Nortec 500 Series
Portable Eddy Current Flaw Detectors
Operation Manual

JULY 2013

PN 7720140.00

Revision B

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Warranty

The Nortec 500 Series flaw detectors have been designed and manufactured as high-quality instruments.

Inspect the unit thoroughly upon receipt for evidence of external or internal damage that may have occurred during shipment. Notify the carrier making the delivery immediately of any damage, since the carrier is normally liable for damage in shipment. Preserve packing materials, waybills, and other shipping documentation in order to establish damage claims. After notifying the carrier, contact Olympus so that the company may assist in the damage claims and provide replacement equipment, if necessary.

Olympus guarantees the Nortec 500 to be free from defects in materials and workmanship for a period of one year (twelve months) from the date of shipment. This warranty covers only equipment that has been used in a proper manner as described in this instruction manual and that has not been subjected to excessive abuse, attempted unauthorized repair, or modification. DURING THIS WARRANTY PERIOD, OLYMPUS LIABILITY IS STRICTLY LIMITED TO REPAIR OR REPLACEMENT OF A DEFECTIVE UNIT AT ITS OPTION. Olympus does not warrant the Nortec 500 suitability for intended use or fitness for any particular application or purpose. Olympus accepts no liability for consequential or incidental damages including damage to property and/or personal injury. In addition to our standard one-year warranty, Olympus also offers an optional two-year warranty.

The warranty does not include probes, probe cables, batteries, or seals. The customer must maintain the condition of seals in the battery door and office connection doors. The customer will pay any expenses to ship to the Olympus plant for warranty repair; Olympus will pay for the return of the repaired equipment. For instruments not under warranty, the customer will pay shipping expenses both ways.

In this manual, we have attempted to teach the proper operation of the Nortec 500 consistent with accepted techniques. We believe the procedures and examples given are accurate. However, the information contained herein is intended solely as a teaching aid and should not be used in any particular application without independent testing and/or verification by the

operator or the supervisor. Such independent verification of procedures becomes more important as the criticality of the application increases.

For these reasons, we make no warranty, expressed or implied, that the techniques, examples, or procedures described herein are consistent with industry standards or that they will meet the requirements of any particular application. Olympus expressly disclaims all implied warranties of merchantability and of fitness for any particular application.

Olympus reserves the right to modify all products without incurring the responsibility for modifying previously manufactured products. Olympus does not assume any liability for the results of particular installations, as these circumstances are not within the company's control.

THE WARRANTIES SET FORTH HEREIN ARE EXCLUSIVE AND ARE IN LIEU OF ALL OTHER WARRANTIES WHETHER STATUTORY, EXPRESSED, OR IMPLIED (INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OR TRADE).

Safety

CE

WEEE Directive

In accordance with European Directive 2002/96/EC on Waste Electrical and Electronic Equipment, this symbol indicates that the product must not be disposed of as unsorted municipal waste, but should be collected separately. Refer to your local Olympus distributor for return and/or collection systems available in your country.

EMC Directive Compliance

The Nortec 500 and its accessories have been tested in accordance with EN61326:2002 as required by the EMC directive 2004/108/EC. The Nortec 500 and its accessories meet the emissions requirements of EN61326:2002 for Class A equipment and the immunity requirements of EN61326 Annex A:2002.

To ensure compliance with the EMC directive, any cable attached to the USB, VGA, analog I/O, BNC, or probe connectors must be shielded and must be less than three (3) meters in length. Longer cables may be used if installed in conductive cable trays or conduit and may require ferrites.

⚠️ **Warning:** Changes or modifications to this instrument or use of unauthorized accessories not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment in countries that require compliance with the EMC directive.

Hazardous Area Operations

The Nortec 500 may be used in potentially explosive atmosphere areas as defined by Class 1, Division 2, Group D of the National Fire Prevention Association Code 70 (NFPA 70), Section 500.

The Nortec 500 and its accessories have been tested to meet requirements in accordance with MIL-STD-810F, Method 511.4, Procedure 1.

Operators of this instrument must understand and be familiar with NFPA 70 and MIL-STD-810F. The instrument must be checked for proper operation prior to entering any hazardous area.

Limitations Of Use In Hazardous Areas

This instrument must be operated from internal batteries, and all external power sources must be disconnected.

⚠️ **Warning:** Changes or modification to this instrument or use of unauthorized accessories not expressly approved by Olympus void the user's authority to operate the Nortec 500 in hazardous areas.

1. Nortec 500 Series Portable Eddy Current Flaw Detectors

1.1 About This Manual

This manual contains information on the four Nortec 500 models: Nortec 500, Nortec 500C, Nortec 500S, and Nortec 500D. Information applies to all models unless specifically noted in section headers, or in function or application sections.

Nortec 500 eddy current flaw detectors incorporate a full range of features: internal balance coils, VGA output connector (for "heads-up display," monitors, and projectors), and a USB interface for rapid information transfer. The Nortec 500 also includes the PowerLink feature for automatic probe recognition and program set-up.

The Nortec 500 is available in four configurations. Each configuration includes digital connectivity, high-resolution, and low-noise. Internal balance coils allow the use of absolute probes without the need for external balance coil adapters. A built-in preamp adds extra gain when needed. A VGA output allows for the addition of an optional "heads-up display" allowing hands-free operation. The optional remote-null adapter adds convenience by allowing the probe to be nulled and the instrument screen erased from the probe.

- The Nortec 500 delivers basic single-frequency eddy current inspection including external outputs.
- The Nortec 500C adds digital conductivity and coating thickness measurement.
- The Nortec 500S builds on the on the functions of the Nortec 500 and the Nortec 500C models and adds rotating scanner capability.
- The Nortec 500D includes the functionality of the Nortec 500S and adds dual frequency.

1.2　Preparation for Operation

Preparation for operation includes the following topics:

- Unpacking the Nortec 500 Series
- Optional Accessories
- Initial Inspection Checklist
- Power Requirements
- Li-ion Battery Characteristics
- Charging the Li-ion Battery Pack
- Charger Specifications
- Charger Operation Instructions
- Battery Safety
- Battery Characteristics

1.2.1　Unpacking the Nortec 500 Series

Cartons should be opened and inspected on receipt. The cartons and contents should be inspected for signs of damage. If damage is noted, contact the carrier and retain the damaged shipping materials until an inspection can be performed by a representative of the carrier. Except for the battery charger and any external accessories, Nortec 500 options are installed before the unit is shipped. Check the packing list to ensure that all ordered accessories have been received.

1.2.2　Optional Accessories

The following list (see Table 1 on page 2) includes most Nortec 500 accessories. Contact your sales representative for additional information.

Table 1 Optional accessories

Description	Function
Probes	Primary sensor for flaw detection or conductivity measurement

Table 1 Optional accessories *(continued)*

Description	Function
External Null/Erase adapter	Provides Null/Erase function near probe on eddy current instruments
External bench-top Li-ion battery charger	Charges batteries outside the instrument
Replacement batteries (2.4 Ah or 8.8 Ah Li-ion)	Primary power source
Portable printer	Printouts and reports
Probe adapters	Provides means to connect other manufacturers' probes to this eddy current instrument.

1.2.3 Initial Inspection Checklist

After the Nortec 500 has been unpacked and the contents of the carton have been checked against the packing list, a visual inspection and basic operation test should be performed.

- Cosmetic or structural damage?
- Instrument power ON? When the instrument powers up, it is normal operation for random lines or colors to be displayed for up to ten seconds, until the instrument display drivers have had time to load.
- Sign On Message displays?

1.2.4 Power Requirements

As a fully portable inspection instrument, the Nortec 500 relies on one Li-ion battery as the primary source of power. The battery compartment is located at the rear of the unit and is conveniently accessed by loosening the four quick-release screws and removing the battery cover.

The Li-ion battery pack provided with the Nortec 500 instrument is small, lightweight, portable, and capable of delivering long service life between recharges or battery replacement. Replacement batteries are available through the factory or an authorized retailer.

The battery charger is provided with the Nortec 500 for recharging the Li-ion battery pack while in the instrument and also for allowing the Nortec 500 to be operated from AC line power. The charger unit auto senses 100 V to 240 V AC line power at 47 Hz to 63 Hz.

The condition of the batteries used in the Nortec 500 is monitored by the charger. Fully discharged Li-ion batteries will require approximately 6 hours to charge. The charger will not charge batteries that are too hot, too cold, or too deeply discharged.

Note: Fully charge the battery before first use. Instrument run time is affected by variables such as quality of charge, age of battery, and display type. The battery charge indicator on the display is an estimation of expected run time. Instruments are equipped with a circuit that shuts off power prior to full discharge. Battery life is affected by number of charge/discharge cycles, storage conditions, temperature, and use. Batteries stored for extended periods of time (months/years) without use may no longer recharge. Under normal use a Lithium-ion battery will last approximately 300 cycles. Expect to change the batteries after 1 year of heavy use or 3 years of light use, under normal conditions. Batteries must be disposed of in accordance with local law or returned to Olympus. Olympus does not warrant batteries due to operating conditions beyond the company's control affecting battery life.

For Optimum Performance

- Upon first use, or after prolonged periods of storage, you may need to charge and discharge your battery two or three times before obtaining optimum performance.
- It is best to charge the battery at a room temperature ranging between 15 °C (59 °F) and 30 °C (86 °F).
- It is normal for the battery to become warm during charging or after use.
- It is not necessary to fully discharge your battery before charging. You can top off the charge at any time.
- A charged battery will gradually lose its charge if left in storage. We therefore suggest that you top off the charge before use.

Safety Precautions

- Do not disassemble or attempt to open the battery under any circumstances.
- The battery can explode, leak, or catch on fire if heated or exposed to fire or high temperature.
- Do not short circuit the battery by directly connecting the metal terminals (+, −). Be certain that no metal objects such as coins, paper clips, etc., touch the terminals.

Use only a battery charger supplied from the instrument manufacturer or one that meets

manufacturer specifications.

To Avoid Damage to the Battery

- Do not drop the battery or subject it to mechanical shock.
- Use the battery only with equipment that specifies its use.

1.2.5   Li-ion Battery Characteristics

Higher capacity	Up to 60 % longer run time than ordinary nickel metal hydride (NiMH) batteries of equivalent size
Fast charge	Approximately 6 hours
Long cycle life	Up to 300 charge/discharge cycles
Temperature range (charging)	0 °C to 40 °C (32 °F to 104 °F)
Temperature range (operating)	–20 °C to 60 °C (–4 °F to 140 °F)
Temperature range (storage)	–20 °C to 50 °C (–4 °F to 122 °F)
Environmental friendliness	0 % cadmium, no disposal problems
Size (L × W × H)	215 mm × 59 mm × 23 mm (8.5 in. × 2.3 in. × 0.9 in.)
Weight	493 g (17.6 oz.)
Nominal voltage	10.8 V
Rated capacity	2.4 Ah or 8.8 Ah nominal
Hours of operation	6 hours or more with monochrome or color LCD display

1.2.6   Charging the Li-ion Battery Pack

Proper charging of the lithium ion (Li-ion) battery packs is critical for overall life and performance. The battery charger can either charge the Li-ion battery in the instrument or function as a battery eliminator to operate the instrument from the an AC power source. Batteries do not have to be installed to operate the instrument from AC.

When operated from the charger without a battery installed in the instrument, the battery charge indicator will not display. Instead the AC icon will be displayed alone to indicate the battery is not present, as shown in Figure 1-1 on page 6.

Figure 1-1 AC icon displayed without battery charge indicator

> **Note:** If the battery is not seated correctly in the battery compartment and therefore not charging or if the battery is faulty, the battery charge indicator will not appear above the AC icon. Recheck the positioning of the battery or replace the faulty battery and the charge indicator will then appear.

The instrument can be operated while a Li-ion battery is being charged, but it is not recommended to charge the Li-ion battery and operate rotary scanners at the same time.

1.2.7   Charger Specifications

- Power Requirements: 85 V to 240 V, 50 Hz to 60 Hz.
- Positive (+) center connection.
- Diameter of connector: 2.5 mm.
- The charger contains internal current-limiting circuitry.
- The charger charges one Li-ion battery at an approximately 1.5 Ah rate. An 8.8 Ah battery charges in approximately 6 hours.
- Temperature range: Batteries should be charged between 4 °C to 38 °C (40 °F to 100 °F) for best results.
- If the batteries become too hot, the battery charger will terminate the charging process.

- To start a charge cycle, the charger can be reset by disconnecting and reconnecting either the instrument or the AC power to the battery charger.

1.2.8   Charger Operation Instructions

- Connect the charger to a source of AC power. Connect the charger to the Nortec 500. The red charging indicator on the Nortec 500 will light, indicating that the batteries are charging, and the AC icon appear below the battery charge indicator. The LED indicator will turn green when the battery is fully charged and the AC icon will continue to appear until the battery charger is removed.
- During use, the charger case will become warm.
- The charger is designed to shut off after a Li-ion battery is fully charged (the instrument power remains available). It does not provide a maintenance charge because Li-ion batteries can be damaged by trickle charging.
- Li-ion batteries have a long shelf life and should only require recharging after many months of storage if not used.

1.2.9   Battery Safety

Used batteries that no longer deliver satisfactory service should be disposed of in a legal and environmentally friendly manner. If there is no battery recycling center nearby, the batteries may be returned to Olympus for proper disposal.

No battery should be disposed of by fire or abused by puncturing its case or disassembled. Li-ion batteries do not contain lead, cadmium, or mercury; however, all batteries contain potentially hazardous chemicals.

Lithium-ion batteries contain an internal safety circuit and internal fuses. If the fuse blows or the safety circuit shuts off the battery, the battery is no longer fit for service. The internal safety circuits are not serviceable.

Olympus purchases batteries only from reputable vendors. Although Olympus tests and qualifies the batteries for use in its products, Olympus cannot guarantee that batteries obtained from other sources will be satisfactory or that Olympus supplied batteries will work in non-Olympus products.

1.2.10   Battery Characteristics

Most batteries will not deliver their full charge on first use or after extended storage. Use them until the instrument shuts off after full discharge (automatic low-battery shut off) and then

recharge. This will recondition the battery.

The battery is considered by the manufacturer to be beyond its service life when it delivers less than 80 % of its rated capacity. Li-ion batteries should have a life expectancy of 300 charge/discharge cycles. These specifications were obtained under laboratory conditions and actual results may be different. Battery life will be prolonged if batteries are not subjected to harsh temperatures, either too hot or too cold, and are stored in a charged condition.

Batteries have a reduced capacity at low temperatures; exact percentages are not specified, but operation below freezing is not recommended. Newer versions of Li-ion batteries, also known as SMBus Smart Batteries, have a microprocessor built into them that monitors the battery usage and displays the condition on a charge indicator on the battery. It is possible that errors may occur over time due to temperature extremes, aging, self discharge, and other factors.

The charge indicator on the battery and the charge indicator on the instrument front panel display the same information from the SMBus Smart Battery internal microprocessor.

The optional Li-ion external bench-top charger has a recalibration feature that charges, discharges, recharges, and stores updated information in the microprocessor within the SMBus capable batteries. This feature is only needed when the charge indicator on the battery does not show the proper information.

Examples of a battery requiring recalibration are after running the instrument for a short time and the battery charge indicator has one or no bars showing or when fully charged, the charge indicator has four or less bars showing. Refer to the instructions provided with the external charger for proper operation and usage.

> **Note:** (Nortec 500S and Nortec 500D Only) Scanners draw enough current from the batteries to significantly shorten battery life and operation of the instrument. Loading a scanner can activate the automatic low-battery shutoff circuit when the batteries are nearly discharged.

Operating Environment

The Nortec 500 is designed as a portable instrument and, as such, requires no special site preparation before operation. When operating, the instrument should be firmly supported to prevent damage due to a fall. The unit is manufactured to meet IP65 specifications but should be protected as much as possible from water or chemical splashes and rapid temperature changes, and should be operated away from large electrical equipment that could interfere with

the operation of internal circuitry.

Note: The test instrument and reference standard should be allowed to stabilize to the same temperature as the parts or material to be tested. To check for temperature drift, take several readings at timed intervals until the values have stabilized. Always check the calibration before taking a reading. A 15-minute warm-up period before calibration is recommended.

Note: Poor-quality or excessively long cable, while not detrimental to the instrument, can adversely affect signal-to-noise ratio. For best results, use quality cables that are no longer than necessary for the operation.

2. Nortec 500 Series Technical Data

This chapter presents the Nortec 500 Series technical specifications.

Basic performance

Frequency range	50 Hz to 12 MHz
Gain	0 dB to 90.0 dB
Sensitivity	Adjustable to 200 V/Ω
Flaw response	0 Hz to 2000 Hz (nominal)
Digitizing rate	6000 samples/second (max.)
Rotation variable	0° to 360° in 1° steps
Sweep variable	0.005 s/div. to 4 s/div.
Low-Pass filter	10 Hz to 500 Hz in 1 Hz increments, 500 Hz to 2000 Hz in 50 Hz increments, Wb setting of 4 kHz. Greater than 4-pole response.
High-Pass filter	(0(DC), 2, 4, 6, 8, and 10) Hz to 500 Hz in 1 Hz increments. Two-pole response available in frequency 1 only.
Probe drive	Adjustable in three steps (low, medium, high) corresponding to (2, 6, and 12) V peak-to-peak into 75 Ω, ± 0.5 V.
Null	Three-stage digital null.
Variable persistence	Screen persistence varies between 0.1 s and 5 s in 0.1 s steps. Operator can select periodic screen erase at intervals of up to 1 minute. Basic stored-screen time is infinite with manual erase.

Probe types	Absolute and differential in either bridge or reflection configuration, ID, OD, bolt-hole, sliding, and custom special-product orders (SPO).
Scanner drive	Drives PS-5AL, MiniMite, Spitfire 2000, or RA2000 scanners at the following speeds (Nortec 500S and Nortec 500D only):
	PS-5AL: 40 rpm to 240 rpm MiniMite: 600 rpm to 3000 rpm Spitfire 2000: 600 rpm to 3000 rpm RA2000: 600 rpm to 2400 rpm
Alarms	Can be set to trigger when signal enters the alarm area or is outside alarm area.
Alarm modes	Impedance Plane Display: 1 to 3 independent box gates, one polar gate. Sweep display: high and low threshold gates (Nortec 500S and Nortec 500D models only).
Waterfall display	4 to 60 lines with 32-line maximum display simultaneously. 105 to 210 points/sweep recorded (Nortec 500S and Nortec 500D models only).
Conductivity accuracy	$\pm$0.5 % IACS accuracy from 0.9 % to 62 % IACS and $\pm$1.0 % IACS accuracy over 62 % IACS. Lift-off accuracy from 0 mil to 15 mils $\pm$1 mil. Conductivity measurements with greater than 10 mils of lift-off have reduced accuracy (Nortec 500C, Nortec 500S, and Nortec 500D models only).
Nonconductive coating thickness	Measures nonconductive coating thickness from 0.00 in. to 0.025 in. Coating accuracy $\pm$0.001 in. over 0.00 in. to 0.015 in. thickness (Nortec 500C, Nortec 500S, and Nortec 500D models only).
Trace storage	Stores up to 200 traces for recall. Locations may store any combination of frozen screens or movement of the impedance spot for up to 60 seconds.

Program storage	Instrument setups may be stored and recalled. The date and time of storage are recorded and available to the operator. Each location may be labeled with alphanumeric names up to 29 characters. The instrument can maintain storage up to two days with batteries removed. It is suggested that instrument data be backed up to a PC if the instrument is to be placed in storage for extended periods. This can be accomplished via the included EddyMaster 500 software.
Serial interface	USB On-The-Go (OTG) compatible serial interface communicates with external computer or USB printer. Instrument parameters, except power on/off, can be controlled through the serial interface. All programs and stored screen locations are accessible through this interface.
Printout	Printout available with optional USB printer. Printout text may be customized from either the front panel of the Nortec 500 or from an external computer.
Supported printers	Pentax PocketJet 3 or HP USB.

