would give unwanted responses.

Types shown:

5P458 Angle tolerent probe for inspection of rotating steel bar
5P411 General purpose differential probe
5P504 pointed tip probe for detection of very small defects

11.4 Special probe application questionnaire

Please photocopy this page and use as a form for special probe or application enquiries.

Complete and mail or fax to the Application Support Department at Hocking NDT, Fax number +44 1727 845058. Please attach any other relevant information, including a drawing of the part to be inspected, clearly mark area to be inspected and expected defect location/orientation if known

Customer Details:

Contact Name_____ Company _____

Address_____

_____

Tel_____ Fax _____

Description of Part_____

Description of Inspection _____

Material Type _____

(If Steel state type: magnetic/ Nonmagnetic etc.)

Material Finish in area to be inspected,

Detail any coatings etc_____

Approximate temperature of part to be inspected _____

Inspection volume (number of parts total or per day) _____

Other inspectors/sites doing same job _____

Desired flaw size (DxWxL) to detect _____ Depth if subsurface _____

Any environmental comments (heat/humidity/radiation etc) _____

Any appropriate specification? e.g. BS/ DIN/ ASTM etc. _____

Any comments about expected probe e.g. frequency, element type (abs/diff/reflection, shielded),

scan width, cable length etc? Attach sketch if appropriate.

_____

_____

Any special or restricted access requirements?_____

Any known similar Hocking or competitors probe? _____

11.5 Troubleshooting guide

Probe does not appear to respond correctly
Check that the mode setting Abs/Diff/Refl is correct, in particular check if the probe is a bridge or driver/pick-up type, and that you are using the correct cable. If using an adapter for a probe fitted with another type of connector note that 'special' settings may be required.

Check also that Frequency and filter settings are correct.

Signal appears to 'limit' and move in a straight line
Check that the instrument is balanced correctly. It may be necessary to reduce Probe drive power or Input Gain. If high pass filter is in use a higher setting may be required (>25Hz).

Batteries don't charge in the instrument
For rechargable batteries, check that the internal switch is set to 'Nicad', and that the battery parameters such as capacity are set correctly. If problems persist try a new set of batteries and/or a new charger. Do not mix old and new batteries together. Batteries can be recharged out of the instrument using a suitable proprietary NiCad battery charger, please observe manufacturers instructions.

Instrument does not recognise rotating drive
When a rotating drive is connected to the instrument it is interrogated by the Phasec to determine its type and what settings are required. During this process the alarm LED mounted on the drive will flash slowly, it is important that the motor button on the drive is not pressed until the LED has stopped flashing. If problems occur disconnect the drive and try again.

Printout not functioning or corrupted
Ensure that the serial parameters (baud rate, parity, data, stopbits & handshake) are correctly set to match the attached printer.

If the printout becomes corrupted after printing the first few lines correctly check the handshake setting, this must match the setting of the printer. When it is supported by the printer software, hand-shaking (XON/XOFF) tends to be more reliable.

The data bits must be set to 8 if graphics printing is to function correctly.

The standard printer cable (47A002) is configured for an Epson FX850 or similar, some printers may require an additional adapter.

Instrument switches off immediately after switching on
The batteries may be discharged. Or the 'Run from Batteries' parameter may be disabled.

It is possible that a software 'glitch' may cause an error in the Power supply microcontroller, this may also result in the instrument not switching off. The

microcontroller may be reset by pressing the 'ON' button for around 20 seconds.

Messages which sometimes appear below the trace display:

Prompts	what to do next
Progress	what is happening
Status	what has happened
Error	why your command cannot be followed
Warning	Automix problem - press HELP for more details or REC to retry
Fault	what has gone wrong with the processor hardware

Message	**Type**	**Comments**
Now lift the probe - AUTO to quit	Prompt	Lift the probe to trigger auto-lift-off. If there is insufficient signal, press AUTO again to quit, then increase the gain and press AUTO to retry.
Auto-Lift-off angle set.	Status	Auto-Lift-off sequence successfully completed.
Invalid key - press HELP, AUTO.	Error	AUTO key is only valid: 1) in 1-channel modes (Auto-Lift-off) 2) in 2-channel modes during Replay (Auto-Mix)
Signal too small.	Status	- by user keypress (AUTO)
Invalid Probe Type for AUTO	Error	Auto mix is only available with 'Standard' probe type.
No AUTO in 1 channel replay	Error	AUTO key is only valid: 1) in 1-channel modes (Auto-Lift-off) 2) in 2-channel modes during Replay (Auto-Mix)
Calculating mix parameters	Prompt	Press AUTO to see the resultant mix from the recorded signal
Mix done AUTO to resume	Status / Prompt	Press AUTO to resume normal operation
Frozen, FRZ to thaw EXEC to copy.	Status / Prompt	Trace is frozen - may be due to pressing FRZ or: 1) Alarm triggered auto freeze - check Alarm action in Set-Up Alarm menu 2) Rotary probe has stopped.
Balancing.....	Progress...	Trailing dots are added as Balance proceeds.
Optimising Zero point	Progress	This takes a few seconds.

Message	**Type**	**Comments**
Not balanced, check probe etc.	Status / Error	There may be a large signal present on the input, this may be: - a steady offset, try: 1) using a non-DC High Pass filter. 2) check the balance load is suitable. 3) another probe - this one may be faulty. - or a varying signal, try: 1) hold the probe still on a reference surface. 2) hold the probe clear of any conductive material.
Store locked, cannot clear.	Error	Select Unlock, EXEC, first.
Clearing store no....	Progress	Seen when 2200 is switched on with the top <&> held to clear all stores.
Trace too big. Cannot store.	Error	Trace storage relies on 'compressing' the trace into memory. This cannot be done sufficiently if the trace is very complex. Waterfall traces with more than 20 scans on screen are usually too complex.
Store in use. Reselect or clear.	Error / Prompt	An occupied store cannot be accidentally over-written.
Store empty. Reselect or Exit	Error / Prompt	Cannot recall trace or settings from an empty store.
Wrong probe type, cannot recall	Error	The stored settings are incompatible with the current probe.
Wrong display mode, cannot recall	Error	Reference trace cannot be recalled to wrong display mode.
Incompatible Ref. trace.	Error	The stored trace is incompatible with the current display mode.
Recalling....	Progress	Takes a few seconds to recall operational settings and reconfigure.
2 channel modes not supported	Error	Attempt to recall 2-channel settings on 1-channel instrument - settings may have been saved on a 2-channel 2200 and downloaded.
Printing.....	Progres...	Trailing dots are added as Printing proceeds
Comms error: check port and printer	Error	Is the printer correctly connected and 'On Line'? Does the 2200 handshake setting match the printer ?

Message	**Type**	**Comments**
No data, Reselect or Exit, EXEC.	Error	Attempt to Lock, Unlock, or Clear a store which is empty or corrupted.
No space. Recall and Clear	Error / Prompt	Failed to Save because all 50 stores are occupied.
Select function, then EXECute.	Prompt	Recall/Save menus: select Clear, Save/Recall Lock, Unlock, Header, Exit.
Selecting Load...	Progress...	2200 is selecting best built-in load to match current absolute probe.
Unable to select good load	Error	None of the built-in loads is satisfactory. Use an external load – see manual.
Press BAL to start optimise offsets	Prompt	2200 does not require a probe to be connected - internal optimisation.
Poor Match - HELP or REC	Warning	Auto-mix is a complex but robust system. Though very tolerant of initial signal conditions, these are checked and the following messages are used to report to the user where changes in intial conditions would improve the quality of the resulting mix. If any of these messages are seen, HELP will give further guidance.
Count error - HELP or REC	Warning	
Error in coeffs - HELP or REC	Warning	
Decrease Gain1 - HELP or REC	Warning	
Decrease Gain 2 - HELP or REC	Warning	
Decrease Gains - HELP or REC	Warning	
Decrease Gain2/ Gain1 - HELP or REC	Warning	
Decrease Ratio1 - HELP or REC	Warning	
Increase Gain1 - HELP or REC	Warning	
Cannot fit constraints - HELP or REC	Warning	
Increase Gain2 - HELP or REC	Warning	