Inputs/Outputs (all models)

Power	2-pin connector to operate from AC power and charge internal batteries.
USB connector	For bidirectional serial data by way of USB OTG. Links to external computers, terminals, or printers.
Outputs	DB15F connector provides analog out for vertical and horizontal signals (±5 V, 10 mA (max.), 1 V/div.) on both frequency 1 and frequency 2 and 5 V TTL-compatible (3 V logic) active-high alarm output.
Probe connectors	16-pin LEMO and single BNC connector.
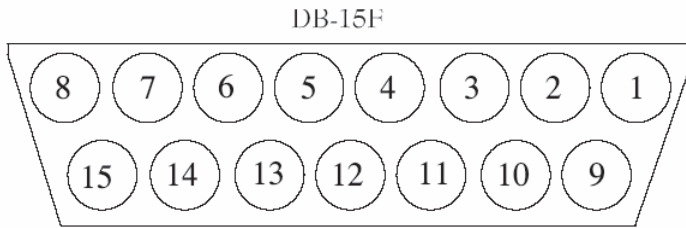
Figure 2-1 Nortec 500 auxiliary outputs (view into pins)

Table 2 Auxiliary outputs connector pinout

Pin	Eddy current
1	Ground
2	Frequency #1 Vertical
3	Frequency #1 Horizontal
4	Frequency #2 Vertical
5	Frequency #2 Horizontal
6	Mixed Vertical
7	Mixed Horizontal
8	Ground
9	#1 Alarm (Box 1)
10	#2 Alarm (Box 2)
11	#3 Alarm (Box 3)
12	Polar or Sweep Alarms
13	Lock On
14	+ Battery Voltage (Relays)
15	Special

The RF and video outputs have adjacent pin grounds. Pin 15 is tied to an internal wire point for SPOs. The instrument auxiliary is a standard density 15-pin D female connector.

Additional features

Reports field	User-defined 38-character report header, up to 7 user-defined 40-character report fields and 26-character labels, up to 3 user-defined 26-character report entries may be downloaded to the USB port or entered through the report edit function. Clock, calendar time, and date are stored and printed with each waveform. Instrument ID, manufacturer's name, and model are printed with each waveform (PowerLink probes only). International, menu-selectable languages include English, Spanish, French, and German.
Conductivity (Nortec 500C, Nortec 500S, and Nortec 500D only)	Frequency: 60 kHz or 480 kHz Probe Type: Conductivity Probe Digital Conductivity: Digital conductivity display from 0.9 % to 110 % IACS. Accuracy within ±0.5 % IACS from 0.9 % to 62 % IACS and within ±1.0 % of values over 62 % IACS. Meets or exceeds BAC 5651. Conductivity measurements with greater than 10 mils of lift-off have reduced accuracy. Alarms: Independent high- and low-limit alarms can be set for conductivity lift-off. Alarms can be set to trigger when the signals are inside the limits or outside the limits.
Dual frequency (Nortec 500D only)	Second Frequency: 100 Hz to 3 MHz, 2nd frequency is an exact division of the first frequency in ratios of 1/2 (F1 < 6 MHz), 1/4, and even divisors to 1/32. Display: frequency 1 only, frequency 2 only, sum of frequencies 1 and 2, difference between frequencies 1 and 2, split screen with selected combinations of frequencies 1 and 2, and mixed frequencies.

General

Dimensions (L × W × D)	241 mm × 140 mm × 92 mm (9.5 in. × 5.5 in. × 3.6 in.)
Weight	1.27 kg (2.8 lb) with 2.4 Ah battery and 1.72 kg (3.8 lb) with 8.8 Ah battery

Display	133 mm × 99 mm, 165 mm diagonal (5.25 in. × 3.9 in., 6.5 in.) full VGA color LCD (640 × 480 pixels)
Operating temperature	−10 ºC to 55 ºC (14 °F to 131 ºF)
Storage temperature	−51 ºC to 71 ºC (−60 ºF to 160 ºF)
Power DC	One 8.8 Ah Li-ion or one 2.4 Ah Li-ion battery
Power AC	External charger/adapter. Fully charges batteries in approximately 6 hours. Line voltage 85 V to 240 V AC, 50 Hz to 60 Hz.
Low battery	Display bar-graph charge indicator indicates approximate operating time. A low battery annunciator indicates when approximately 10 minutes of operating time is left.
Operating time	3 to 8 hours, depending on battery configuration and scanner usage.
Humidity	MIL-STD-28800—Safe operation in exposure to Class 3 temperature/humidity environment (−10 °C to 55 °C at 95 % ±5 % relative humidity, noncondensing).
Altitude	Maximum operating and nonoperating altitude 4600 m (15 000 ft).
Hazardous area operation	Safe operation as defined by Class I, Division 2, Group D, as found in the National Fire Association Code (NFPA70), Section 500, and tested using MIL-STD-810F, Method 511.4, Procedure 1.
Ingress protection	Designed (not tested) to withstand environments to IP-65.

3. Nortec 500 Series Control Descriptions

This chapter includes the following topics:

- PowerLink Operation
- Instrument Controls
- Power and lock Button
- Soft Keys (Left and Right Side)
- Display
- SmartKnob
- Function Keys
- Basic Functions
- Alarm Operation
- Dual Frequency Mode
- Program Storage
- Data Storage
- Setup Menu
- Special Functions
- Waterfall Display Function
- Conductivity Mode
- Preamplifier

3.1 PowerLink Operation

The PowerLink feature enables the Nortec 500 instrument to recognize Nortec PowerLink probes and scanners, configuring the instrument according to the parameters programmed into the ID chip. Each PowerLink probe is programmed at the factory to identify itself by model

number, preselected operating frequency, and serial number.

The PowerLink connection is automatically made when a PowerLink probe is connected to the Nortec 500 instrument. When a PowerLink probe is connected, the instrument displays the following screen (see Figure 3-1 on page 18).
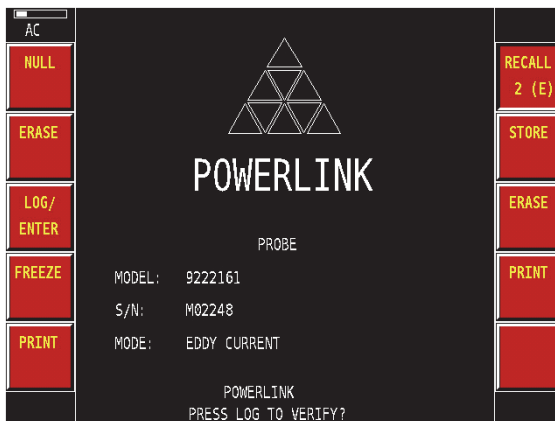
Figure 3-1   PowerLink detection screen

To proceed without using the PowerLink feature, press the MAIN function key twice (see Figure 3-2 on page 18).

Figure 3-2   MAIN function key

To use the PowerLink feature, press the **LOG/ENTER** soft key to download information (see Figure 3-3 on page 19).

Figure 3-3 LOG/ENTER soft key

After pressing the **LOG/ENTER** soft key, the display refreshes and displays the following information (see Figure 3-4 on page 19):
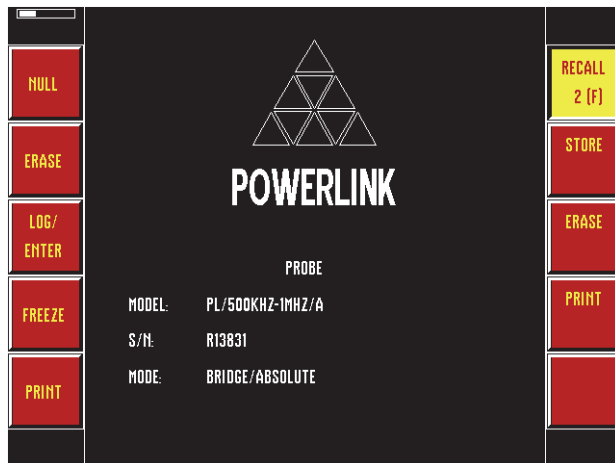
Figure 3-4 PowerLink completed screen

After the PowerLink program is downloaded to the instrument, the serial number of a Powerlink probe allows you to recall all programs previously stored using the probe. To do this, press the **RECALL** soft key and rotate the SmartKnob until the desired program number

is shown, and then press the **RECALL** soft key again.

PowerLink probes can also be programmed for Level II commands, and any of the instrument parameter commands can be preloaded at the factory to fully set up a desired test.

Level III PowerLink programming (user programmable) is supported by using a Nortec WorkStation or PowerStation. Level III programming allows the user to program the ID chip to meet their specific needs. Large data capacity allows for a chip to be reprogrammed if the need arises. For each probe, PowerLink can be bypassed to allow the probe to be used for any applicable test.

3.2   Instrument Controls

Instrument controls are displayed in Figure 3-5 on page 20.
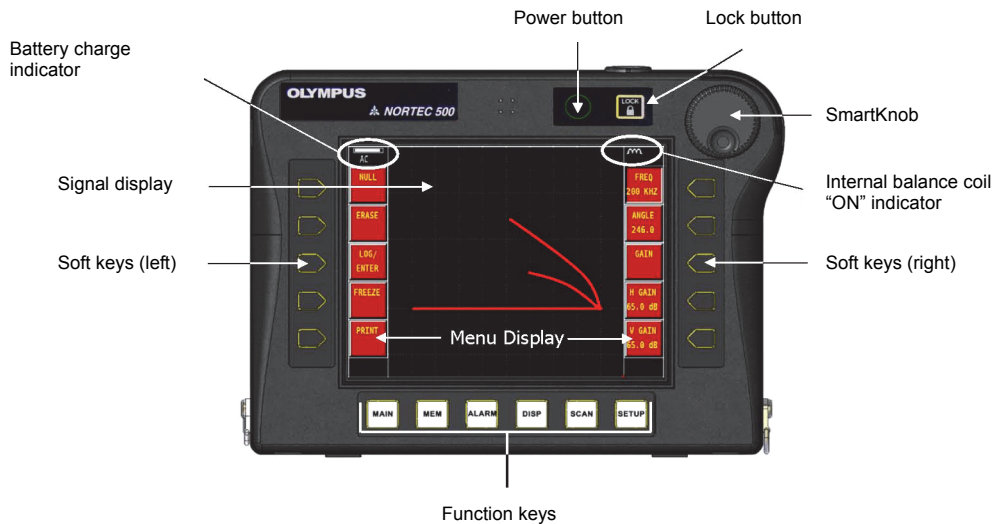
Figure 3-5 Instrument controls

3.3   Power and LOCK Button

The power button toggles instrument power on and off. The instrument will normally attempt to restore its last configuration.

The LOCK button disables most of the instrument function keys, the soft keys, and the SmartKnob when pressed. The only functions not disabled when this function is enabled are the **NULL** and **ERASE** function keys. When a locked function is attempted, the error message **PARM LOCKED** will appear at the bottom of the instrument display to indicate that the lock feature is engaged.

To disable the lock feature, simply press the LOCK button.

> **Note:** The Nortec 500 instruments contain a secondary lock feature which cannot be turned off by pressing the LOCK button. For more details, see "Instrument Preferences" on page 49.

The instrument display contains a bar graph (Battery Charge Indicator, see Figure 3-5 on page 20), indicating remaining battery life and directly below it an **AC** icon, which indicates the charger is connected.

When the unit has approximately ten minutes operating time remaining, a status message in the battery level window indicates the low-battery condition. A low-battery cut-off circuit will automatically switch off the unit to protect the batteries from excessive discharge.

3.4   Soft Keys (Left and Right Side)

The soft keys located on the left and right side of the display are used to select instrument parameters for adjustment (using the SmartKnob). For some parameters, the soft keys when pressed repeatedly will toggle through specific parameter settings (discrete steps). When a soft key is pressed, the parameter located in the display box directly beside the key will be highlighted, appearing as a depressed button (see Figure 3-6 on page 22).
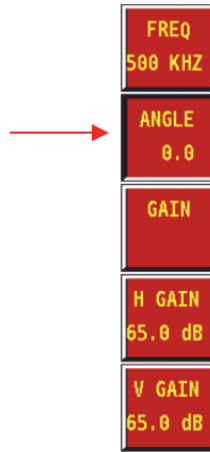
Figure 3-6 Example of depressed button

3.5 Display

The instrument is configured with a color Liquid Crystal Display (LCD) and offers 640 x 480 resolution (full VGA). The LCD display shows the eddy current signal, menu display, status bar, annunciators, and full screen text when required (see Figure 3-7 on page 23).
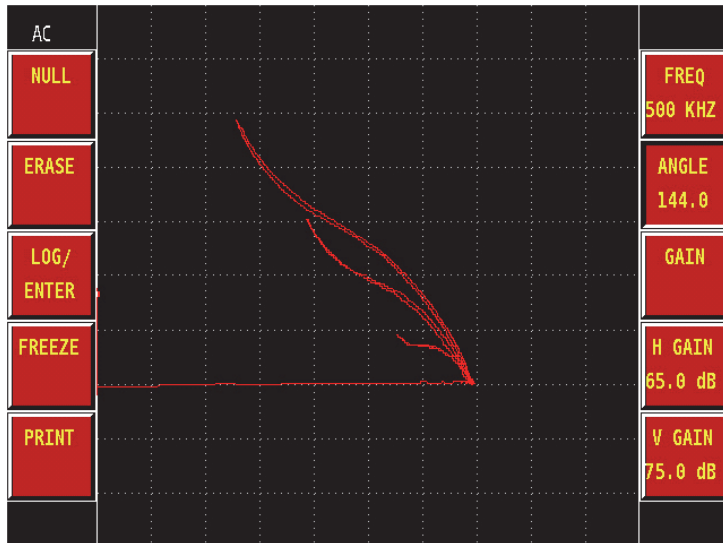
Figure 3-7 Display

3.6   SmartKnob

The primary function of the SmartKnob is to adjust the selected instrument parameters. The display box of the parameter being adjusted will be highlighted, appearing as a depressed button located to the right or left of the menu soft keys. In some instances the SmartKnob may be used to respond to various prompts.

3.7   Function Keys

The function keys (see Figure 3-5 on page 20) are used to activate an operating menu on the instrument. These keys are normally pressed first, before changing values using the SmartKnob or menu soft keys.

MAIN

The basic functions are found in the Main menu. These functions affect the basic eddy current operation of the instrument.

MEM

The memory menu contains the functions to store, recall, name, and delete data and programs.

ALARM

The alarm menu contains the functions for alarm operation.

DISP

The display menu controls settings that set the way in which the eddy current signal is displayed on the screen, as well as persistence (**PERSIST**), display erase (**DISP ERS**), and sweep erase (**SWP ERS**).

SCAN

The scanner menu controls scanner functions such as sweep mode (**SWP MODE**), sweep time (**SWP TIME**), **RPM**, sync angle (**SYNC ANG**), and waterfall (**WATRFALL**). This function key is present on the Nortec 500, but most functionality is limited to the Nortec 500S and Nortec 500D models.

SETUP

The setup menu controls functionality of the instrument such as date and time settings (**CLOCK SETUP**), probe drive (**PROB DRV**), language setting (**LANG**), soft key functionality (**SOFTKEY**), and capture settings (**CAPTURE SETUP**).

STANDARD MENUS

MAIN

- Frequency 1 — Freq / Angle / Gain / HGain / VGain
- Frequency 2 — Freq / Angle / Gain / HGain / VGain
- Filter — HiPass / LoPass / ContNull / Preamp / Balance
- AutoLiftoff

MEM

- Program — Recall / Store / Erase / Print / Name
- Data — Recall / RefMem / Erase / Print / Name
- Report — Done / Edit / Clear / Default

Text Edit Menu
→
Ers Line / Quit / Save

ALARM

- Box 1 — Top / Bottom / Left / Right / Off + -
- Polar — Horz / Vert / Radius / Off + -
- Sweep — Top / Bottom / Off + -
- Horn
- More
- Back
- Box 2 — Top / Bottom / Left / Right / Off + -
- Box 3 — Top / Bottom / Left / Right / Off + -
- Alarm Dwell

DISP

- Screen — H Pos / V Pos / Dot/Box
- Disp Ers — Persist / Disp Ers / Swp Ers / Graticule
- Main Disp
- Second Disp
- Tracking

SCAN

- Swp Mode
- Swp Time
- RPM
- Scan Sync
- Watrfall — Start / Stop / Wtrf Ang / Depth

SETUP

- Inst — Prb Drv / Ang Step / Frq Mode / Hmix Gn / Vmix Gn
- Capture — Cap Mode / Cap Time
- Pref — Key Lock / Language / SKey Pos / Auto Ers / Radix Pt
- Clock — Minute / Hour / Day / Month / Year
- Special — Color / Default Ins / Unlock Ftr / Shortcuts / Inst Ver

Text Edit Menu
→
Ers Line / Quit / Save

CONDUCTIVITY MODE MENUS

MAIN

- Cal Mode
- Cal Pt
- Cal Value
- Save

ALARM

- Cond Alm — Upper / Lower / Off + -
- Lift Alm — Upper / Lower / Off + -
- Horn

SETUP

- Pref — CondUnits / LiftoffUnits / Language / Radix Pt
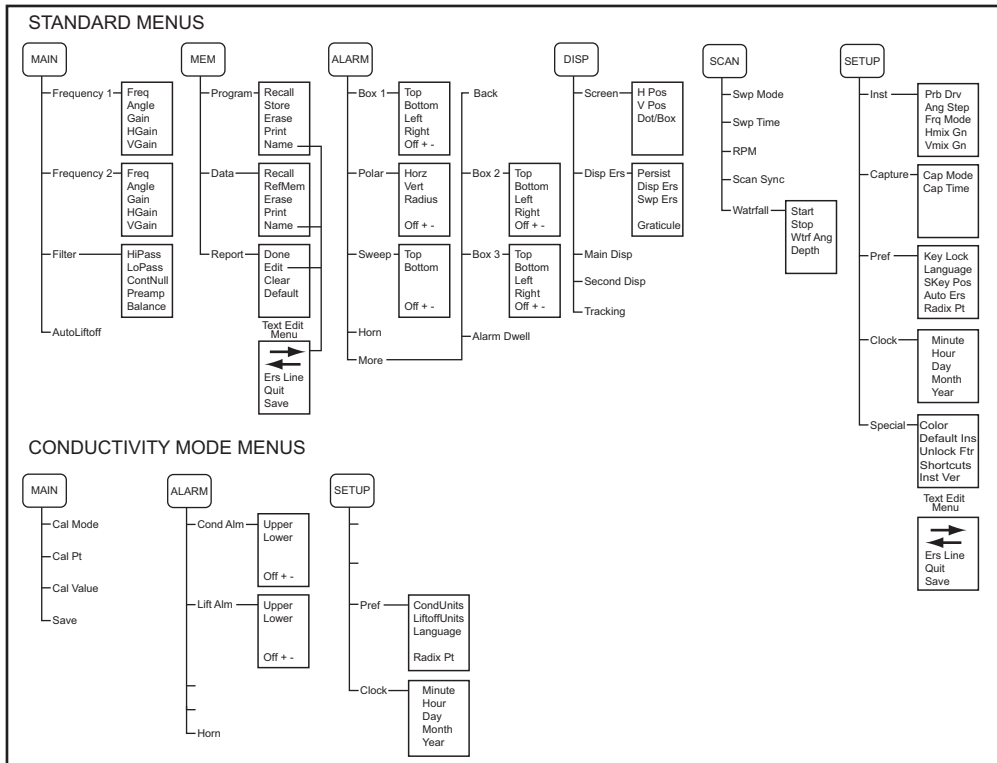- Clock — Minute / Hour / Day / Month / Year

Figure 3-8 Menu tree

3.8   Basic Functions

Terms (as shown on the instrument):

- Gain (GAIN)
- Frequency (FREQ)
- Angle (ANGLE)
- Filter (FILTER)
- Continuous Null (CONTNUL)
- Balance (BALANCE)
- Null (NULL)

- Erase (ERASE)
- Sweep Mode (SWP MODE)
- Display (DISP)
- Vertical or Horizontal Position (V POS or H POS)
- Variable Persistence (PERSIST)
- Sweep Erase (SWP ERS)
- Display Erase (DISP ERS)
- Dot/Box (DOT/BOX)
- Graticule (GRATICUL)
- Auto Lift-off (AUTOLIFT)

Gain

Gain is adjustable from 0.0 dB to 90.0 dB. The displayed gain setting is adjusted in 0.1 dB steps. At full gain (90.0 dB), with the instrument probe drive (**PROB DRV**) set to **MID**, instrument sensitivity is 100 V/Ω as measured on the side panel horizontal and vertical outputs, or 100 screen divisions per ohm on the display. (10 division display represents an impedance change of 0.1 Ω).

Gain may be adjusted in either the horizontal or vertical direction, or both together. Regardless of which gain parameters are being entered, the primary method of adjusting gain is performed by turning the SmartKnob. Gain may also be changed by pressing the **GAIN** soft key. With every press and release of the **GAIN** soft key, the gain increases by 5 dB. The change can be both vertical and horizontal together, or independently.

> **Note:** The first time that a **GAIN** key is pressed, the key is highlighted. The second time the key is pressed, the gain will be increased to a gain value ending in 0 or 5. Once the gain value ends in 0 or 5, each time a **GAIN** keys is pressed the gain will increment by 5 dB. To reduce the gain setting, the SmartKnob must be used.

To adjust the horizontal and vertical gain simultaneously, press the MAIN function key, then the **FREQ1 SETUP** soft key, and then the **GAIN** soft key. The gain may then be adjusted with the SmartKnob. The selected value will be applied to both the horizontal and the vertical gain and the difference between the horizontal and vertical gains will remain the same; that is, they will track together.

To adjust the horizontal gain without changing the vertical gain, press the **H-GAIN** soft key. The SmartKnob will now adjust only the horizontal gain. Likewise, to adjust only the vertical gain, press the **V-GAIN** soft key. The SmartKnob will now adjust only the vertical gain. See "Shorcuts" on page 54 for a description of alternate methods of changing gain settings.

Frequency

The frequency setting determines the frequency of the eddy current probe drive signal. This is adjustable from 50 Hz (0.05 kHz) to 12 MHz.

To adjust the frequency, simply press the MAIN function key, then the frequency 1 setup (**FREQ1 SETUP**) soft key, and then the **FREQ** soft key. Rotate the SmartKnob to adjust to the desired value.

Angle

The phase angle (or rotation) of the eddy current signal is set using the **ANGLE** soft key. By default, rotation is set in 1° increments from 0° through 359° but may be changed to 0.5° or 0.1° angle steps.

To adjust the phase angle, simply press the MAIN function key, then the **FREQ1 SETUP** soft key, and then the **ANGLE** soft key. Rotate the SmartKnob to adjust to the desired value. See "Shorcuts" on page 54 for a description of alternate methods of changing gain settings.

Filter

Low-pass filters may be set from 10 Hz to 100 Hz in 1 Hz increments and 5 Hz increments up to 500 Hz, followed by 25 Hz increments up to 2000 Hz. High-pass filters may be set from 0 Hz to 500 Hz in 2 Hz increments up to 8 Hz, 1 Hz increments from 9 Hz to 100 Hz, and 5 Hz increments up to 500 Hz.

To adjust the filter settings, simply press the MAIN function key and then the **FILTER SETUP** soft key. Select either the low-pass filter soft key (**LOWPASS**) or the high-pass filter soft key (**HIPASS**) to adjust the filter settings. Once the filter type has been selected, rotate the SmartKnob to the desired value.

Continuous Null

CONTNUL allows a very low-frequency high-pass filter to be turned on and is useful to keep the null point of the eddy current probe at the point specified, if required. When turned on, this function adds a 0.2 Hz, 0.5 Hz, or 1 Hz high-pass filter. By default, this feature is set to **OFF**.

To turn on continuous null, simply press the MAIN function key, followed by the **FILTER**

SETUP soft key, and then the **CONTNUL** soft key. Rotate the SmartKnob to adjust to the desired value.

Balance

Allows selection of internal balance coils for the use of single-coil bridge probes. Choices include 1.2 μH, 8.2 μH, 15 μH, 22 μH, 47 μH, 82 μH, and 120 μH. Due to the variety of probe manufacturers, trial and error may be needed to determine which internal balance coil to use with a given probe. The internal balance coil that is best suited will have the best signal-to-noise ratio and will produce the best flaw amplitude, when using the same frequency and gain settings, compared with all internal balance coils being evaluated.

To select the internal balance coil, simply press the MAIN function key, then the **FILTER SETUP** soft key, followed by the **BALANCE** soft key. Rotate the SmartKnob to select the desired balance coil value.

Note: When the internal balance coil feature is activated, the following icon displays in the upper-right corner (see Figure 3-9 on page 28).

Figure 3-9 Internal balance coil icon

The internal balance coils should only be used with probes connected to the BNC connector on the top rear of the instrument!

Null

The null function moves the dot (impedance plane display or sweep display) to the selected null position, often in the middle of the screen. This function is implemented simply by pressing the **NULL** button. Null should be performed prior to performing a test, and at periodic intervals when performing eddy current tests. Refer to the test procedures for a specific test to determine whether to null the signal with the probe held in air or on the test part.

Erase

The erase function will perform a screen erase when the **ERASE** key is pressed during normal operation. This operation clears all data from the screen and is useful to eliminate screen clutter. To erase the screen at any time that the eddy current signal is displayed, press the **ERASE** soft key.

> **Note:** The instrument is also capable of automatically erasing the screen by using the display erase (**DISP ERS**) or variable persistence (**PERSIST**) functions.

Sweep Mode

(Limited functionality in the Nortec 500 and Nortec 500C)

The sweep feature on the Nortec 500 instrument is controlled through the SCAN menu. Sweep moves the signal horizontally at a fixed rate selected from the front panel, continually retracing across the screen. The sweep functions are detailed below.

AUTO

Auto sweep may be set in a range from 0.005 second (5 milliseconds) per division to 4 seconds per division. At sweep time periods of 0.055 second/division and longer, the display will update in an incremental fashion. Auto sweep displays both the horizontal amplitude and the vertical amplitude of the eddy current signal in a combined, single horizontal sweep across the instrument screen.

AUTO XY

Auto XY sweep may be set in a range from 0.005 second (5 milliseconds) per division to 4 seconds per division. At sweep time periods of 0.055 second/division and longer, the display will update in an incremental fashion. Auto XY sweep displays the horizontal amplitude and vertical amplitude of the eddy current signal in two individual horizontal sweeps (X and Y) across the instrument screen. The upper sweep represents the horizontal

amplitude of the eddy current signal and the lower sweep represents the vertical amplitude of the eddy current signal.

EXTERN (External)

External sweep synchronizes the sweep to the rotation of an attached scanner, which is optional (Nortec 500S and Nortec 500D only).

EXT/IMP

In the external/impedance sweep mode (also known as "split screen"), the external sweep is on the left screen and the impedance plane is on the right. Any adjustment to the impedance plane signal is linked to the external sweep display (Nortec 500S and Nortec 500D only).

WATRFALL

Displays the sweeps associated with the waterfall function when used with the optional PS5AL scanner. See "Waterfall Display Function" on page 56 for more information on this feature.

To turn on a specific sweep function, press the SCAN function key, followed by the sweep mode (**SWP MODE**) soft key. Rotate the SmartKnob to adjust the sweep function.

Display

The display feature contains menu parameters that control signal position, persistence, display erase, sweep erase, and graticule. The following parameters may be adjusted:

Vertical or Horizontal Position

The position feature controls the position of the eddy current signal display. When the **NULL** key is pressed or the signal is in a null state, the dot or sweep line will be in the selected null position. The position may be controlled in steps of 0.5 % of full screen, with the lowest values at the bottom left of the screen.
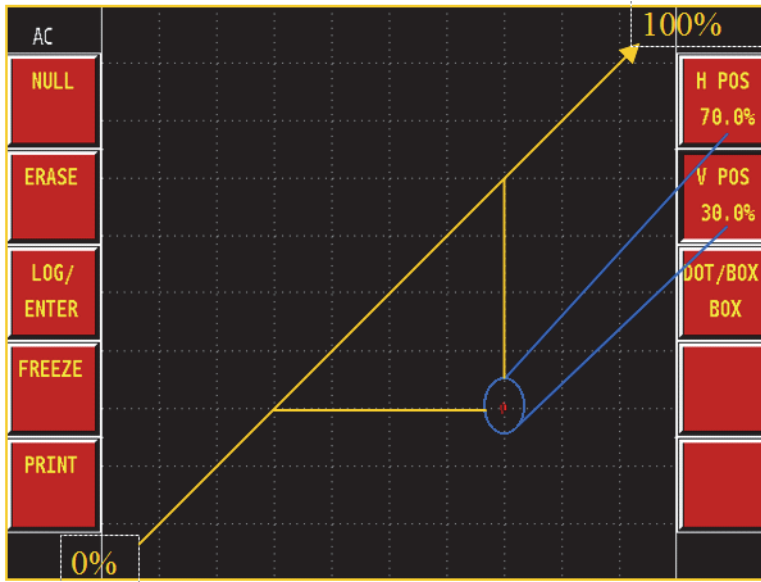
Figure 3-10 Null position

To change the position (also known as the null position), first press the DISP function key, then the **SCREEN SETUP** soft key, and then choose either the horizontal position (**H POS**) soft key or the vertical position (**V POS**) soft key (see Figure 3-10 on page 31). Rotate the SmartKnob to adjust to the desired value.

Variable Persistence

Variable persistence (**PERSIST**) is a mode of automatic screen erase. It allows the operator to set an impedance plane (not sweep) display so that the signal traces on the screen will be erased after a selected amount of time. This time may be set from 0.1 second to 5 seconds, in 0.1 second increments. The variable persistence erases all information at a particular point after the selected amount of time has expired, even if more information is displayed there at a later time. As a result, the display might appear somewhat broken where eddy current signals intersect those being erased.

Despite this, the resulting display is very useful for repetitive testing because the need to manually erase the screen is avoided. This function is not allowed when display erase (**DISP ERS**) or sweep mode (**SWP MODE**) are active.

To activate the variable persistence function, first press the DISP function key, then the

D ERASE SETUP soft key, and then press the **PERSIST** soft key. Rotate the SmartKnob to adjust to the desired value.

Sweep Erase

(Nortec 500S and Nortec 500D only)

The sweep erase (**SWP ERS**) function erases the sweep display once per trace. In the sweep erase mode, traces that are set for 0.055 second (55 milliseconds) per division or longer will erase incrementally as each new set of data is drawn to the screen. Thus, all data will be on the screen for the same amount of time, regardless of its horizontal position on the sweep display.

The sweep erase function only applies to the sweep mode. Refer to the explanation of sweep mode on page 29 for further information on this function. When the erase function is turned off, the sweep display must be erased manually.

When the instrument is loaded with its default settings, the sweep erase (**SWP ERS**) function is set to **ON**, which is the normal mode of operation.

To activate sweep erase (**SWP ERS**), press the DISP function key, followed by the **D ERASE SETUP** soft key, and then press the **SWP ERS** soft key. Rotate the SmartKnob to adjust to the desired value.

Display Erase

Display erase (**DISP ERS**) erases the eddy current display at intervals set by the operator. The available range for the display erase function is from 0.1 second to 60 seconds in 0.1 second intervals. This function differs from the variable persistence function in that the screen is completely erased at each interval, rather than incrementally erased.

The display erase function is not allowed when variable persistence (**PERSIST**) is turned on.

To activate display erase (**DISP ERS**) press the DISP function key, followed by the **D ERASE SETUP** soft key, and then press the **DISP ERS** soft key. Rotate the SmartKnob to adjust to the desired value.

Dot/Box

The dot/box feature allows the operator to change the shape of the signal focal spot. The default is the larger square box. A smaller dot is also obtainable.

To adjust the dot/box function, first press the DISP function key, followed by the **SCREEN SETUP** soft key, and then press the **DOT/BOX** soft key. Rotate the SmartKnob to adjust to the

desired value.

Graticule

The 10x10 graticule may be set **ON** or **OFF** at any time without affecting any eddy current information on the display.

To turn **ON** or **OFF** the graticule function, first press the DISP function key, followed by the display erase setup (**D ERASE SETUP**) soft key, and then press the graticule (**GRATICUL**) soft key. Rotate the SmartKnob to adjust to the desired value.

Auto Lift-off

Auto lift-off (**AUTOLIFT**) automatically adjusts the phase angle produced from the lift-off. To access the auto lift-off feature, press the MAIN function key followed by the **AUTOLIFT** soft key. Pressing the **AUTOLIFT** soft key a second time starts the auto lift-off compensation process.

To use the auto lift-off feature:

1. Using an eddy current probe, maintain contact with the material and press the **AUTOLIFT** soft key twice. The probe will null.
2. When **LIFT PROBE** appears in the display, slowly tilt the probe off the material. When the instrument trace moves across the instrument screen, the process is finished. The lift-off trace will then point toward the left of the screen, horizontally.

3.9   Alarm Operation

The Nortec 500 will operate using either a box or a polar (circular) alarm in the impedance plane mode. In the sweep modes, the alarm is a threshold alarm that senses a crossing in the vertical direction.

All alarms respond to the eddy current signal as it is being processed, and therefore react rapidly. The operation of the alarms may be dwelled, which is a function that forces the alarm to be on for a minimum amount of time. An internal, audible alarm horn may be turned on, and will respond to the alarm condition, subject to the dwell function settings. On-screen alarm indicators flash when the instrument is in an alarm condition.

Box and polar alarms may be used at the same time in impedance plane mode. One polar alarm and three box alarms are available. When the instrument is set in the sweep mode, only a threshold (sweep) alarm is available.

All alarms may be individually set to **POSITIVE** or **NEGATIVE** polarity. Positive polarity activates the alarm whenever the eddy current signal is inside the alarm threshold, while negative polarity activates the alarm whenever the eddy current signal is outside the alarm threshold.

The ALARM function key enables the user to activate the alarm setup soft keys to turn the alarm **ON** and **OFF**, and to set its size, position, and polarity.

ALARM SETUP is divided into two menus with **BOX 1 SETUP**, **POLAR SETUP**, **SWEEP SETUP**, **HORN**, and **MORE** being the options allowed for setup from the first menu. Upon pressing **MORE**, the options available are **BACK**, **BOX 2 SETUP**, **BOX 3 SETUP**, and alarm dwell (**ALM DWELL**). After pressing an alarm setup soft key, the operator can control the alarm functions. The extent and position of the alarms can be defined, polarity set, audible horn volume controlled, and alarm dwell time adjusted. The SmartKnob is used to change the values for the alarm functions.

Prior to adjusting the alarm, the proper alarm type must be selected by pressing one of the available alarm setup soft keys. The available alarm types are box, polar (circular), and sweep (threshold).

To select the alarm type, press the ALARM function key. The five display boxes for the parameters will change to indicate the options available: **BOX 1 SETUP**, **POLAR SETUP**, **SWEEP SETUP**, **HORN**, and **MORE** (more options). Pressing the **MORE** soft key will allow more options to be adjusted including **BACK** (back to previous menu), **BOX 2 SETUP**, **BOX 3 SETUP**, and alarm dwell (**ALM DWELL**). Press the soft key for the option you wish to adjust. The SmartKnob is used to change the values for the alarm functions.

Each alarm is turned on/off separately. Therefore, if the alarm type is changed, it will have to be activated if it was previously turned off. Once the alarm type is selected, it may be turned on/off and set to **POSITIVE** or **NEGATIVE** polarity through one of the alarm setup soft keys. For further details, refer to the individual alarm functions on the following pages.

Note: When the "split screen" is on, box and polar alarms are identical on both screens.
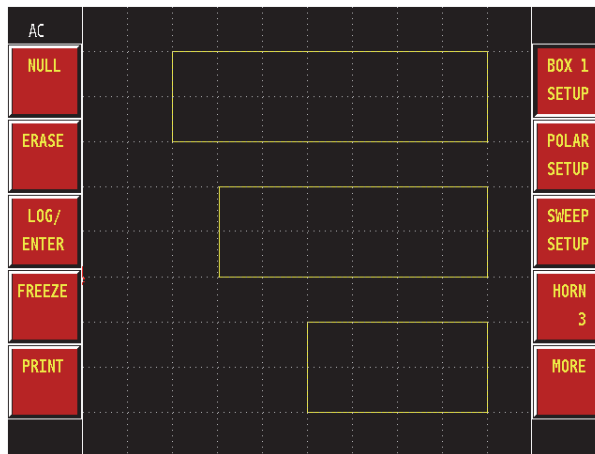

3.9.1   Box Alarm

Figure 3-11 Box alarm display

The box alarm is a rectangular box that represents limits to the allowable signal excursion before an alarm threshold setting is crossed. The box alarm is the most commonly used alarm and is specified in many test procedures (see Figure 3-11 on page 35).

The box alarm on the Nortec 500 has an additional feature in that, if it should touch the edge of the screen, the alarm box will be considered to extend beyond the edge of the screen, allowing the setup of a quadrant alarm.

To select the alarm that will be adjusted, press the soft key corresponding to the desired box alarm (1, 2, or 3). Once the proper alarm has been selected, it may be set to **POSITIVE** or **NEGATIVE** polarity by pressing the **OFF–+** soft key and rotating the SmartKnob.

To adjust the limits of the alarm, simply press the **TOP**, **BOTTOM**, **LEFT**, or **RIGHT** soft key.

Once the side of the alarm to be adjusted has been selected, the SmartKnob will allow movement of that side. The menu display will indicate, as a percentage of the screen, the location of the side of the alarm.

3.9.2   Polar Alarm

The polar alarm is a circular alarm normally used to detect a magnitude change only when the

eddy current signal is beyond a certain threshold. The operator may vary the size and position of the polar alarm, although its default position at the center of the screen is normally the best position.

To activate the polar alarm, press the ALARM function key, followed by the **POLAR SETUP** soft key, and then the **OFF–+** soft key to select **POSITIVE** or **NEGATIVE** polarity as desired. Once the alarm appears on the screen, its size may be adjusted by selecting the **RADIUS** soft key.

To move the polar alarm, select the desired direction by pressing either the horizontal (**HORZ**) or vertical (**VERT**) soft key, and then rotate the SmartKnob to move it. The menu display will indicate the screen position.

3.9.3   Sweep Alarm

The sweep alarm is a simple high/low threshold alarm and is the only alarm available when the Nortec 500 instrument is operated in sweep mode.

The polarity of the sweep alarm can be positive or negative. The negative alarm is normally used, triggering the alarm whenever one of the thresholds is exceeded. The positive alarm can be used when it is desired to have an alarm in only one direction.

To activate the sweep alarm, press the ALARM function key, then the **SWEEP SETUP** soft key, and then press the **OFF–+** menu soft key. Rotate the SmartKnob until the menu readout displays **POSITIVE** or **NEGATIVE** as appropriate.

The **TOP** and **BOTTOM** soft keys allow the operator to adjust the top and bottom thresholds. Pressing the **TOP** or **BOTTOM** soft key, and then rotating the SmartKnob, will change the selected threshold.

3.9.4   Alarm Horn

The alarm horn is an audible annunciator. This horn is internal to the instrument and is best used when background noise in the testing area is low. The alarm horn is turned on/off by pressing the ALARM function key, followed by the **HORN** soft key. Rotating the SmartKnob clockwise turns the horn on and increases the horn volume. Rotating the SmartKnob counterclockwise decreases the horn volume and turns the horn off. There are four volume levels available for the alarm horn: **OFF**, **1** (low), **2** (mid) and **3** (high).

3.9.5   Alarm Dwell

Alarm dwell keeps the alarm on for a set period after the event that caused the alarm has ended. Thus, if alarm dwell is set for 1 second and an alarm occurs, the instrument will continue to alarm for a period of 1 second after the alarm condition is over. Alarm dwell may be set in increments of 0.2 second, from 0.0 (off) to 10.0 seconds. Dwell applies to the alarm on-screen indicators and the alarm horn (if on). To change alarm dwell, press the ALARM function key, followed by the **MORE** soft key, and then the alarm dwell (**ALM DWEL**) soft key. The value may be entered by rotating the SmartKnob.

3.10 Dual Frequency Mode

(Nortec 500D Only)

Nortec 500 dual-frequency operation is an extension of single-frequency operation. Parameters that are adjustable for the second frequency are frequency, gain, and rotation. Dual-frequency mode is controlled via the SETUP menu.

To enable dual-frequency mode, first press the SETUP function key, followed by the instrument setup (**INST. SETUP**) soft key, and then the frequency mode (**FRQ MODE**) soft key. The value may be changed between single frequency (**SINGLE**) and dual frequency (**DUAL FRQ**) by rotating the SmartKnob. By default, frequency mode (**FRQ MODE**) is set to single frequency (**SINGLE**).

Note: Nortec 500 instruments always attempt to power up in the same manner as when turned off. Therefore, if the frequency mode = dual frequency (**DUAL FRQ**) on shutdown, then the instrument will power up with frequency mode = dual frequency (**DUAL FRQ**). Dual frequency must be turned on or off each time it is required or not required. By performing the default instrument (**DEFAULT INST.**) function, frequency mode (**FRQ MODE**) is set to single frequency (**SINGLE**). See "Setup Menu" on page 45 for more information on the default instrument (**DEFAULT INST.**) function.

Second frequency controls are as follows:

Frequency 2

The frequency 2 (**FREQ2**) soft key controls the frequency of the Nortec 500. The allowable

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range for this setting is 1/2 to 1/32 of the main frequency. To change the frequency 2 (**FREQ2**) setting, press the MAIN function key, followed by the **FREQ2 SETUP** soft key. Adjust frequency 2 by pressing the frequency 2 (**FREQ2**) soft key and rotating the SmartKnob to the desired frequency.