Message	**Type**	**Comments**
Increase Gains - or REC	Warning	Auto-mix is a complex but robust system. Though very tolerant of initial signal conditions, these are checked and the following messages are used to report to the user where changes in intial conditions would improve the quality of the resulting mix. If any of these messages are seen, HELP will give further guidance.
Increase Gain2/ Gain1 - HELP or REC	Warning	
Increase Ratio1 - HELP or REC	Warning	
Negative F - HELP or REC	Warning	
Can't set Phase2 - HELP or REC	Warning	
Cannot set Ratio2 - HELP or REC	Warning	
Please restart - event nn	Fault	Hardware trap code - see below

Processor hardware traps, please:

1 Note the event number/code and what you were doing when it happened.

2 Switch the instrument off, then on again to resume work.

3 Inform Hocking of the event so that we can investigate the cause.

Event & message	**Meaning**	**Comment**
02, Non Mask	Non Maskable Interrupt	Not used on Phasec 2200
04, Stack O'flow	Program Stack Overflow	Too many calls
06, Stack U'flow	Program Stack Underflow	Too many returns
0A0080	Undefined Opcode	Invalid instruction
0A0008	Protected Instruction Fault	Bad instruction format
0A0004	Illegal Word Operand Access	Odd addressing error
0A0002	Illegal Instruction Access	Odd addressing error
0A0001	Illegal External Bus Access	Ext. bus not used.

11.6 Function survey

11.6.1 First Level Function menus

◀ Mode ▶ Diff 2Ch	Rotary Mini	◀ Mode ▶ Conduct	Ch1 Freq 200kHz	Ch2 Freq 1.0kHz		Hi-pass DC	X-pos 1 0	Speed 1s/div	Top OFF	INNER 20	Record Playback
Display 2XY	RPM 300	Freq. 60kHz	Ch1 Phase 0.0°	Ch2 Phase 0.0°	Sum Phase 0.0°	Lo-pass 2.0kHz	Y-pos 1 0		Left OFF	OUTER 40	START 1.00s
1◀View▶2 Ch1 Sum	Display W/Fall	Task Measure	Ch1 Gain 35.0dB	Ch2 Gain 35.0dB	Sum Gain 0.0dB	Inp. Gain 0dB	X-pos 2 0	Y-pos 1 0	Right OFF	START 40.0°	LENGTH 0.29s
Persist Perman't	Persist Perman't	◀ Units ▶ MS/m mm	Ch1 X:Y 0.0dB	Ch2 X:Y 0.0dB		Bal. Load 120µH	Y-pos 2 0		Bottom OFF	END 310.0°	Scroll 0.1 s
Mode (Standard)	Mode (Rotary)	Mode (Conduct.)	Chan1	Chan2	Sum	Input	PosXY	SetYT	Alarm (Box)	Alarm (Sector)	Play

Menus apply as follows:

Appropriate 'Mode' menu in each operating configuration.

Chan1 menu in Standard (Single or dual channel) or rotary mode

Chan2 menu in dual channel mode

Sum menu in dual channel mode when 'View' includes sum

Input menu in Rotary or standard modes

Pos XY menu in standard or rotary modes when Display is XY or 2XY

Set YT menu in standard or rotary modes when Display is YT or 2YT

Alarm menus as appropriate to setting of 'Alarm Shape' in standard or rotary modes

Play menu as appropriate to connected probe type, during replay of recorded data.

11.6.2 Second Level Function menus

Baud 9600	Dialogue English	Alarm Stretch 0.2s	Probe Standard	Probe Conduct.	◀Hour Min▶ 11 : 31	Charge Battery ◀Stop Start▶
◀Data Stop▶ 8 1	Printer I.B.M.	Alarm Shape Box	Drive 0dB 2.0V	Cal. Block 1 57.8 IACS	◀Day Month▶ 10 Oct	Battery Size 4.4 Ah
Parity None	Brightness Normal	Apply to Trace 1	Analogue 1 Out OFF	Cal. Block 2 8.8 IACS	Year '95	Run from Batts Enabled
Handshake CTS	Graticule Rect.	◀Alarm action▶ Run Silent	Analogue 2 Out OFF	◀ Units ▶ IACS in		
Ser'l	**Conf.**	**Alarm**	**I/O**	**Cond.**	**Time**	**Batt.**

Standard and Rotary mode have all second level menus except Conductivity.

Conductivity mode has Serial, Configuration. ,Conductivity Time and Batt second level menus

Note that some auxiliary menus (e.g. the File menu) also exist, these are discussed in the relevant sections of the manual

11.6.3 Control function List

Function	Type / Location	See Section	Description	Allowed Values
Alarm Action Freeze/Run	Level2 Alarm	5.4	If set to freeze an alarm condition will cause the display to freeze after half the persistence period.	Freeze/Run
Alarm Action Silent/Tone	Level 2 Alarm	5.4	If set to tone an alarm condition will cause an audible tone.	Silent/Tone
Alarm Shape	Level 2 Alarm	5.4	Sets Alarm shape	Box, Sector, Off
Alarm Stretch	Level 2 Alarm	5.4	Sets MINIMUM alarm on time	Off, 0.2s, 0.5s, 1.0s

Function	Type / Location	See Section	Description	Allowed Values
Analogue 1 Out	Level 2 I/O	8.3	Sets which channel is available on Analogue Output number 1	Off, Ch1 X, Ch1 Y, Ch2 X, Ch2 Y, Sum X, Sum Y
Analogue 2	Level 2 I/O	8.3	As Analogue 1 Out	As above
Apply to	Level 2 Alarm	5.4	Sets which of two displayed traces the alarm is applied to	Trace 1, Trace 2
AUTO	Direct	4.2	i) Activates Automatic Mix function when instrument in 2 channel mode with data recording active. ii) Activates Automatic lift-off compensation otherwise.	
Bal. Load	Level 1 Input		Select inductance value for Absolute mode balance load	0, 8.2µH, 22µH, 47µH, 82µH, 120µH
BALance / LOAD	Direct	4.2	i) Short press activates automatic balance. ii) Long press activates automatic balance load selection (Absolute mode)	
Battery size	Level 2 Batt		Set capacity of rechargeable batteries fitted	4.0-10.0 Ah
Baud	Level 2 Ser'l	6.1	Sets baudrate (speed) of serial interface	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Bottom	Level 1 Alarm	5.4	Sets Bottom limit of Box alarm gate	Off, -58,...(Top-10)
Brightness	Level 2 Conf.	4.4	Sets EL display panel intensity	High, Low
Cal. Block 1	Level 2 Cond.	5.8	Sets Value of upper Conductivity Standard	40.00 to 110.00 %IACS. Variable in steps of 0.01%IACS or 0.001MS/m

Function	Type / Location	See Section	Description	Allowed Values
Cal. Block 2	Level 2 Cond.	5.8	Sets Value of lower Conductivity Standard	0.90 to 30.00 %IACS. Variable in steps of 0.01%IACS or 0.01MS/m
CH1 Phase CH2 Phase	Level 1 Chan1 or Chan2	5.2	Sets phase rotation of appropriate channels - may be automatically set by AUTO lift-off or Mix	0 to 359.9 in steps 0.1 degrees
CH1 Freq CH2 Freq	Level1 Chan1 or Chan2	5.2	Sets operating frequency of appropriate channels	Single frequency: 60Hz to 6MHz, Dual frequency: 100Hz to 2MHz
Character	File or File/ Header	6.1, 6.2	Selects the character to be inserted in file name or header at current position from available values	
Charge Battery Stop/Start	Level 2	4.4	Start - tells instrument that batteries are empty Stop - tells instrument that batteries are full	
CLR (Clear) / REF.	Direct	4.2	i) Short press clears the trace data from the screen ii) Long press clears reference trace	
Copy Mode	Copy	6.2	Selects action performed by COPY key	Print, Save, Recall
Copy data	Copy	6.2	Selects type of data transferred or saved	Trace, Settings
Data	Level 2 Ser'l	6.1	Sets number of data bits for serial (RS232) interface	7 or 8
Day	Level 2 Time	4.4	Sets current day of the month for internal clock	1, 2.....31
Dialogue	Level 2 Conf.	4.4	Sets operating language	English, French etc.
Display	Level 1 Mode	5.3	Sets Display Mode, options depend on operating conditions, all modes (except conductivity) have XY, YT, Dual frequency modes have 2XY, 2YT, Rotating drive modes has waterfall diagram.	
Drive	Level 2 I/O	5.2	Sets Drive voltage (peak to peak) to probe	0dB (2V) -10dB (632mV) +10dB (6.32V)