Angle 2

The angle 2 (**ANGLE2**) soft key controls the phase angle of frequency 2. However, if **TRACKING** is **ON** (see "Tracking" on page 40), the angle 2 option controls the phase angle of both frequency 1 and frequency 2. The phase angle for frequency 2 is always displayed. To change the angle setting for frequency 2, press the MAIN function key, followed by the **FREQ2 SETUP** soft key, and then the **ANGLE2** soft key. Angle 2 can now be adjusted by rotating the SmartKnob.

Gain 2

The gain 2 (**GAIN2**) soft key controls the gain applied to the frequency 2 signal, or if **TRACKING** is **ON**, the gain of both frequency 1 and frequency 2. The gain setting on frequency 2 is always displayed. To change the gain setting for frequency 2, press the MAIN function key, followed by the **FREQ2 SETUP** soft key, and then the **GAIN2** soft key. Adjust the gain of frequency 2 by rotating the SmartKnob.

Horizontal Gain 2

The horizontal gain 2 (**HGAIN2**) soft key controls the horizontal gain of frequency 2, or if **TRACKING** is **ON**, the horizontal gain of both frequency 1 and frequency 2. The horizontal gain of frequency 2 will always be displayed. To change the horizontal gain setting for frequency 2, press the MAIN function key, followed by the **FREQ2 SETUP** key, and then the **HGAIN2** soft key. Adjust the horizontal gain of frequency 2 by rotating the SmartKnob.

Vertical Gain 2

The vertical gain 2 (**VGAIN2**) soft key controls the vertical gain of frequency 2, or if **TRACKING** is **ON**, the vertical gain of both frequency 1 and frequency 2. The vertical gain of frequency 2 will always be displayed. To change the vertical gain setting for frequency 2, press the MAIN function key, followed by the **FREQ2** soft key, and then the **VGAIN2** soft key. Adjust the vertical gain of frequency 2 by rotating the SmartKnob.

Dual display

Dual display is used to display both frequency 1 and frequency 2 signals at the same time. To enable the dual display, instrument must first be set to operate in dual-frequency mode. First

press the SETUP function key, followed by the instrument setup (**INST. SETUP**) soft key. Next, press the frequency mode (**FRQ MODE**) soft key. The frequency mode (**FRQ MODE**) of the Nortec 500 can be changed from single frequency (**SINGLE**) to dual frequency (**DUAL FRQ**) by rotating the SmartKnob.

Main Display

The main display (**MAIN DSP**) controls the data on the main display. The main display is the only display when the second display (detailed in "Second Display" on page 39) is **OFF**, or the left side of the display when second display (**2ND DSP**) is **ON**. To change the main display (**MAIN DSP**) setting, press the DISP function key, followed by the **MAIN DSP** soft key. Adjust the setting by rotating the SmartKnob.

The selections available are as follows:

- **F1** displays frequency 1 data
- **F2** displays frequency 2 data
- **F1+F2** displays sum of frequency 1 and frequency 2 data
- **F1–F2** displays difference of frequency 1 and frequency 2 data

Second Display

The second display (**2ND DISP**, also known as the "split screen") controls whether only the main display is shown, or the main and second display screens are shown in a split-screen format. When using a scanner in the split-screen mode, the sweep display will be on the left with the impedance display on the right. To change the second display (**2ND DISP**) setting, press the DISP function key followed by the second display (**2ND DISP**) soft key. Adjust the setting by rotating the SmartKnob.

When second display (**2ND DISP**) is on, the following adjustments are possible:

- **F2** displays frequency 2 data and frequency 1 data.
- **F1+F2** displays sum of frequency 1 and frequency 2 data.
- **F1–F2** displays difference of frequency 1 and frequency 2 data.

Note: When second display (**2ND DISP**) is set to **ON**, the timed display erase (**DISP ERS**) function and alarms are available, but the variable persistence function is not.

Tracking

The tracking feature controls either the angle/gain parameters for both frequency 1 & 2, or only the frequency 2 gain and rotation. If this feature is **ON**, any adjustment to angle affects both frequency 1 and 2 angles; adjusting any horizontal gain on the MAIN menu affects both frequency 1 and 2 horizontal gain, and so forth. To change the tracking feature, press the DISP function key, followed by the **TRACKING** soft key. Adjust the setting by rotating the SmartKnob.

3.11 Program Storage

The Nortec 500 is capable of storing and retrieving complete instrument setups. The setups are recorded with date and time, and may be named using up to 29 alphanumeric characters. These names are input directly from the front panel of the instrument or by using EddyMaster 500 software (included with each instrument).

Whenever a program setting is recalled, the currently active instrument settings are overwritten and cannot be recovered unless these settings were previously stored in another program location.

Functions pertaining to program storage are as follows:

- **STORE** saves the current instrument settings to the selected program location.
- **RECALL** programs the instrument settings with the selected program number.
- **ERASE** erases the selected program number.
- **NAME ITEM** allows the operator to assign a name to the program for easier reference.
- **PRINT** allows printout of all the program settings to a USB printer.

Program storage locations are automatically assigned and are accessed by pressing the MEM function key.

To use any of the program features, first press the MEM function key, followed by the **PROGRAM SETUP** soft key. Program storage locations will, until named, record the time and date the program was saved. It is recommended that the stored program locations be named, for easy recall at a later time, immediately after storing the program. Functions that apply to program storage locations are **RECALL**, **ERASE**, **NAME ITEM**, and **PRINT**.

Once a program has been saved, the **RECALL**, **ERASE**, **NAME ITEM**, and **PRINT** function can be initiated by first selecting the desired program with the SmartKnob, and then pressing the appropriate menu soft key.

After performing the desired operation, any of the function keys, such as MAIN or DISP, will

return the instrument to normal operation.

3.11.1 Store

STORE records the instrument settings currently in use to a storage location. All instrument settings, including alarm, are saved to the program. Once a program is stored, it may be named using the name item program function.

To store a setup, make sure that the settings the instrument is currently using are the desired ones. Press the memory MEM function key, followed by the **PROGRAM SETUP** soft key. Press the **STORE** menu soft key twice to store the program. The display screen will be redrawn and the selected location will be listed with the time of day and the date the program was stored. If you wish to name the program setting, perform the name item function outlined in section 3.11.2 on page 41.

3.11.2 Name Item

The **NAME ITEM** function allows the operator to enter a name of up to 29 characters for a stored program. Names may be used to describe the test settings that are stored, reference a written test procedure, and so on. Only programs that are not empty may be named. All capital letters will be used, together with the digits 0 through 9 and several special characters (. / # %) and blanks. When the name feature is selected, a screen similar to Figure 3-12 on page 41 will appear, displaying a list of available characters, as well as a highlighted entry line with an (^) arrow used to point to the current character being entered.

Figure 3-12 Text editor

Pressing the **LOG/ENTER** soft key selects the character and moves the (^) arrow on the entry line one character to the right.

Pressing the **SAVE** menu soft key twice will record the name changes made into the current program setting.

Pressing the **QUIT** soft key, or any function key, will eliminate any changes made, retain any original values, and exit the name item function.

3.11.3 Recall

The **RECALL** function changes the current instrument settings to those stored in the selected program storage location. Any settings used by the instrument prior to performing this function are overwritten.

To recall a setting from the instrument, press the memory MEM function key followed by the **PROGRAM SETUP** soft key. Rotate the SmartKnob until the display highlights the desired program number. Once the location has been selected, press the **RECALL** soft key twice to load the program settings into the instrument.

3.11.4 Erase

The **ERASE** function allows the operator to erase the selected program setting. This is normally done before saving a new program.

In order to erase a program setting, press the memory MEM function key followed by the **PROGRAM SETUP** soft key. Rotate the SmartKnob until the program storage location you wish to erase is highlighted. Once it is highlighted, press the **ERASE** soft key twice. Once this is done, a message to verify the erase function appears at the bottom of the instrument screen. When the message **PRESS LOG TO VERIFY?** appears, press the **LOG/ENTER** soft key to erase, or any other soft key or function key to escape.

3.11.5 Print

The program **PRINT** function uses the optional external USB printer to make a hard copy of the currently selected program settings, listing all settings including alarm levels and status.

To use this feature, a USB printer must be properly attached and operating. If a printer is not properly connected, selecting the **PRINT** function will cause the error message *** PRINT ERROR *** to display at the bottom of the instrument screen.

Printing a program setting requires first that the desired program number be selected. Then,

simply pressing the **PRINT** menu soft key will start the printout.

3.12 Data Storage

The Nortec 500 has an extensive selection of data storage capabilities. Data may be stored using one of three different methods, and once stored, the information and instrument setups may be accessed in a variety of ways.

Data may be stored as frozen data, captured data, or waterfall data. Frozen data (**FREEZE**) captures an image as it is displayed on the screen, frozen at that instant of time. Captured data saves data for a period of time ranging from 2.5 seconds to 60 seconds, and can replay this data back to the screen, complete with alarms. Waterfall data is data captured from a waterfall (multiple sweeps) display using a PS-5AL scanner. It is the only data that can be modified after it is captured (see "Waterfall Display Function" on page 56).

The captured data may be recorded using one of three modes:

1. **FREEZE** captures an immediate image as it is displayed on the screen, frozen at that instant of time.
2. Capture once (**CAP ONCE**) starts recording the capture as soon as the operation is selected and will automatically end when the selected time has been reached.
3. Capture continuous (**CAP CONT**) stops recording data when the operation is ended and automatically stores the preceding data for the selected time period. This capture is ended manually by pressing the **LOG/ ENTER** soft key.

When the capture continuous is ended, the information stored is the information that was being recorded at the end of the capture.

Once data has been stored through the frozen (**FREEZE**), capture (**CAP ONCE** or **CAP CONT**) or waterfall methods, the following list provides the various options for the stored data.

- Data may be recalled to the screen for viewing.
- The data may be printed out on an inspection report.
- The instrument settings in effect when the data was stored may be reviewed or restored to the instrument as outlined in "Program Storage" on page 40.
- The data and/or instrument settings may be downloaded to an external computer for further processing.

Up to 200 data storage locations are available. When any of the storage functions are selected, the status line shows both the storage location number and the status of the storage.

The functions available through the data storage are **RECALL**, reference memory (**REF MEM**), **ERASE**, **PRINT**, and **NAME ITEM**.

Recall

To recall stored data, first press the memory MEM function key. Then select the desired storage location using the SmartKnob. Press the **RECALL** menu soft key twice to recall the stored image. Frozen data will be displayed immediately; captured (replay) data will be displayed at the same rate it was recorded. Once the display is finished, press any function key to bring the display back to the listing of stored data.

Erase

The data storage **ERASE** function provides the operator with the means to clear a single storage location. In order to perform the erase data function, press the memory MEM function key, followed by the **DATA SETUP** soft key. Then select the storage location by rotating the SmartKnob until the desired location is selected. Once the location number is selected, press the **ERASE** key a second time. The status line will display **PRESS LOG TO VERIFY?**. Press the **LOG/ENTER** soft key to erase the location, or any other key to abort.

Name Item

The data storage **NAME ITEM** function allows the operator to enter a name of up to 29 characters for data and program file locations. Names may be used to describe the test results that are stored, reference a written test procedure, and so on. Only file locations that have data in them may be named. When naming storage locations, all the capital letters may be used, as well as the digits 0 through 9, several special characters (. / # %), and blanks. When the name function is selected, the text editor screen will appear (see Figure 3-13 on page 45) displaying the list of available characters and a highlighted entry line with an (^) arrow used to point to the currently selected character space.

Rotating the SmartKnob moves the highlight from character to character.

Pressing **LOG/ENTER** soft key selects the character and moves the arrow on the entry line to the right one character.

The **SAVE** soft key will record the changes made to the current stored data number.

The **QUIT** soft key will return the name to its original value prior to selecting this function.

Figure 3-13 Text editor

Print

The data storage **PRINT** function uses an external USB printer (optional) to make a hard copy of the information in the currently selected data storage location. This printout includes the screen data and all instrument settings that were in effect at the time the data was saved. In addition, this information is presented in an inspection report format that can be customized to suit individual needs.

To use this feature, a USB printer must be properly attached and operating. If a printer is not properly connected, selecting the print function will cause the error message **PRINT ERROR** to display on the instrument screen. Printing stored data requires first pressing the memory MEM function key. Then, the desired location number is selected by rotating the SmartKnob. After this is done, simply press the **PRINT** soft key and the printout will begin.

3.13 Setup Menu

The Setup menu allows the user to set and load defaults for the Nortec 500 (see Figure 3-14 on page 46). These include probe drive, frequency mode (dual or single), capture mode and capture time, user preferences for language and soft key orientation, clock settings, and screen color choices. This menu also allows access to the default instrument (**DEFAULT INST.**) function should the need arise to reset the instrument.
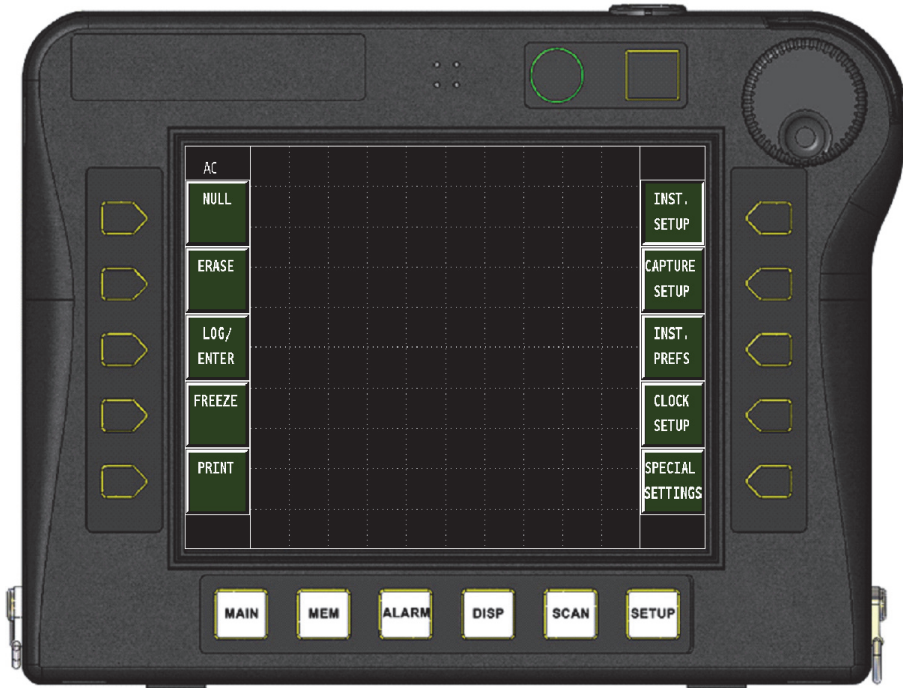
Figure 3-14 Nortec 500 setup screen

3.13.1 Instrument Setup

The **INST. SETUP** (Instrument Setup) Soft Key controls the following:

PROB DRV (Probe Drive)

The Nortec 500 instrument has 3 levels of probe drive, which are operator selectable. These levels are denoted as **LOW**, **MID**, and **HIGH**. The approximate peak-to-peak voltages for each are 2 V, 6 V, and 12 V, respectively.

MID probe drive (default) is normally sufficient for most eddy current testing. However, there are certain instances where high probe drive is desirable:

•   Insufficient gain at lower probe-drive setting
•   Testing lower conductivity materials

- Finding smaller flaws in the test material
- Deeper penetration into test material

To set the probe drive level, press the SETUP function key, followed by the instrument setup (**INST. SETUP**) soft key, followed by the probe drive (**PROB DRV**) soft key. Once the probe drive function is selected, the desired level can be selected by rotating the SmartKnob.

Angle Step

This function is used to change the rotation angle (MAIN menu) steps in increments of 1.0 (coarse), 0.5 (medium) or 0.1 (fine). The default is 1.0 (coarse) but can be decreased to improve the accuracy of the angle function.

To set the angle step (**ANG STEP**) response level, press the SETUP function key, followed by the instrument setup (**INST. SETUP**) soft key, followed by the angle step (**ANG STEP**) soft key. Once the **ANG STEP** function is selected, it may be changed by rotating the SmartKnob until the desired level is selected.

Frequency Mode

(Nortec 500D only)

Frequency mode (**FRQ MODE**) is used to change the Nortec 500 instrument from a single-frequency instrument to a dual-frequency instrument.

To change the frequency mode (**FRQ MODE**):

1. Press the SETUP function key, followed by the instrument setup (**INST. SETUP**) soft key, followed by the frequency mode (**FRQ MODE**) soft key.
2. Once the **FRQ MODE** function is selected, it may be changed by rotating the SmartKnob until the desired frequency mode is selected: **SINGLE** or **DUAL FRQ**.

Horizontal Mix Gain

(Nortec 500D only)

Horizontal mix gain (**HMIX GN**) allows additional gain to be applied to the mixed signal path (F1 + F2 and F1 − F2). This can be adjusted from 0 dB to 12 dB. Modifying **HMIX GN** does not change any of the settings that apply to frequency 1 or frequency 2 individually.

Vertical Mix Gain

(Nortec 500D only)

Vertical mix gain (**VMIX GN**) allows additional gain to be applied to the mixed signal (F1 + F2 and F1 – F2) signal path. This can be adjusted from 0 dB to 12 dB. Modifying **VMIX GN** does not change any of the settings that apply to frequency 1 or frequency 2 individually.

To change the horizontal mix gain (**HMIX GN**) or vertical mix gain (**VMIX GN**), press the SETUP function key, followed by the **HMIX GN** or **VMIX GN** soft key. Once the **HMIX GN** or **VMIX GN** function is selected, it may be changed by rotating the SmartKnob. **HMIX GN** or **VMIX GN** may be set to 0 dB (off), +6 dB, or +12 dB.

Note: Changes to horizontal mix gain (**HMIX GN**) or vertical mix gain (**VMIX GN**) must be applied in the **MAIN DSP** = **F1** window when displaying only frequency 1 on the instrument display or in dual-display mode with the left screen **MAIN DSP** = **F1**.

3.13.2 Capture Setup

The **CAPTURE SETUP** Soft Key controls the following:

Capture Mode

The Nortec 500 has an extensive selection of data storage capabilities. Data may be stored using one of three different methods, and once stored, the information and instrument setups may be accessed in a variety of ways. See "Data Storage" on page 43 for details.

To access capture mode (**CAP MODE**), press the SETUP function key followed by the instrument setup (**INST. SETUP**) soft key and then the **CAPTURE SETUP** soft key. Once capture mode (**CAP MODE**) is selected, the mode of capture may be changed by rotating the SmartKnob.

Capture Time

This function sets the time period for the length of the capture once (**CAP ONCE**) and capture continuous (**CAP CONT**) commands. The available time period is from 2.5 seconds to 60 seconds, in steps of 2.5 seconds. The chosen time period is based on the time required and the speed of the test data being recorded. Shorter periods of time offer higher resolution, and will capture brief movements of the eddy current signal. Longer periods of time record slow-moving data well, but faster data may appear coarse when replayed. Selection of the time period may require some trial-and-error testing for optimum results. See "Data Storage" on page 43 for complete details on this function.

3.13.3 Instrument Preferences

The **INST. PREFS** (Instrument Preferences) Soft Key controls the following:

LOCK

This Soft Key performs the same function as the LOCK button located near the power button and can be set to on or off.

To change LOCK, press the **SETUP** function key, followed by the **INST. PREFS** (Instrument Preferences) soft key followed by the **LOCK** soft key. Once the LOCK function is selected, it may be changed by rotating the SmartKnob until the desired function of **ON** or **OFF** is selected.

> **Note:** The lock functionality described here provides the same functionality of the LOCK button near the power button on the front of the Nortec 500 instrument. It is different however in that it can be a stored program feature and recalled in the "ON" condition along with the other program settings such as gain, frequency, etc.

> **Note:** The LOCK button (located near the power button) and the **LOCK** function located in Instrument Preferences are identical but separate functions. Turning on the LOCK feature via the Instrument Preferences menu cannot be turned off by pressing the LOCK button on the front of the instrument and vice versa.

Language

This function sets the language used for menu text. Selections include English, French, German, Spanish, Italian, Polish, and Chinese.

To change language (**LANG**), press the SETUP function key, followed by the instrument preferences (**INST. PREFS**) soft key, followed by the language (**LANG**) soft key. Once the **LANG** function is selected, it can be changed by rotating the SmartKnob until the desired **LANG** setting is selected. The screen text changes immediately to the chosen language.

Soft Key

This function, in conjunction with left- and right-side interchangeable hand strap, allows the operator to change the soft keys from right-handed to left-handed operation (left- and right-side soft keys, see Figure 3-5 on page 20).

To change soft key (**SOFTKEY**), press the SETUP function key, followed by the instrument preferences (**INST. PREFS**) soft key, followed by the **SOFTKEY** soft key. Once the **SOFTKEY** function is selected, it can be changed by rotating the SmartKnob until the desired **SOFTKEY** setting is selected. The soft keys change immediately (left or right) when the SmartKnob is rotated.

Auto Erase

This function (all models) controls whether the instrument screen is automatically erased after the **NULL** soft key is pressed. The default setting is **ON** (that is, set to automatically erase the screen after the null function is performed).

To change auto erase (**AUTO ERS**), press the SETUP function key, followed by the instrument preferences (**INST. PREFS**) soft key, followed by the **AUTO ERS** soft key. Once the **AUTO ERS** function is selected, it can be changed by rotating the SmartKnob until the desired **AUTO ERS** setting is selected.

Radix Point or decimal separator

Radix point refers to the symbol used in numerical representations to separate the integral part of the number. The radix point can be changed to either a small dot (decimal point) or a comma (,) by rotating the SmartKnob.

To change radix point or decimal separator (**RADIX PT**), press the SETUP function key, followed by the instrument preferences (**INST. PREFS**) soft key, followed by the **RADIX PT** soft key. Once the **RADIX PT** function is selected, it can be changed by rotating the SmartKnob until the desired **RADIX PT** setting is selected. When the SmartKnob is rotated, the **RADIX PT** changes immediately.

3.13.4 Clock Setup

The **CLOCK SETUP** Soft Key controls the following:

Clock

Date and time are stored internally in the Nortec 500 instruments. This information is shown

on program and data printouts, and the date is also shown on the listings of stored programs and eddy current data. Occasionally, it may be necessary to change the date or time, such as, when the instrument is transported across time zones.

To change date and time (clock) settings, press the SETUP function key, followed by the **CLOCK SETUP** soft key, followed by the desired soft key next to **MINUTE**, **HOUR**, **DAY**, **MONTH**, and **YEAR**. Once the desired item is selected, it can be changed by rotating the SmartKnob until the desired setting is correct. Once all the desired changes have been made, pressing the MAIN key will make the changes current and exit the clock menu.

Note: The Nortec 500 uses a 24-hour time convention for its internal clock.

3.13.5 Special Settings

The **SPECIAL SETTINGS** Soft Key controls the following:

Color Palette

This function changes the color scheme on Nortec 500 models. To change color palette (**COLORS**), press SETUP, and then **SPECIAL SETTINGS**.

Colors may be changed when **COLORS** is highlighted. Rotate the SmartKnob to choose from the color palette (see Table 3 on page 52).

Note: Color palette 5 is designed for outdoor use and might not display correctly on some external monitors, including the optional heads-up display (HUD). It is not recommended for this purpose. Colors have been optimized for display on the instrument. There may be color variations when displayed on external monitors.

Table 3 Color palette

LAYER	BACKGROUND	SOFTKEY TEXT	GRATICULE	FREQ. 1	FREQ. 2	ALARMS
0	BLACK	TEXT RED	GRAY	RED	YELLOW	YELLOW
1		TEXT GREEN	GRAY	GREEN	PINK	YELLOW
2		TEXT BLUE	GRAY	BLUE	LIGHT BLUE	WHITE
3		TEXT YELLOW	GRAY	RED	YELLOW	WHITE
4		TEXT GRAY	GRAY	WHITE	LIGHT BLUE	RED
5	WHITE	TEXT WHITE	BLACK			
6	BLACK	TEXT DARK RED	GRAY	DARK RED	RED	RED

Default Instrument

This function restores the instrument to a known state, before changing instrument parameters for a new test, to assure that parameters are a constant value. Default settings follow:

Parameter	Default setting
Display	SWEEP OFF
Graticule	ON
Frequency	100 kHz
Gain	40.0 dB, horizontal and vertical
Angle	0°
Position	50 %, horizontal and vertical (middle of screen)
Filter	Low pass = 100 Hz; High pass = 0 Hz

Probe drive	MID
Alarms	All alarms off
Sweep alarm	Top threshold set to 75 %, Bottom threshold set to 25 %
Box alarm	Top threshold set to 75 %, Bottom threshold set to 25 % Left threshold set to 25 %, Right threshold set to 75 %
Polar alarm	Middle of screen, 25 % radius
Dot type	BOX
Radix point	Decimal
Report header	Instrument Default
LOCK	OFF

The default instrument function will replace any parameter settings currently in the instrument with those listed above. It will not affect stored programs or stored data.

To perform the default instrument function, first press the SETUP function key, followed by the **SPECIAL SETTINGS** soft key, followed by the **DEFAULT INST.** soft key. The instrument displays **PRESS LOG TO VERIFY**.

If you wish to load the default settings, press the **LOG/ ENTER** soft key. Pressing any other key, or rotating the SmartKnob, will abort this function.

Unlock Features

Unlock features allows certain functions of the various Nortec 500 instrument family to be unlocked (upgraded). For example a model Nortec 500 instrument does not have the capability of operating a rotary scanner device such as the MiniMite scanner. For a nominal fee an unlock code can be purchased allowing the Nortec 500 to have additional functionality.

For more information on this feature, contact your local Olympus representative. Contact information for your region can be found by visiting the Olympus web site at http://www.olympus-ims.com/en/contact-us/.

Shorcuts

This feature enables new functionality in the use of the **ANGLE**, **GAIN**, **H GAIN** and **V GAIN** soft keys. By default this feature is disabled (set to **OFF**). Enabling the feature has the following effect on soft key presses using the individual soft keys:

- **ANGLE**: Single key press decreases the angle in increments of 5; pressing and holding the soft key increases the angle increases the angle in increments of 1.
- **GAIN**: Single key press increases the combined gain (**H GAIN** and **V GAIN**) in increments of 5^1; pressing and holding the soft key decreases the combined gain (**H GAIN** and **V GAIN**) in increments of 1.
- **H GAIN** and **V GAIN**: The key presses for these two soft keys is the same as **GAIN** except the functionality is for the respective soft key being pressed. Example: pressing the **H GAIN** soft key continuously decreases the horizontal gain in increments of 1 and vertical gain is not changed.

To enable this feature:

1. Press the **SETUP** function key.
2. Press the **SPECIAL SETTINGS** soft key.
3. Press the **SHORTCUTS** soft key.
4. Rotate the SmartKnob to change the value to **OFF** (feature disabled) or **ON** (feature enabled).

Instrument Version or Revision

This feature displays the instrument configuration information. Occasionally, when required by service technicians or product representatives, this feature will help factory personnel identify your instrument. It is provided for our customers to help meet their current requirements, and also for any future instrument expansion.

To access instrument version or revision (**INST. VERSION**), press the SETUP function key, followed by the **SPECIAL SETTINGS** soft key, followed by the **INST. VERSION** soft key. Once the **INST. VERSION** soft key is selected, the impedance plane display will disappear and be replaced by text similar to that in the following example (see Figure 3-15 on page 55).

1.The first time that the GAIN soft key is depressed, the gain will be changed to a value ending in 5 or 0. Example: 77 dB becomes 80 dB and 61 dB becomes 65 dB, and then subsequent increments will increase the value by 5.

Figure 3-15 Instrument version screen

This information, as well as the instrument serial number, will be the information that factory personnel use to identify your instrument.

3.14 Special Functions

Scanner RPM

The scanner RPM function (Nortec 500S and Nortec 500D only) is used to set the RPM of a rotating scanner (optional) connected to the instrument. The instrument will automatically detect the type of scanner connected via PowerLink, and set the range of RPM accordingly.

The RPM increments are dependent on the type of scanner attached. The Spitfire, MiniMite and RA2000 scanners are controlled in increments of 10 RPM; the PS-5 scanner is adjusted in increments of 1 RPM. The 19/RA scanner is not compatible with the Nortec 500S or Nortec 500D instruments.

To change scanner RPM, select the SCAN function key, then press the **RPM** soft key. Once **RPM** is activated, the value may be changed by rotating the SmartKnob.

Sync Angle

The sync angle function (Nortec 500S and Nortec 500D only) is used to adjust the display synchronization with respect to scanner position. If a flaw is displayed at the edge of the display in the external sync sweep mode, changing the sync angle to 180 degrees will move the flaw to the middle of the display.

To change sync angle (**SYNC ANG**), select the SCAN function key, and then press the **SYNC ANG** soft key. Once **SYNC ANG** is activated, the value may be changed by rotating the SmartKnob.

3.15 Waterfall Display Function

(Nortec 500S and Nortec 500D Only)

The waterfall display function is typically used in conjunction with a PS-5AL scanner. The term *waterfall* is descriptive of the type of screen display that appears when this mode is used. It consists of a consecutive series of sweeps across the screen, each vertically offset slightly below the previous sweep. This display will only work when an optional scanner is connected to the Nortec 500 instrument. An example of a waterfall display with the scanner and eddy current probe rotating in air is shown below in Figure 3-16 on page 56.
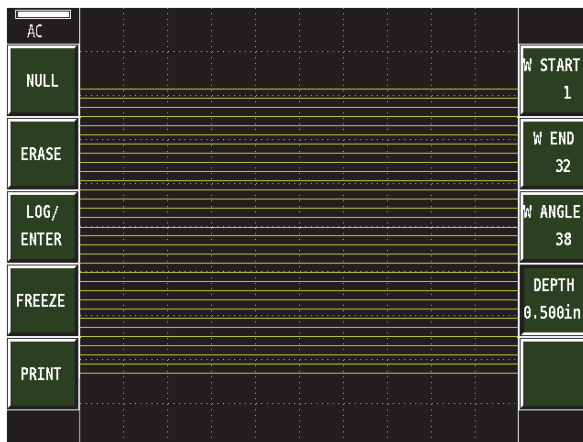

Figure 3-16 Waterfall display from probe in air

Each sweep represents one rotation of the scanner connected to the instrument, provided a sync

pulse is supplied by the scanner in use. The number of sweeps is adjustable from a minimum of 4 to a maximum of 60 using the waterfall display function. The default value is 32 sweeps.

To select the waterfall display function, press the SCAN function key, and then the sweep mode (**SWP MODE**) soft key. Once the **SWP MODE** soft key is selected, rotate the SmartKnob until waterfall (**WATRFALL**) is selected.

To generate a waterfall display, the **ERASE** soft key must be pressed and the scanner must be rotating. Note that the PS-5AL scanner and Nortec 500 instrument both have an erase option. Press the either the ERASE button on the PS-5AL or the **ERASE** key on the Nortec 500 instrument to restart the waterfall display. A typical waterfall display with flaw generated from a reference standard is shown in Figure 3-17 on page 57 below.
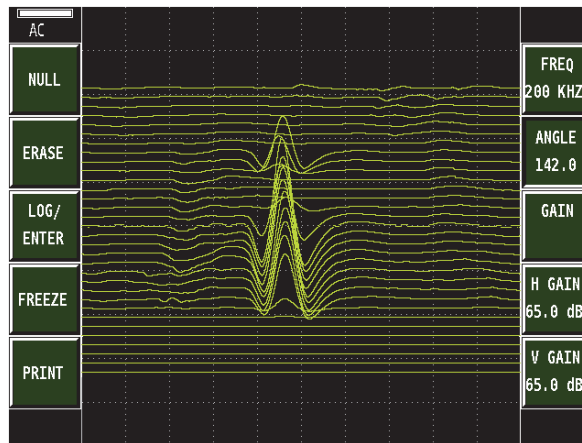
Figure 3-17 Waterfall display from a reference standard

To change the waterfall display, select the waterfall setup (**WATRFALL SETUP**) soft key. Once the **WATRFALL SETUP** soft key is activated, the starting (**W START**) and ending sweeps (**W END**), waterfall angle (**W ANGLE**), and depth (**DEPTH**) can be controlled.

Waterfall Start

The waterfall start function (Nortec 500S and Nortec 500D only) allows adjustment of the first sweep displayed during the waterfall scan.

To change waterfall start (**W START**), select the **W START** soft key. Once **W START** is activated, the value may be changed by rotating the SmartKnob.

Waterfall End

The waterfall end function (Nortec 500S and Nortec 500D only) allows adjustment of the last sweep displayed during the waterfall scan.

To change waterfall end (**W END**), select the **W END** soft key. Once **W END** is activated, the value may be changed by rotating the SmartKnob.

Waterfall Angle

The waterfall angle (Nortec 500S and Nortec 500D only) allows the data captured in a waterfall display to be examined using XY-coordinate display angles. Adjusting this value will redisplay the waterfall display with the selected impedance plane angle.

To change waterfall angle (**W ANGLE**), select the **W ANGLE** soft key. Once **W ANGLE** is activated, the value may be changed by rotating the SmartKnob.

Depth

The depth feature (Nortec 500S and Nortec 500D only) selects which waterfall scan line is highlighted or displayed. For the PS-5AL scanner, each rotation of the probe while indexing (translating) represents 0.025 inches of travel in or out of the hole. So, adjusting the depth control with the Nortec 500C will highlight a selected scan line and list its depth from the starting point of the waterfall scan to the highlighted scan line.

To change **DEPTH**, select the **DEPTH** soft key. Once **DEPTH** is activated, the value may be changed by rotating the SmartKnob.

Note: For data evaluation, the waterfall angle (**W ANGLE**) and **DEPTH** soft keys are used after the waterfall display has been generated (post processing). After highlighting one of these keys, pressing it again will cycle through, displaying the whole waterfall scan, the highlighted scan by itself or displaying the highlighted scan as an impedance plane signal. Examples of this feature are shown in the following examples (see Figure 3-18 on page 59 and Figure 3-19 on page 59) using data generated from Figure 3-17 on page 57.
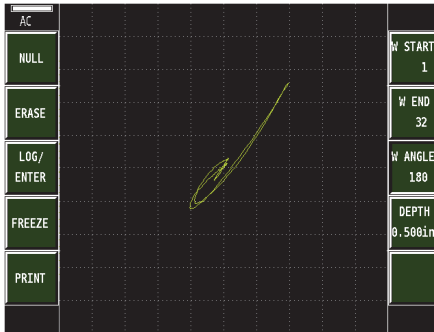
Figure 3-18 Impedance display (left) and external sweep display (right) of flaw at a depth of 0.500 in. in the reference standard
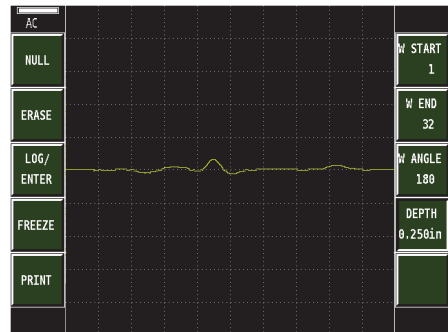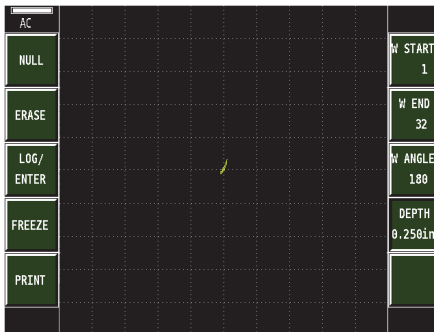

Figure 3-19 Impedance display (left) and external sweep display (right) of flaw at a depth of 0.250 in. in the reference standard

3.16 Conductivity Mode

(Nortec 500C, Nortec 500S, and Nortec 500D Only)

The Nortec 500 instrument is capable of automatically detecting the presence of an Olympus 16-pin LEMO 60 kHz or 480 kHz conductivity probe, and will reconfigure the operating parameters to allow for conductivity measurements. This operating mode will differ from the

normal operating mode in that there is no display of the eddy current signal.

Note: Only Olympus branded conductivity probes enable this functionality.

Upon connection of an Olympus PowerLink conductivity probe, the following screen will be displayed (see Figure 3-20 on page 60). In this instance, the PowerLink program recognition and setup are automatic and there is no need to confirm the PowerLink function.
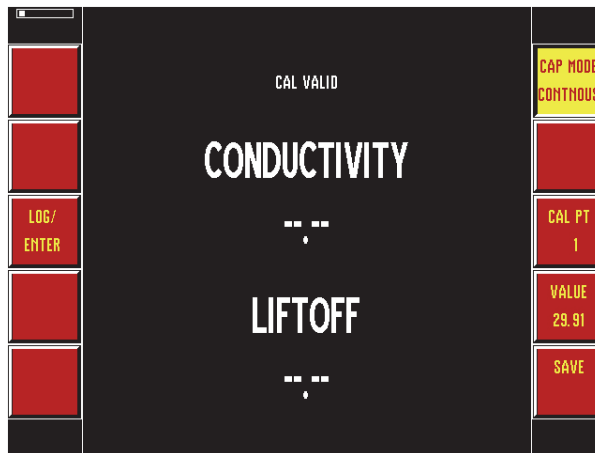

Figure 3-20 Conductivity display

3.16.1 Main Menu

The MAIN key function provides access to the conductivity main menu, which allows the operator to perform a conductivity calibration. In addition, the conductivity main menu allows the operator to set the Nortec 500 instrument for updating conductivity and lift-off data either continuously or when the capture key is pressed. At any time the conductivity readings may be saved by pressing the **LOG/ENTER** soft key.

> **Note:** Reviewing stored conductivity readings is not allowed while the conductivity function is active. The **LOG/ENTER** soft key acts as a data logging function and can be reviewed once the conductivity probe is disconnected from the instrument.

Capture Mode

The capture mode (**CAP MODE**) feature is for selecting the conductivity and lift-off data continuously (**CAP MODE CONTNOUS**) or only when the soft key is pressed (**CAP MODE REPRESS**).

When the soft key is set to **REPRESS** mode, the instrument will hold the reading until the **CAP MODE REPRESS** soft key is pressed again, and another reading taken.

When the soft key is set to **CONTINUOUS** mode, the instrument will update the reading every time the probe is in contact with the material being tested.

To change the capture mode (**CAP MODE**), press the **CAP MODE** soft key. Once **CAP MODE** is highlighted, the value may be changed by rotating the SmartKnob.

Calibration Point

The calibration point (**CAL PT**) soft key is used for initial setup of conductivity calibration points and then displays the calibration point automatically during the calibration steps. If recalibration is desired, this feature should be set to 1, and the calibration procedure repeated.

To change the calibration point (**CAL PT**), press the **CAL PT** soft key. Once **CAL PT** is highlighted, the value may be changed by rotating the SmartKnob.

Calibration Value

The calibration value (**VALUE**) feature allows for adjustment of the instrument in order to match the conductivity of the calibration standard being used. To identify materials by their conductivity, reference standards will be required that have conductivities both above and below the conductivity of interest.

The minimum and maximum values are set to the following range: ±0.5 % IACS (±0.3 MS/m) accuracy from 0.9 % IACS to 62 % IACS (0.5 MS/m to 36 MS/m); and ±1.0 % IACS (±0.6 MS/m) from 62 % IACS to 110 % IACS (36 MS/m to 63.8 MS/m)—lift-off accuracy

from 0 mil to 15 mils ±1 mil. This must be set to the proper value before performing calibration.

The conductivity value shown for **CAL PT1** is the conductivity for the lowest conductivity sample, and the conductivity value shown for **CAL PT2** is the conductivity for the highest conductivity sample.

To change the calibration value (**VALUE**), press the **VALUE** soft key. Once **VALUE** is highlighted, the value may be changed by rotating the SmartKnob.

Save

The **SAVE** soft key (when highlighted and pressed) will store the calibration data for the calibration point shown in the **CAL PT** soft key.

3.16.2 Conductivity Alarm Menu

The Nortec 500 conductivity mode has two alarms setups; the first alarm setup is the conductivity alarm (value) and the second is the lift-off alarm setup (paint thickness or non-conductive coating). These alarms are only adjustable when an Olympus conductivity probe is attached to the Nortec 500.

To access the conductivity alarm menus press the ALARM function key while a conductivity probe is attached to the Nortec 500.

Conductivity Alarm Setup

The **COND ALM SETUP** (Conductivity Alarm Setup) soft key adjusts when the conductivity alarm is triggered and sets the visual and audible alerts.

Upper

The upper conductivity alarm limit is in **%IACS** or MS/m (**MS/M**), which directly compares with the conductivity reading on the display.

To change the upper conductivity alarm, press the ALARM function key, followed by the conductivity alarm setup (**COND ALM SETUP**) soft key, and then the **UPPER** soft key. Once **UPPER** is highlighted, the value may be changed by rotating the SmartKnob.

Lower

The lower conductivity alarm limit is in **%IACS** or MS/m (**MS/M**), which directly compares

with the conductivity reading on the display.