Function	Type / Location	See Section	Description	Allowed Values
End	Level 1 Alarm	5.4	Sets sector Alarm End Angle	0...359 degrees clockwise from left
EXECute	Direct	4.2	Starts the Execution of a selected function. Used in the Copy mode and mmory function fields, also used to exit header editing.	
FRZ/COPY	Direct	4.2	Freezes current trace and allows a store or print operation: i) Short press - brings up copy mode select menu. ii) Long press - executes previously selected operation.	
Function	File	6.2	Selects action to be performed (on selected file location where appropriate)	Clear, Recall, Lock Unlock, Header, Exit
Graticule	Level 2 Ser'l	5.3	Selects whether graticule is displayed, and whether polar or rectangular co-ordinates are used.	Off, Polar, Rectangular, Axes
Handshake	Level 2 Ser'l	6.1	Sets serial port handshake mode to match PC/printer	CTS (Hardware) XON (/xoff - software)
HELP	Direct	4.3	Acesses instrument HELP function	
Hi-Pass	Level 1 Input	5.2	Set High Pass Filter 'knee' frequency	DC (off), 1Hz...2kHz in small steps
Hours	Level 2 Time	4.4	Sets Hour of current time for internal clock	0, 1....23
Inner	Level 1 Alarm	5.4	Sets Sector Alarm Inner Limit	Off, 5..(Outer-10)
Inp. Gain	Level 1 Input		Sets input (preamplifier) gain	0dB (Low) +20dB (High)
Left	Level 1 Alarm	5.4	Set Left limit of Box alarm gate	Off, -109...(Right-10) N.B. Limit varies in 2XY display mode.

Function	Type / Location	See Section	Description	Allowed Values
Line	File	6.2	Selects line/file location from storage/retrieval of data	1-50
Lo-Pass	Level 1 Input	5.2	Sets Low Pass Filter 'knee' frequency	3, 10, 30, 100, 300, 500Hz, 1kHz, 2kHz
Mins	Level 2 Time	4.4	Sets Minutes of current time for internal clock	0, 1...59
Mode	Level 1 Mode		Selects, shows current mode of operation, Options vary depending on probe type connected.	Standard probe: Abs, Diff, Refl // 1, 2 Ch
Month	Level 2 Time	4.4	Sets current Month for internal clock	Jan....Dec
Outer	Level 1 Alarm	5.4	Sets Sector Alarm outer Limit radius	(Inner+10)..125, Off (2XY Display max 85)
Optimise	Level 1 Input	5.2	Starts amplifier offset elimination process when both buttons, then BAL button, pressed.	
Parity	Level 2 Ser'l	6.1	Sets serial port parity to match PC/printer	None (recommended) Odd, Even
Persist	Level 1 Mode		Sets display persistence, i.e. time for which data is retained	Permanent, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20 seconds (XY) 1, 2, 4, 8, 16, 20, 25, 33, 50 sweeps (max 20 secs) (YT)
Position	File and File/Header	6.2	Selects insertion point when editing filename or Header text	Within current line length
Printer	Level 2 Conf.	6.1	Specify printer type connected	IBM-proprinter or compatible, IBM graphics printer, Epson-FX80, H.P. PCL - Laserjet, Deskjet etc. Seiko DPU