To change the lower conductivity alarm, press the ALARM function key, followed by the conductivity alarm setup (**COND ALM SETUP**) soft key, and then the **LOWER** soft key. Once **LOWER** is highlighted, the value may be changed by rotating the SmartKnob.

OFF–+

The **OFF–+** feature changes the alarm between positive polarity and negative polarity. Positive polarity activates the alarm when the lift-off or conductivity is inside the upper and lower limits set, whereas the negative polarity activates the alarm when the lift-off or conductivity is outside the set alarm threshold. **OFF** disables the alarm.

To change **OFF–+**, select the ALARM function key, and then press the **OFF–+** soft key. Once **OFF–+** is highlighted, the value may be changed by rotating the SmartKnob.

Lift-off Alarm Setup

The **LIFT ALM SETUP** (Lift-off Alarm Setup) soft key adjusts when the lift-off alarm is triggered and sets the visual and audible alerts.

Upper

The upper limit for the lift-off alarm is in mils (0.001 in.) or mm; this directly correlates with the lift-off reading on the display.

To change the upper lift-off alarm, select the ALARM function key, then press the lift-off alarm setup (**LIFT ALM SETUP**) soft key, followed by the **UPPER** soft key. Once **UPPER** is highlighted, the value may be changed by rotating the SmartKnob.

Lower

The lower limit for the lift-off alarm is in mils (0.001 in.) or mm; this directly correlates with the lift-off reading on the display.

To change the lower lift-off alarm, select the ALARM function key, then press the lift-off alarm setup (**LIFT ALM SETUP**) soft key, followed by the **LOWER** soft key. Once **LOWER** is highlighted, the value may be changed by rotating the SmartKnob.

OFF–+

The **OFF–+** feature changes the alarm between positive polarity and negative polarity. Positive polarity activates the alarm when the lift-off or conductivity is inside the upper and lower

limits set, whereas negative polarity activates the alarm when the lift-off or conductivity is outside the set alarm threshold. **OFF** disables the alarm.

To change **OFF–+**, select the ALARM function key, then press the **OFF–+** soft key. Once **OFF–+** is highlighted, the value may be changed by rotating the SmartKnob.

3.16.3 Setup Menu

The SETUP function key provides access to the conductivity setup menu, which allows the operator to choose the conductivity display value (**%IACS** or **MS/M**) and lift-off value (**MIL** or **MM**). Instrument language may also be changed and Radix point can be selected.

UNITS

UNITS configures the conductivity units displayed on the instrument main screen and can be made to display in either **%IACS** or **MS/M**.

To change **UNITS**, press the SETUP function key followed by the **INST. PREFS** (Instrument Preferences) soft key, then followed by the **UNITS** soft key. The default value is **%IACS** but can be changed to **MS/M** by rotating the SmartKnob.

LIFTOFF

LIFTOFF configures the lift-off units displayed on the instrument main screen and can be made to display in either **MIL** (1 mil = 0.001 inch) or **MM** (millimeters).

To change lift-off units, press the SETUP function key followed by the **INST. PREFS** (Instrument Preferences) soft key, then followed by the **LIFTOFF** soft key. The default value is **MIL** but can be changed to **MM** by rotating the SmartKnob.

LANG

LANG configures the instrument user language and the functionality here is the same as previously stated. The default value is **ENGLISH** but can be changed by rotating the SmartKnob.

RADIX PT

RADIX PT configures the symbol used to separate numerical representations to separate integral part of a number. The radix point can be changed between a small dot (decimal point) or a comma (,) by rotating the SmartKnob.

3.16.4 Conductivity Calibration

(Nortec 500C, Nortec 500S and Nortec 500D Only)

To calibrate conductivity:

1. Connect an Olympus conductivity probe to access the conductivity function.

2. Set conductivity value for calibration point 1. Press the **VALUE** soft key and rotate the SmartKnob to change the calibration value (**VALUE**) to match the value of the lowest conductivity standard in the IACS range you are testing.

3. Set conductivity value for calibration point 2. Press the **VALUE** soft key and rotate the SmartKnob to change the calibration value (**VALUE**) to match the value of the highest conductivity standard in the IACS range you are testing.

4. Press the **CAL PT** soft key and rotate the SmartKnob to change the calibration point (**CAL PT**) to **CAL PT 1**.

5. Place the conductivity probe on the reference sample (value of the lowest conductivity standard in the IACS range you are testing) and press the **SAVE** soft key twice. **SAVING** will appear in the display window and the unit will then proceed to calibration point 2.

Note: It is normal for the Nortec 500 instrument to have a 2- to 3-second delay after pressing **SAVE** soft key (twice) in the previous step 5. Do not move the conductivity probe until after the **SAVING** prompt has stopped displaying at the bottom of the instrument.

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6. Place the conductivity probe on the reference sample (value of the highest conductivity standard in the IACS range you are testing) and press the **SAVE** soft key once. **SAVING** will appear in the display window and the unit will then proceed to calibration point 3 (**CAL PT3**).

7. Place a 0.1 mm (4 mils or 0.004 in.) non-conductive shim over the first sample (from **CAL PT1**). Place the probe on top of the shim and press the **SAVE** key once. **SAVING** will appear in the display window and the unit will then proceed to calibration point 4 (**CAL PT4**).

8. Place a 0.1 mm (4 mils or 0.004 in.) non-conductive shim over the second sample (from **CAL PT2**). Place the probe on top of the shim and press the **SAVE** key once. **SAVING** will appear in the display window.

9. **CAL VALID** will appear on the top of the conductivity display (if the calibration was successful). Conductivity readings may now be taken.

> 🖉 **Note:** If **CAL VALID** does not appear, attempt the calibration process again (step 4 above).

10. If the capture mode (**CAP MODE**) is in **REPRESS** mode, the **REPRESS** soft key must be pressed to take a reading. To change to continuous readings, press the **CAP MODE** soft key and rotate the SmartKnob until **CAP MODE CONTNOUS** is displayed.

> 🖉 **Note:** The instrument can be made to display in either %IACS or MS/m. To change this setting, first press the SETUP function key followed by the **INST. PREFS** (Instrument Preferences) soft key, then the **UNITS** soft key. The default value is **%IACS** but can be changed to **MS/M** by rotating the SmartKnob.

3.17 Preamplifier

The preamplifier (**PREAMP**) function provides an additional 5X gain (14 dB) to the eddy current probe signal when activated. It is not recommended that this feature be used with **HIGH** probe drive (**PROB DRV**).

To activate the preamplifier (**PREAMP**), press the MAIN function key, followed by the **FILTER** setup soft key, and then the **PREAMP** soft key. Rotating the SmartKnob turns the preamplifier on or off.

4. Applications

This chapter includes the following topics:

- Impedance Plane Display—Conductivity Curve
- Surface Flaw Detection
- Second Layer Crack Detection
- Thickness Measurement
- Conductivity—Sorting
- Conductivity—Lift-off Measurement
- Scanner Operation
- Waterfall Display Functions
- Corrosion Detection with Dual Frequency

The following probes and accessories are used in this section of the manual:

- Nortec SL/1 kHz to 50 kHz/.31 PowerLink Surface Probe—P/N 9222161
- Nortec PL/500 kHz to 1 MHz/A PowerLink Surface Probe—P/N 9222162
- Nortec SPO-3806L Sliding/Reflection Probe—P/N 9222242
- Nortec SL/1 kHz to 20 kHz/.62 Surface Probe—P/N 9222161
- Nortec Eddy Slide Rule—P/N 3306888
- Nortec Conductivity Samples (set of six)—P/N 1902474
- Nortec TB-S1 Crack Standard (.04 in., .02 in., and .008 in. deep notches)—P/N 1902510
- Nortec SPO-3932 Second Layer Crack Sample (1/16 in. Al on 1/16 in. Al)—P/N 1916915
- Nortec SPO-4304 Tapered Aluminum Standard—P/N 1916914
- CL/SC/6 Cable—P/N 9122083

4.1 Impedance Plane Display—Conductivity Curve

The following procedure is for the impedance plane display—conductivity curve.

Equipment required:

- Nortec SL/1 kHz to 50 kHz/.31 PowerLink Surface Probe
- Nortec Conductivity Samples (set of six)
- CL/SC/6 Cable

Follow these steps for impedance plane display—conductivity curve:

1. Connect the probe. The PowerLink screen will appear. Press the **LOG/ ENTER** soft key to confirm. The screen will display information about the probe. Press the MAIN function key to proceed with the test setup.
2. Adjust the frequency to 25 kHz if necessary. Press the **FREQ1 SETUP** soft key, and then the **FREQ** soft key. Rotate the SmartKnob until 25 kHz appears in the **FREQ** box.
3. Adjust the phase angle to approximately 73°. Press the **ANGLE** soft key. Rotate the SmartKnob until **73°** appears in the **ANGLE** box.
4. Adjust the gain to approximately 45.0 dB. Press the **GAIN** soft key. Rotate the SmartKnob until **45.0 dB** appears in the **H-GAIN** and **V-GAIN** boxes.
5. Hold the probe in air, away from the conductivity sample, and press the **NULL** soft key.
6. Touch the probe to the middle of each of the six conductivity samples. The display should look like Figure 4-1 on page 69. Some fine tuning may be necessary. This is accomplished by using the **GAIN** and **ANGLE** buttons, and then the SmartKnob.
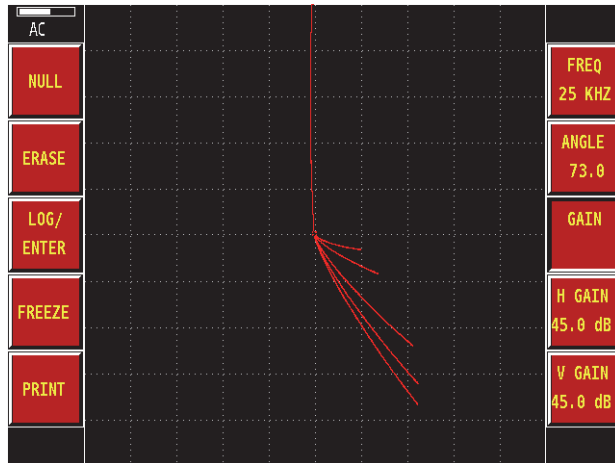
Figure 4-1 Conductivity curve

4.2   Surface Flaw Detection

The following procedure is for detection of surface flaws.

Equipment required:

- Nortec PL/100 kHz to 500 kHz/A PowerLink Surface Probe
- Nortec TB-S1 EDM Standard, with .040 in., .020 in., and .008 in. deep notches
- CL/SC/6 Cable

Follow these steps for surface flaw detection:

1. Connect the probe. The PowerLink screen will appear. Press the **LOG/ENTER** soft key to confirm. The screen will display information about the probe. Press the MAIN function key to proceed with the test setup.

2. Adjust the frequency to 200 kHz if necessary. Press the **FREQ1 SETUP** soft key, and then the **FREQ** soft key. Rotate the SmartKnob until **200 kHz** appears in the **FREQ** box.

3. Adjust the phase angle to approximately 78°. Press the **ANGLE** soft key. Rotate the SmartKnob until **78°** appears in the **ANGLE** box.

4. Adjust the horizontal gain to 65.0 dB and the vertical gain to 72.0 dB. Press the **H-GAIN** menu soft key. Rotate the SmartKnob until **65.0 dB** appears in the **H-GAIN** box. Now,

press the **V-GAIN** menu soft key. Rotate the SmartKnob until **72.0 dB** appears in the **V-GAIN** box.

5. Adjust the horizontal position to 80 % and the vertical position to 40 %. Press the DISP function key, followed by the **SCREEN SETUP** soft key. Press the **H POS** soft key. Rotate the SmartKnob arrow keys until **80 %** appears in the **H POS** box. Now, press the **V POS** soft key. Rotate the SmartKnob until **40 %** appears in the **V POS** box.

6. Place the probe on the TB-S1 crack standard, away from the cracks and engraving. Press the **NULL** soft key.

7. Slide the probe smoothly over the three EDM notches. The response should look similar to those in Figure 4-2 on page 70. These settings are only guidelines. Some fine tuning may be necessary. This is accomplished by using the **GAIN** and **ANGLE** buttons, and then the SmartKnob.
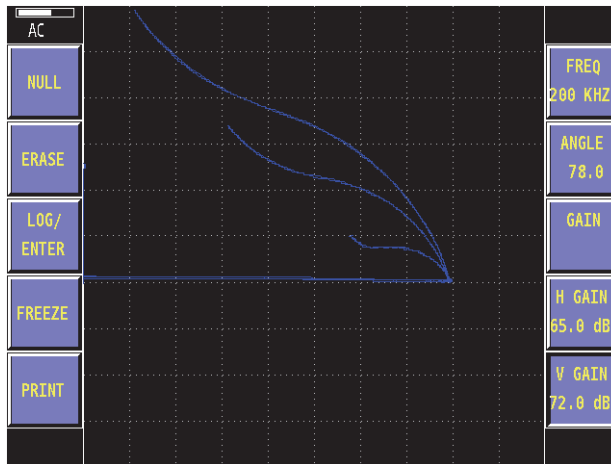
Figure 4-2 Surface flaw detection

4.3   Second Layer Crack Detection

Second layer crack detection is an eddy current inspection method used mainly by the aerospace industry. Ultrasonic inspections of any but the top layer are usually impossible because the interface between layers reflects ultrasonic energy, preventing any usable penetration. However, these interfaces are practically invisible to eddy current devices applied normally to the surface of the layers. Therefore, when using eddy current, the number of layers is insignificant, and the total depth of material is the only limiting factor.

Equipment required:

- Nortec SPO-3806L Sliding/Reflection Probe
- Nortec SPO-3932 Second Layer Crack Sample (1/16 in. Aluminum over 1/16 in. Aluminum)
- Detachable Cable-CL/SC/6

Follow these steps for second layer crack detection:

1. Connect the probe. The PowerLink screen will appear. Press the **LOG/ENTER** soft key to confirm. The screen will display information about the probe. Press the MAIN function key to proceed with the test setup.
2. Adjust the frequency to 2.5 kHz if necessary. Press the **FREQ1 SETUP** soft key, and then the **FREQ** soft key. Rotate the SmartKnob until **2.5 kHz** appears in the **FREQ** box.
3. Adjust the phase angle to 260°. Press the **ANGLE** soft key. Rotate the SmartKnob until **260°** appears in the **ANGLE** box.
4. Adjust the horizontal gain to 60 dB and the vertical gain to 65 dB. Press the **H-GAIN** soft key. Rotate the SmartKnob until **60 dB** appears in the **H-GAIN** box. Now, press the **V-GAIN** soft key. Rotate the SmartKnob until **65 dB** appears in the **V-GAIN** box.
5. Adjust the horizontal position to 75 % and the vertical position to 15 %. Press the DISP function key followed by the **SCREEN SETUP** soft key. Press the **H POS** soft key. Rotate the SmartKnob until **75.0 %** appears in the **H POS** box. Press the **V POS** soft key. Rotate the SmartKnob until **15 %** appears in the **V POS** box.
6. Turn off the screen graticule. Press the DISP function key, followed by the **D ERASE SETUP** soft key, and then the graticule (**GRATICUL**) soft key. Rotate the SmartKnob until **OFF** appears in the **GRATICUL** box. The display should look similar to Figure 4-3 on page 72. These settings are only guidelines. Some fine tuning may be necessary. This can be accomplished using the **GAIN**, **ANGLE**, and SmartKnob.
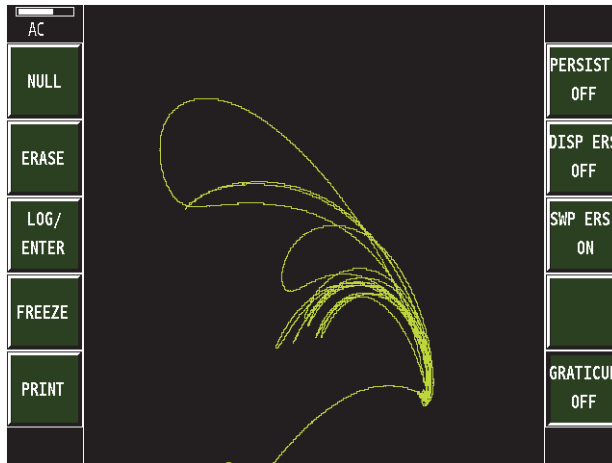
Figure 4-3 Second layer crack detection

4.4   Thickness Measurement

Thickness measurements of nonferrous metals can be accomplished using eddy currents. It is important that a low-enough frequency is selected to allow the eddy currents to penetrate the complete thickness being measured. The critical thickness for a given material and frequency is known as "one standard depth of penetration."

This type of testing is most useful when trying to determine the remaining wall thickness as a result of internal corrosion.

Equipment required:

- Nortec SL/100 Hz to 20 kHz/.62 Surface Probe
- Nortec SPO-4304 Tapered Aluminum Standard
- CL/SC/6 Cable
- Nortec Eddy Current Slide Rule

Follow these steps for thickness measurements:

1. Connect the probe. The PowerLink screen will appear. Press the **LOG/ENTER** soft key to confirm. The screen will display information about the probe. Press the MAIN function key to proceed with the test setup.

2. Adjust the frequency to 1 kHz. Press the **FREQ1 SETUP** soft key, and then the **FREQ** soft key. Rotate the SmartKnob until **1 kHz** appears in the **FREQ** box.

3. Adjust the phase angle to 41°. Press the **ANGLE** soft key. Rotate the SmartKnob until **41°** appears in the **ANGLE** box.

4. Adjust the gain to approximately 58 dB. Press the **GAIN** soft key. Rotate the SmartKnob until **58 dB** appears in the **H-GAIN** and **V-GAIN** boxes.

5. Adjust the horizontal position to 78.5 % and the vertical position to 60 %. Press the DISP function key, followed by the **SCREEN SETUP** soft key. Press the **H POS** soft key. Rotate the SmartKnob until **78.5 %** appears in the **H POS** box. Press the **V POS** soft key. Rotate the SmartKnob until **60 %** appears in the **V POS** box.

6. Place the probe approximately 1.5 in. from the thin end of the sample. Press the **NULL** soft key.

7. Place the probe at various locations representing different thicknesses. The display should look similar to Figure 4-4 on page 73.

8. Carefully slide the probe down the entire length of the taper (this will produce the curve). The display should look similar to Figure 4-5 on page 74.
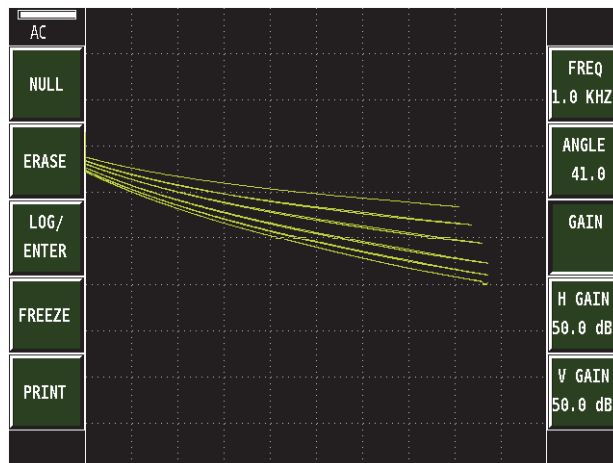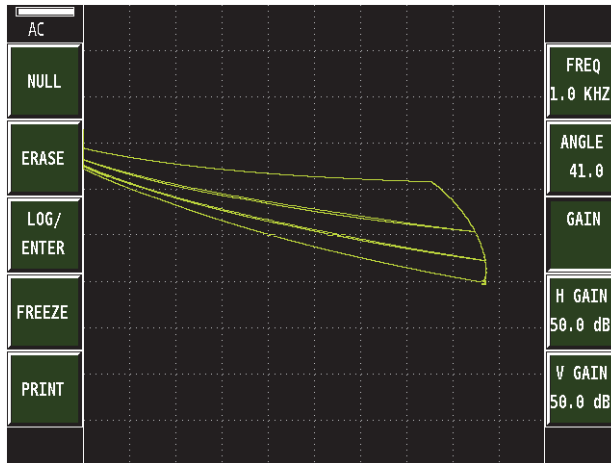

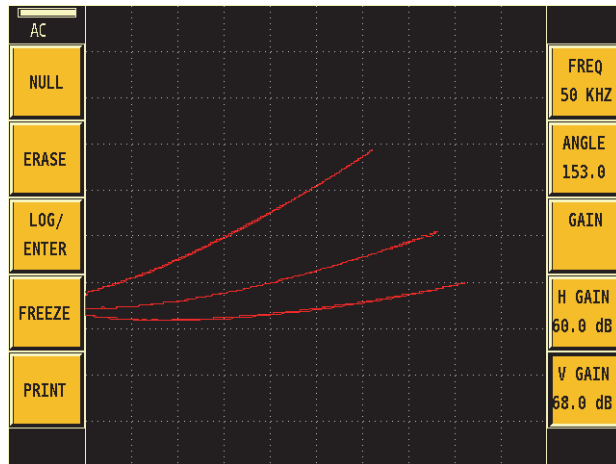**Figure 4-4 Thickness measurement**

Figure 4-5 Thickness measurement with curve

9. These settings are only guidelines. Some fine tuning might be necessary. This can be accomplished using the **GAIN**, **ANGLE**, and SmartKnob.

4.5   Conductivity—Sorting

Equipment required:

- Nortec SL/1k Hz to 50 kHz/.31 PowerLink Surface Probe
- Nortec Conductivity Standards—set of six
- CL/SC/6 Cable

Follow these steps for conductivity—sorting:

1. Connect the probe. The PowerLink screen will appear. Press the **LOG/ENTER** soft key to confirm. The screen will display information about the probe. Press the MAIN function key to proceed with the test setup.

2. Adjust the frequency to 50 kHz. Press the **FREQ1 SETUP** soft key, and then the **FREQ** soft key. Rotate the SmartKnob until **50 kHz** appears in the **FREQ** box.

3. Adjust the phase angle to 153.0°. Press the **ANGLE** soft key. Rotate the SmartKnob until **153.0°** appears in the **ANGLE** box.

4. Adjust the horizontal gain to 60 dB and the vertical gain to 68 dB. Press the **H-GAIN** soft key. Rotate the SmartKnob until **60 dB** appears in the **H-GAIN** box. Now, press the **V-GAIN** soft key. Rotate the SmartKnob until **68 dB** appears in the **V-GAIN** box.

5. Adjust the horizontal position to 75.0 %. Press the DISP function key followed by the **SCREEN SETUP** soft key. Press the **H POS** soft key. Rotate the SmartKnob until **75.0 %** appears in the **H POS** box.

6. Place the probe on the 7075-T6 sample and press the **NULL** soft key.

7. Place the probe on the MAG, and 7075-0 samples. The display should look similar to Figure 4-6 on page 75.

Figure 4-6 Conductivity curve

These settings are only guidelines. Some fine tuning may be necessary. This can be accomplished using the **GAIN**, **ANGLE**, and SmartKnob.

4.6   Conductivity—Lift-off Measurement

(Paint Layer Thickness Measurement, Nortec 500S and Nortec 500D Only)

The conductivity/nonconductivity lift-off feature of the Nortec 500 can only be accessed by connecting a Nortec conductivity probe.

Equipment required:

- Nortec 60 kHz Conductivity probe with cable
- Nortec Conductivity Standards (certified % IACS)

> **Note:**
> Recommended operating ranges:
>
> - Best performance can be obtained by using the probes in the following ranges: 0.9 % IACS to 20 % IACS using a 480 kHz probe 9 % IACS to 110 % IACS using a 60 kHz probe.
> - For best accuracy, the material to be measured should be at least one standard depth of penetration thick at the frequency of the probe used.

Follow these steps for conductivity—lift-off measurement:

1. The Nortec 500 should be calibrated before performing the lift-off measurement.
2. Connect a Nortec conductivity probe to access the conductivity function.
3. Set conductivity value for calibration point 1 (**CAL PT1**). Press the **VALUE** soft key and rotate the SmartKnob to change the calibration value (**VALUE**) to match the value of the lowest conductivity standard in the IACS range you are testing.
4. Set conductivity value for calibration point 2 (**CAL PT2**). Press the **VALUE** soft key and rotate the SmartKnob to change the calibration value (**VALUE**) to match the value of the highest conductivity standard in the IACS range you are testing.
5. Press the calibration point (**CAL PT**) soft key and rotate the SmartKnob to change the calibration point to **CAL PT1**.
6. Place the conductivity probe on the reference sample (value of the lowest conductivity standard in the IACS range you are testing) and press the **SAVE** soft key twice. **SAVING** will appear in the display window and the unit will then proceed to **CAL PT2**.

> **Note:** Do not move the conductivity probe from the reference sample until the message **SAVING** is no longer displayed on the instrument.

7. Place the conductivity probe on the reference sample (value of the highest conductivity standard in the IACS range you are testing) and press the **SAVE** soft key once. **SAVING** will appear in the display window and the unit will then proceed to **CAL PT3**.

8. Place a 0.1 mm (4 mils or 0.004 in.) nonconductive shim over the first sample (from **CAL PT1**). Place the probe on top of the shim and press the **SAVE** key. **SAVING** will appear in the display window and the unit will then proceed to **CAL PT4**.

9. Place a 0.1 mm (4 mils or 0.004 in.) nonconductive shim over the second sample (from **CAL PT2**). Place the probe on top of the shim and press the **SAVE** key. **SAVING** will appear in the display window. **CAL VALID** will appear on the top of the conductivity display window. The Nortec 500 instrument and the probe can now be used to measure the conductivity of the test material as well as the thickness of the nonconductive paint layer on the test material. (See "Conductivity Mode" on page 59 for complete operating instructions.)

10. If the capture mode (**CAP MODE**) is in repress mode, the **CAP MODE REPRESS** key must be pressed to take a reading. To change to continuous readings, rotate the SmartKnob until capture mode continuous (**CAP MODE CONTNOUS**) is displayed.

4.7   Scanner Operation

(Nortec 500S and Nortec 500D Only)

The Nortec 500 will operate any of the following optional scanners: RA 2000, Spitfire 2000, PS-5AL and MiniMite. The 19/RA is not supported. Simply connect the scanner to the Nortec 500, and the PowerLink feature will recognize the existence of the scanner. Press the **LOG/ENTER** soft key to confirm the default parameters associated with the scanner and then press the MAIN function key. The scanner will be in impedance mode. After preliminary adjustments are made to the flaw display signal, external sweep must be turned on. Press the SCAN function key, and then press the **SWP MODE** soft key three times to activate the external sweep.

The MiniMite scanner is variable speed, rotating at 600 RPM to 3000 RPM, the Spitfire 2000 rotation speed is adjustable from 600 RPM to 3000 RPM, the PS-5AL rotation speed is adjustable from 40 RPM to 240 RPM, and the RA 2000 scanner rotation speed is adjustable from 600 RPM to 2400 RPM. These four scanners are typically used for inspection of fastener holes.

The presentation of the scanner on the screen is a horizontal line. The line will be nearly flat when no flaws are detected. When a flaw is detected, the line shows a vertical displacement. The horizontal position of this indication shows the angular position of the flaw. The left side of the screen (zero degrees) corresponds to the top of the scanner (opposite from the cable exit or handle) while the middle of the screen (180 degrees) is toward the cable exit or handle.

When using the sweep display, only the vertical amplitude is displayed. Thus, the instrument rotation should normally be set for maximum displacement of the flaw in the vertical direction

in the impedance plane before proceeding to the sweep setting. However, it might also be a good idea to eliminate the noise in the vertical displacement display by changing the angle until the noise signal on the impedance plane becomes horizontal.

Split screen (external sweep and impedance mode) display can be used for setup. To do this, attach the scanner and confirm PowerLink setup. Press the SCAN function key, and then the **SWP MODE** soft key until external/impedance (**EXT/IMP**) is displayed (the SmartKnob can also be used for this function). The split screen will then appear. On the left side of the display is external sweep, on the right of the display is impedance plane. Any adjustment of angle on the impedance plane display is linked to the external sweep display. To go back to full screen external sweep mode, press the **SWP MODE** soft key until **SWP MODE EXTERN** is displayed, or rotate the SmartKnob until **SWP MODE EXTERN** is displayed.

> **Note:** When using **SWP MODE EXT/IMP**, the impedance display (right screen) signal will not erase until (a) the **ERASE** soft key is pressed or (b) the display erase (**DISP ERS**) function is activated (see "Display Erase" on page 32 for more information on the display erase function).

4.8   Waterfall Display Functions

(Nortec 500S and Nortec 500D Only)

The waterfall mode of operation is typically used in conjunction with the optional PS-5AL scanner. The PS-5AL scanner not only rotates the sensor head but also gradually moves the sensor head in an axial direction. When the PS-5AL scanner is used in a fastener hole, the rotation provides a sweep of the hole at a certain depth and the vertical movement of the sensor head provides consecutive sweeps at different depths. These two movements combined provide 3-dimensional information on the flaws in the hole.

The term *waterfall* is descriptive of the type of screen display that appears when this mode is used. This display consists of a consecutive series of sweeps across the screen, each vertically offset slightly below the previous sweep. Each sweep represents one rotation of the scanner connected to the instrument, initiated by a sync pulse supplied by the scanner in use. The number of sweeps is adjustable from a minimum of 4 to a maximum of 60 using the waterfall display function. The default value is 32 sweeps.

When a scanner with a fixed pitch is used, each sweep represents the forward movement of the

probe into the test hole as determined by the pitch of the scanner. When a hand-held scanner is used, the sweep lines only represent the relative forward movement of the probe through a hole.

To start the waterfall display, press the **ERASE** button. The waterfall screen is then started and the instrument captures a new waterfall. The PS-5AL scanner has two buttons to remotely erase or null the display screen on the Nortec 500. Any waterfall display can also be stored in the instrument memory for future use. Once stored, each display can be recalled and analyzed in either the waterfall mode, the impedance plane mode, or one line at a time in the sweep mode. A sidebar adjacent to the screen display shows the parameters of the stored display including rotation angles, the maximum and minimum depth of the displayed lines, and the depth of the selected line. "Scanner Operation" on page 77 should be read before using the waterfall mode.

The following steps should be taken to set up the Nortec 500 instrument for operation in the waterfall mode:

1. Insert a probe into the PS-5AL scanner; check for correct switch settings (see Table 4 on page 79).

Table 4 Switch positions

Probe	Reference coil switch	Probe type switch
Reflection Absolute	External	Reflection
Differential	External	Bridge
Reflection Differential	External	Reflection
3-Pin Absolute	External	Bridge
Absolute	Internal 1 or 2	Bridge
2-Pin Gulton	Internal 1 or 2	Bridge

2. With the instrument turned on, connect the scanner cable to the scanner, and then connect the scanner cable to the probe (16-pin LEMO) connector on the Nortec 500 instrument.

3. The PowerLink function will automatically recognize the existence of the scanner and set up the parameters associated with the scanner. The settings are **LPF 40**, **HPF 8**, and **RPM 240**. Press the **LOG/ENTER** soft key to confirm the PowerLink function. Press the MAIN function key to display the impedance plane display.

4. Setting the operating frequency. Press the **FREQ** soft key and rotate the SmartKnob to the correct value. Set the scanner to rotate mode ON (see PS-5 Scanner operations manual). Turn on the power switch on the PS-5AL scanner.

5. Place the scanner on a reference standard with the coil rotating over an EDM notch. A signal will appear on the display.

6. Press the **ANGLE** soft key and rotate the SmartKnob until the signal is vertical. To increase gain for maximum signal, press the **GAIN** soft key and rotate the SmartKnob until the maximum signal is achieved.

7. Turn on the sweep. Press the SCAN function key followed by the **SWP MODE** soft key. Press the **SWP MODE** soft key five times, or rotate the SmartKnob, until the display reads **SWP MODE WATRFALL** to activate waterfall mode.

8. Press the waterfall (**WATRFALL**) soft key to access the waterfall menu. This menu allows the user to adjust the PS-5AL scanner waterfall display. With the waterfall display now active, the hole may now be scanned (for additional information see "Waterfall Display Functions" on page 78). Place the probe tip at the entrance to a hole. With the scanner running, pressing either the **ERASE** key on the instrument or the ERASE button on the scanner will start the waterfall display, set the scanner to translate mode ON (see PS-5 Scanner operations manual) and the scanner will not only rotate but also translate and inspect the hole.
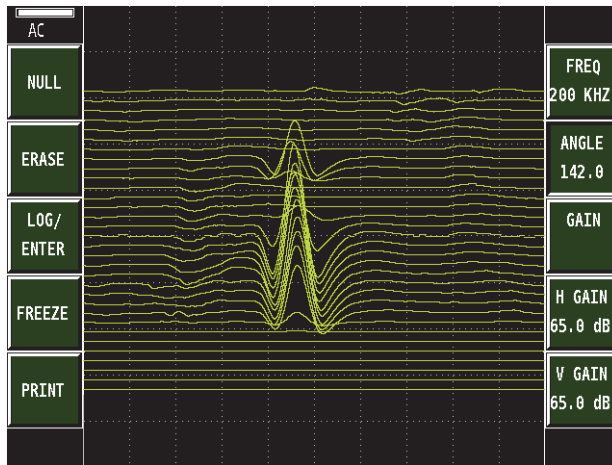

Figure 4-7 Sample defect in a hole standard

> **Note:** Care should be taken when operating a hand-held scanner in order to keep it from binding while being maneuvered in and out of the test hole. This will help prolong the life of the scanner and provide the most accurate waterfall sweeps.

4.9 Corrosion Detection with Dual Frequency

(Nortec 500D Only)

The following procedure is for corrosion detection using dual frequency.

Equipment required:

- CL/SC/6 Cable
- SPO-5327L
- 127-.063 Corrosion Standard

Follow these steps for corrosion detection with dual frequency:

1. With the Nortec 500 instrument turned on and probe connected, press the SETUP function key, followed by the Instrument Setup (**INST. SETUP**) soft key, and then the **FRQ MODE** soft key. Rotate the SmartKnob until the display reads **FRQ MODE DUAL FRQ**.
2. Press the **PRB DRV** soft key and rotate the SmartKnob until it reads **PROB DRV HIGH**.
3. Press the MAIN function key, followed by the **FREQ** soft key, and rotate the SmartKnob until **FREQ** reads **3.0 kHz**. Press the **GAIN** soft key and rotate the SmartKnob until the gain for both **H-GAIN** and **V-GAIN** is 65.0 dB.
4. Press the MAIN function key, followed by the **FREQ2** soft key. Press **FREQ2** soft key, and rotate the SmartKnob until **FREQ2** = **1.5 kHz**. Press the **GAIN2** soft key and rotate the SmartKnob until the gain for both **H-GAIN** and **V-GAIN** is 65.0 dB.
5. Press the MAIN function key, followed by the **FILTER** soft key. Set the low pass filter to 30 by pressing the **LOWPASS** soft key and rotating the SmartKnob until **LOWPASS** reads **30**.
6. Press the DISP function key, followed by the **2ND DISP** soft key. Rotate the SmartKnob until **2ND DISP F2** is displayed. The display will change to the "split screen" mode with frequency 1 displayed on the left screen and frequency 2 on the right screen.

7. Press the **SCREEN SETUP** soft key followed by the **V POS** soft key and rotate the SmartKnob until the **V POS** is 80.0 %. Press the **H POS** soft key and rotate the SmartKnob until the **H POS** is 20.0 %.

8. Place probe on the corrosion standard at position 1 and press the **NULL** soft key (see Figure 4-8 on page 82).
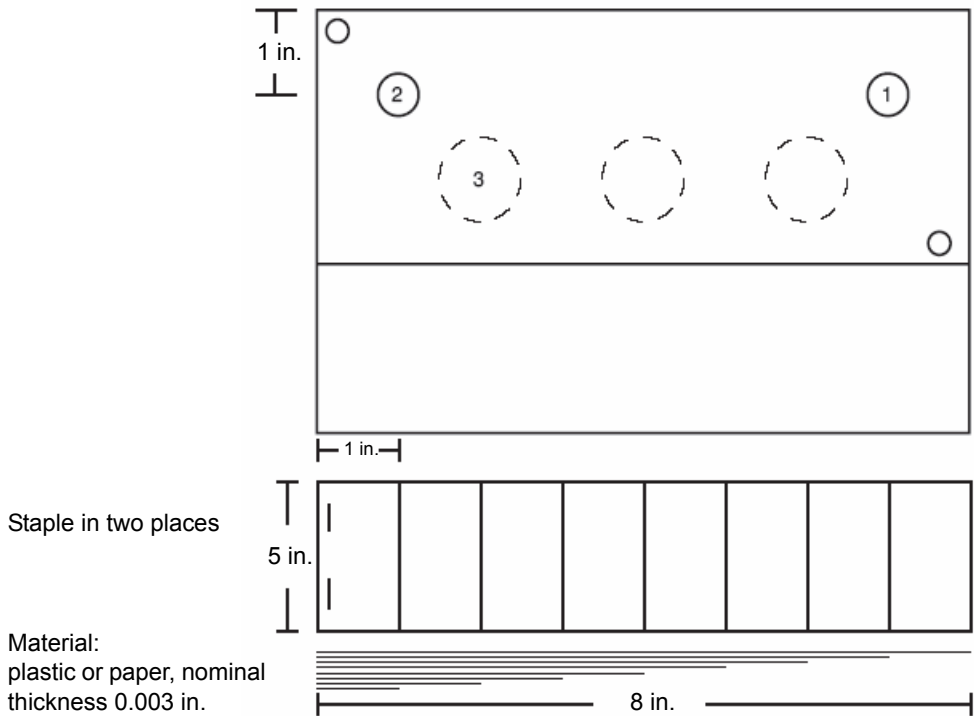
Olympus 127-.063 corrosion standard

Figure 4-8 Olympus 127-.063 corrosion standard

9. Slowly, lift probe off the standard and observe the signal. The lift-off signal must be rotated to move from left to right.

10. Press MAIN function key followed by the **FREQ1 SETUP** soft key. Press the **ANGLE** soft key and rotate the SmartKnob until the lift-off signal moves from left to right in a horizontal direction. Press **ERASE** to clear the screen, if necessary.

11. Place probe on the standard at position 2 and increase the gain until the signal moves down (vertically) 6 divisions.

12. Place probe on position 1 and press the **NULL** key.

13. Place probe back on position 2 and adjust **GAIN** so that the signal moves down (vertically) 6 divisions. If necessary, readjust the angle so that the lift-off line is horizontal.

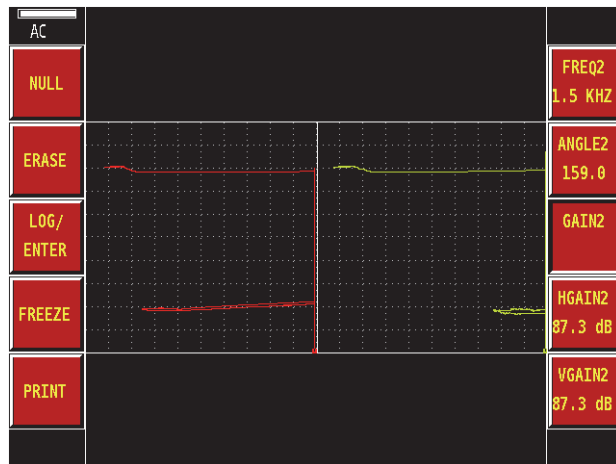14. Repeat this process for frequency 2 until the screen is similar to Figure 4-9 on page 83.

Figure 4-9

15. Once both frequencies have been set-up for positions 1 and 2, it is a good idea to save the setup before you proceed to the mix. To save the setup to this point, press the **LOG/ENTER** soft key. You may also wish to give this program a name for easy recall at a later time. To name the stored program, press the **NAME ITEM** soft key. Using the text editor, name the program and press the **SAVE** soft key twice.

16. Press the DISP function key, followed by the **2ND DISP** soft key. Rotate the SmartKnob until **OFF** appears in the soft key window. The instrument will then return to the standard impedance display.

17. Press the **MAIN DSP** soft key and rotate the SmartKnob until **F1-F2** appears in the soft key window.

18. Press the **SCREEN SETUP** soft key, followed by the **H POS** soft key, and rotate the SmartKnob until the **H POS** reads **80.0 %**. Press the **V POS** soft key and rotate the SmartKnob until the **V POS** reads **20.0 %**. Press the MAIN function key followed by the **FREQ** soft key.