Function	Type / Location	See Section	Description	Allowed Values
Probe type	Level 2 I/O or Cond.		Allows selection of connected probe	Standard, Conductivity, Rotary (auto-selected)
RECord	Direct	6.3	Controls signal recording process. First push starts recording, second push replays last 16s of data. Third push resumes normal operation.	
Right	Level1 Alarm	5.4	Set Right limit of Box alarm gate	(Left+10)...109, Off. N.B. Limit varies in 2XY display mode
Rotary	Level 1 Mode		(Only when rotary probe selected) Specifies type of probe drive connected	Information field Defined by probe drive internal EPROM
RPM	Level 1 Mode		Sets rotary probe drive speed	Dependent on drive type.
Run from batteries	Level 2 Batt.		Controls battery saving functions - A.C. only or power down if inactive.	Enabled, Disabled, Time limited
Speed	Level 1 Set YT		Sets timebase sweep speed	0.1, 0.2, 0.5, 1, 2, 5, 10, 20 seconds per division
Start	Level 1 Alarm	5.4	Sets sector alarm Start angle	0...359 degrees clockwise from left
Stop	Level 2 Ser'l		Sets serial interface protocol, number of stop bits.	1 or 2
Sum Gain	Level 1 Sum		Sets display gain applied to sum trace	-20dB...+20dB Coarse/fine steps
Sum Phase	Level 1 Sum		Sets rotation applied to sum trace	0.0 to 359.9°
Task	Level 1 Mode	5.8	(Conductivity only) Controls calibration/ measurement sequence	Zero Measure Calibrate
Top	Level 1 Alarm	5.4	Sets Top limit of Box alarm gate	(Bottom +1)...58, Off

Function	Type / Location	See Section	Description	Allowed Values
Units	Level 1 Mode Level 2 Cond.	4.4	Displays/selects units used for conductivity and coating thickness measurement	Conductivity: MS/m / IACS Coating: Inch / mm
View	Level 1 Mode		Displays/selects which signals are displayed on screen.	In 2 frequency mode Trace 1 and 2 can be independently set to: Ch1, Ch2, Sum
X:Y Ratio (CH1) X:Y Ratio (CH2)	Level 1 Chan1 or Chan 2		Sets ration of X gain relative to Y gain for appropriate channel	-20dB (Y:X = 10:1) 0dB (1:1) +20dB (Y:X = 1:10)
X-Pos 1 X-Pos 2	Level 1 PosXY	5.2	Sets horizontal balance position of appropriate channel	-100..100 (single trace), - 50...50 (dual trace)
Y Pos 1 Y Pos 2	Level 1 PosXY	5.2	Sets vertical balance position of appropriate channel	-50...50
Ch1 Gain Ch2 Gain	Level 1 Chan 1 or Chan 2	5.2	Sets Gain of appropriate channel	0dB to 90dB - including effect of Input gain and probe drive
Year	Level 2 Time	4.4	Sets Year of current date for internal clock	'00..'99
ZOOM	Direct	4.4	Sets display gain to half, nominal or double with successive presses.	

11.7 "Frequently asked Questions"

Q. The balance load selected by the instrument after the Autoload sequence does not match the inductance engraved on the probe

A. The load selected will be that which gives the lowest mismatch in the bridge. This will normally be the same as the probe inductance, but particularly when operating with long cables, or with probes operating away from their centre frequency. another load may sometimes give better results.

Q. I have a rotating drive unit which I bought for the Hocking Phasec 1.1, Why won't it work on the Phasec 2200?

A. Drive units for the Phasec 2200 contain an EPROM which includes details of the drive type, available speeds, motor speed compensation characteristics etc. The Phasec 1.1 only had one type of drive available so didn't need this. The good news is that old drives can usually be modified to operate with the Phasec 2200, and that most 1.1's can be modified to operate with the new type drives, Contact Hocking or your distributor for more information.

11.8 EC Certificate of Conformity regarding Electromagnetic Compatibility

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