19. Place probe on position 1 and press **NULL** soft key. Lift probe off the standard.
20. If signal moves to the right, decrease the frequency 1 horizontal gain until the signal moves to the left and is almost horizontal (see Figure 4-10 on page 84).
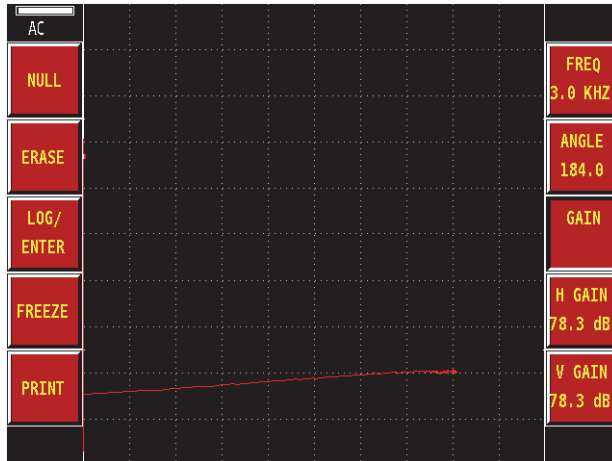

Figure 4-10

21. Place probe on position 1 and null the probe, and then place the probe on position 2 (see Figure 4-11 on page 85).
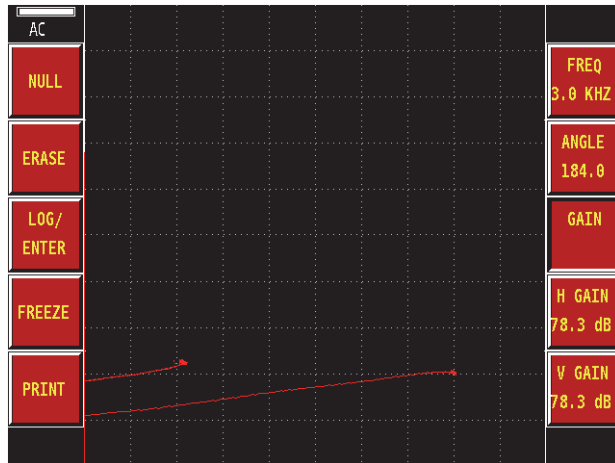
Figure 4-11

22. If the two null points are more than 3 divisions away horizontally, decrease the horizontal gain for frequency 2 until it is 3 divisions from null point 1.

23. Place probe on position 1 and press **NULL** key. Tilt probe and observe lift-off line. If the signal moves from left to right, decrease the **H-GAIN** for frequency 1 until the signal is almost horizontal from right to left. Slide probe to position 2. This is the gap signal.

24. If the gap signal is below the lift-off line, increase the vertical gain on frequency 2.

25. If the gap signal is above the lift-off line, decrease the vertical gain on frequency 2.

26. Place the probe on position 1 and press **NULL** key.

27. Slide the probe down the center of the standard over the simulated corrosion and observe the signals (see Figure 4-12 on page 86 to Figure 4-17 on page 88).
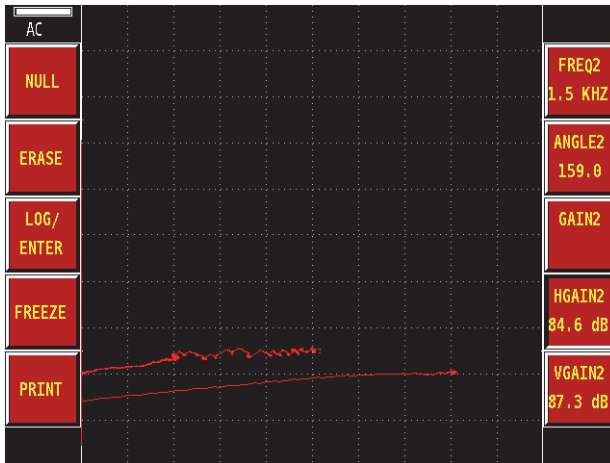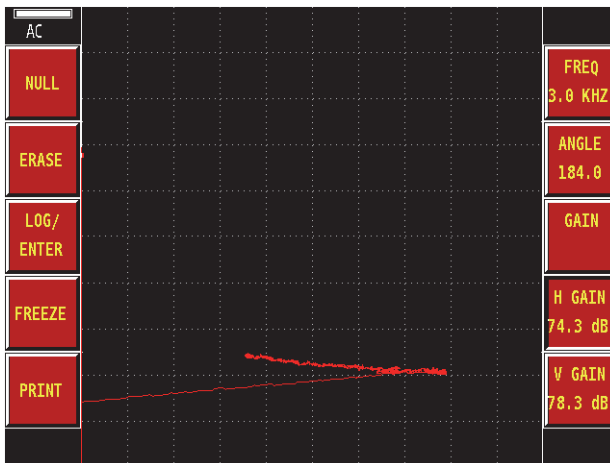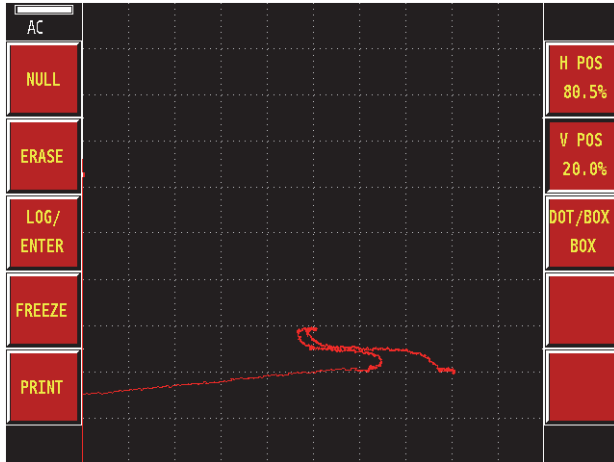
Figure 4-12

Figure 4-13
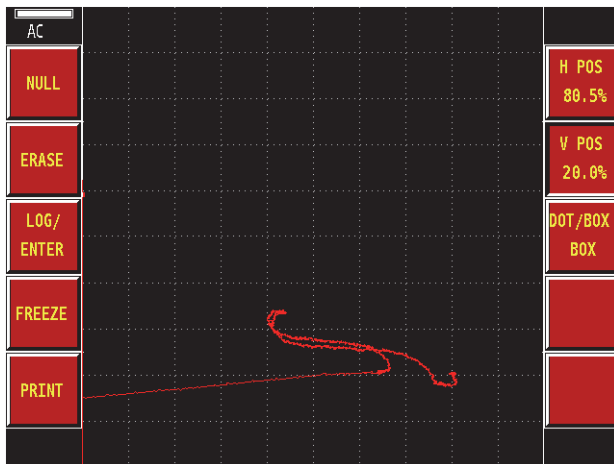
Figure 4-14 Simulated 10 % corrosion signal

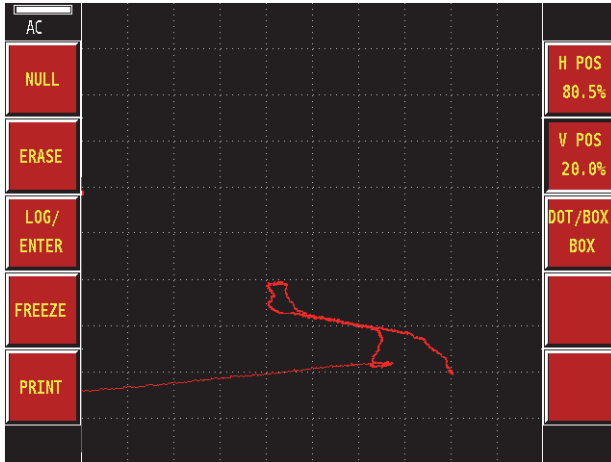
Figure 4-15 Simulated 20 % corrosion signal

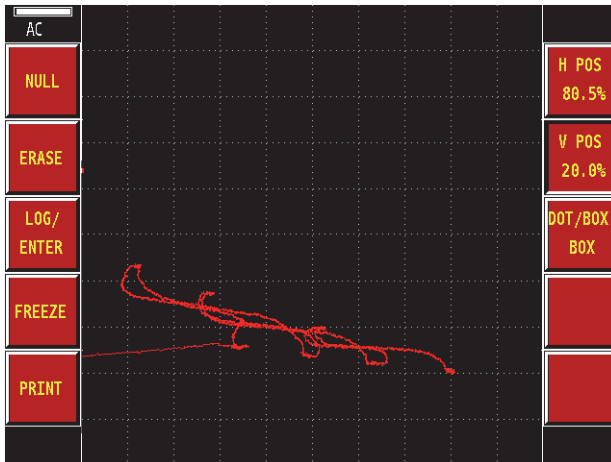**Figure 4-16 Simulated 30 % corrosion signal**

Figure 4-17 Complete scan of the reference standard

Appendix A: USB Communications

The Nortec 500 can be controlled and monitored by an external computer. The USB communication port allows an external device to send commands to and obtain information from the Nortec 500. Except for a few controls, operations available from the front panel are also available from the USB interface.

When monitored and controlled by an external computer, the USB port of the Nortec 500 is configured as a peripheral. The Mini-B plug of the interface cable is connected to the Mini-AB receptacle on the Nortec 500.

> **Note:** Use of single and double quotes in this section is for the purpose of discussion only. The symbols delineate specific characters and character strings used in the USB interface and are not to be used in actual communications.

Commands Strings

Communication from external devices to the Nortec 500 is performed using ASCII characters. A command string comprises three or more ASCII characters and a carriage return (terminator). The command string has three parts, not all of which are used in every case (see Table 5 on page 90).

Table 5 Commands strings format

Parameter specification	A three-character code that identifies the instrument item or function (see "Command Specification Set" on page 91).
Command specification	A one-character code that identifies the operations as READ '?', WRITE '=', or EXECUTE (carriage return).
Parameter value	The type and number of ASCII characters in this part of the command string is variable and depends on the parameter specification.

The Nortec 500 recognizes three types of commands, READ, WRITE, and EXECUTE. The type of command is indicated by the command specification. To perform a READ operation, the '?' symbol is used. To perform a WRITE operation, the '=' symbol is used. To perform an EXECUTE operation, a carriage return is used.

The Nortec 500 does not process a command string until a carriage return is received.

Status Reporting

After receiving a command, the Nortec 500 checks for errors. If no error is detected, the operation is executed. On completion of error checking or command execution, the Nortec 500 reports to the host with a prompt (prompts vary according to the results of error detection). Prompts are used by the host as indications that the Nortec 500 is ready for another command. All responses are terminated by carriage returns and '>' (see Table 6 on page 90).

Table 6 Status report prompts

Prompt	Description
"(carriage return)>"	Command Accepted
"C? (carriage return)>"	Invalid Command
"V? (carriage return)>"	Invalid Parameter Value

EddyMaster 500

EddyMaster 500 has an Issue Command feature located under File. From this window, any command may be issued (see Table 7 on page 91).

Table 7 EddyMaster 500 prompts

Prompt	Description
"Instrument response received"	Command Accepted
"C?"	Invalid Command
"V?"	Invalid Parameter Value

Command Specification Set

Control of the Nortec 500 is achieved using ASCII command strings terminated by carriage returns (0D [hex]). For commands that require ASCII letters (A-Z, a-z), either case may be used. Space (20 [hex]) are usually ignored but may be included in command strings (spaces may be included in the program or data names and print format strings). When specifying a real number value, the decimal point is required only when resolution beyond integers is desired.

Each instrument parameter permits a specific subset of the three command types (READ, WRITE, and EXECUTE). Command types permitted by each parameter are listed in Tables 8 to 20 on pages 92 to 101.

Table 8 Main commands

CODE	FUNCTION	RWX	RANGE
FR1	Frequency 1	RW	(0.05 to 12000) kHz
AN1	Angle 1	RW	(0.0 to 359.9) degrees, 0.1, 0.5, 1.0 degree steps
GN1	Frequency 1 Gain	W	(0.0 to 100.0) dB, 0.1 dB steps
HG1	Frequency 1 Horizontal Gain	RW	(0.0 to 100.0) dB, 0.1 dB steps
VG1	Frequency 1 Vertical Gain	RW	(0.0 to 100.0) dB, 0.1 dB steps
FR2	Frequency 2	RW	1/2 (F1 < 6 MHz), 1/4 to 1/256
AN2	Angle 2	RW	(0.0 to 359.9) degrees, 0.1, 0.5, 1.0 degree steps
GN2	Frequency 2 Gain	W	(0.0 to 100.0) dB, 0.1 dB steps
HG2	Frequency 2 Horizontal Gain	RW	(0.0 to 100.0) dB, 0.1 dB steps
VG2	Frequency 2 Vertical Gain	RW	(0.0 to 100.0) dB, 0.1 dB steps
FHI	Frequency High Pass	RW	"OFF", (2, 4, 6, 8, and 10 to 500) Hz in 1 Hz step
FLO	Frequency Low Pass	RW	(10 to 2000) Hz, FLO = 2001 sets to Wideband, varying steps
CNL	Set Continuous Null	RW	"OFF, 0.2HZ, 0.5HZ, 1HZ"
PRE	Pre Amplifier	RW	"OFF, ON"
BLC	Balance Coils	RW	"1.2UH, 8.2UH, 15UH, 22UH, 47UH, 82UH, and 120UH"

Table 9 Memory commands

CODE	FUNCTION	RWX	RANGE
PRC	Program Recall	W	1 to 400
PST	Program Store	W	1 to 200
PER	Program Erase	W	1 to 200
PPR	Program Print	W	1 to 200 (only works with Bluetooth)
PGN	Program Name	RW	Maximum of 29 characters
LPN	Last Filled Program Location	R	1 to 200
PEF	Program Status	R	EMPTY, EC (Eddy Current)
PGL	Program Location	RW	1 to 400
PVN	Program Structure Version	R	
DRC	Data Recall	W	1 to 200
REF	Reference Memory	RW	"OFF", 1 to 200
DER	Data Erase	W	1 to 200
DAP	Data Print	W	1 to 200 (only works with Bluetooth)
DAL	Data Location	RW	1 to 200
DAN	Data Name	RW	Maximum of 29 characters
DEF	Data Status—Block	R	EMPTY, FIRST BLOCK, MIDDLE BLOCK, LAST BLOCK, UNKNOWN
DVN	Data Structure Version	R	
LDN	Last Filled Data Location	R	1 to 200
CLR	Defaults the Report	X	None
HDC	Clear Report Line Number	W	Maximum of 39 characters
HDN	Report Line Number	RW	0 to 17
HDR	Report Line String	RW	Maximum of 39 characters
CLP	Clear All Programs	X	
CLD	Clear All Data	X	

Table 10 Alarms commands

CODE	FUNCTION	RWX	RANGE
B1T	Box 1 Top	RW	((B1B + 0.5) to 100.0) %, 0.5 % steps
B1B	Box 1 Bottom	RW	(0.0 to (B1T – 0.5)) %, 0.5 % steps
B1L	Box 1 Left	RW	((B1L + 0.5) to 100.0) %, 0.5 % steps
B1R	Box 1 Right	RW	(0.0 to (B1R – 0.5)) %, 0.5 % steps
B1E	Box 1 Polarity	RW	"OFF, NEGATIVE, POSITIVE"
POX	Polar X Position	RW	POR to (100 % – POR), 0.5 % steps
POY	Polar Y Position	RW	POR to (100 % – POR), 0.5 % steps
POR	Polar Radius	RW	0.5 % to min(POX, POY, 100 % – POX, 100 % – POY), 0.5 % steps
POE	Polar Polarity	RW	"OFF, NEGATIVE, POSITIVE"
SWT	Sweep Top	RW	(SWB + 0.5 %) to 100 %, 0.5 % steps
SWB	Sweep Bottom	RW	0.0 % to (SWT – 0.5 %), 0.5 % steps
SWE	Sweep Polarity	RW	"OFF, NEGATIVE, POSITIVE"
HRN	Alarm Horn Volume	RW	"OFF", 1, 2, 3
B2T	Box 2 Top	RW	((B2B + 0.5) to 100.0) %, 0.5 % steps
B2B	Box 2 Bottom	RW	(0.0 to (B2T – 0.5)) %, 0.5 % steps
B2L	Box 2 Left	RW	((B2L + 0.5) to 100.0) %, 0.5 % steps
B2R	Box 2 Right	RW	(0.0 to (B2R – 0.5)) %, 0.5 % steps
B2E	Box 2 Polarity	RW	"OFF, NEGATIVE, POSITIVE"
B3T	Box 2 Top	RW	((B3B + 0.5) to 100.0) %, 0.5 % steps
B3B	Box 2 Bottom	RW	(0.0 to (B3T – 0.5)) %, 0.5 % steps
B3L	Box 2 Left	RW	((B3L + 0.5) to 100.0) %, 0.5 % steps
B3R	Box 2 Right	RW	(0.0 to (B3R – 0.5)) %, 0.5 % steps
B3E	Box 3 Polarity	RW	"OFF, NEGATIVE, POSITIVE"
ADW	Alarm Dwell	RW	(0.0 to 10.0) second, 0.2 second steps

Table 11 Display commands

CODE	FUNCTION	RWX	RANGE
HPO	Horizontal Position	RW	(0.0 to 100.0) %, 0.5 % steps
VPO	Vertical Position	RW	(0.0 to 100.0) %, 0.5 % steps
FDT	Cursor Type	RW	"DOT, BOX"
VAP	Variable Persistence	RW	"OFF", (0.1 to 5.0) second for Single, (0.1 to 2.5) second for Dual Frq, 0.1 second steps
CTE	Display Erase	RW	"OFF", (0.1 to 60.0) second, 0.1 second steps
ASE	Sweep Erase	RW	"OFF, ON"
GRT	Graticule	RW	"OFF, ON"
MSD	Main Display (if in dual frq)	RW	"F1, F2, F1+F2, F1–F2"
SSD	Second Display (dual frq)	RW	"F1, F2, F1+F2, F1–F2"
TRK	Gain/Rotation Tracking	RW	"OFF, ON"

Table 12 Scan commands

CODE	FUNCTION	RWX	RANGE
SWP	Sweep Mode	RW	"OFF, AUTO, AUTOXY, AUTOIMP, EXTERN, EXT/IMP, WATRFALL"
AST	Auto Sweep Time	RW	(0.005 to 4.000) second, 0.005 second steps
RPM	Scanner RPM	RW	(40 to 240) RPM, 5 RPM steps, (600 to 3000) RPM, 50 RPM steps
SCZ	Scanner Sync Angle	RW	(0 to 359) degrees, 1 degree steps
WMN	Waterfall First Sweep (Min)	RW	1 to (WMX – 3)
WMX	Waterfall Last Sweep (Max)	RW	(WMN + 3) to 60
WAN	Waterfall Angle	RW	(0 to 359) degrees, 1 degree steps (W ANGLE = WAN + AN1)
WHI	Waterfall Depth Indicator	RW	1 to 60 (WHI × 0.025 = DEPTH)

Table 13 Setup commands

CODE	FUNCTION	RWX	RANGE
PDR	Probe Drive	RW	"LOW, MID, HIGH"
ANI	Angle Step Increment	RW	"0.1, 0.5, 1.0"
FSD	Frequency Mode	RW	"SINGLE, DUAL", "DUALFRQ" is acceptable for "DUAL"
MGN	Horizontal Mixer Gain	RW	"0dB, +6dB, +12dB"
VMG	Vertical Mixer Gain	RW	"0dB, +6dB, +12dB"
ADW	Alarm Dwell	RW	(0.0 to 10.0) second, 0.2 second steps
HRN	Alarm Horn Volume	RW	"OFF", 1, 2, 3
DCM	Capture Mode	RW	"FREEZE, CAPONCE, CAPCONT"
CCT	Capture Time	RW	(2.5 to 60.0) second, 2.5 second steps
RLK	Lock	RW	"OFF, ON"
LAN	Language	RW	"ENGLISH, FRENCH, GERMAN, SPANISH, ITALIAN"
SFM	Immediate Keys Position	RW	"LEFT, RIGHT"
AUE	Auto Erase After Null	RW	"OFF, ON"
PCM	Radix Point	RW	. (period) , (comma)
MIN	Minutes	RW	0 to 59
HR.	Hours	RW	0 to 23
DAY	Day	RW	1 to 31
MON	Month	RW	1 to 12
YR.	Year	RW	1970 to 2104
TIM	Clock Time	R	Format is HH:MM:SS
SEC	Seconds	RW	0 to 59
DAT	Clock Date	R	Format is M/D/YYYY
CSH	LCD Color Selection	RW	0 to 6, increments of 1
LID	Load Default Instr. Settings	X	None
VER	Software Version	R	Format is RXXX.X
LOD	Load Default Opertng Set	X	None

Table 14 Conductivity—Main commands

CODE	FUNCTION	RWX	RANGE
CCM	Capture Mode (Cond)	RW	"ENTER, CONTNOUS"
CCP	Calibration Point	RW	1 to 4, increments of 1
CCV	Calibration Value	RW	For CCP = 1 or 2: %IACS: (0.90 to 110.00) %, 0.01 % steps (% not req on write) MS/M: (0.52 to 63.80) MS/m, 0.01 MS/m steps
CCV	Calibration Value	R	For CCP = 3, same value as Cal Point 1 For CCP = 4, same value as Cal Point 2

Table 15 Conductivity—Memory commands

CODE	FUNCTION	RWX	RANGE
LCF	Logger Location	RW	1 to 200
LCO	Columns	RW	1 to 500 (LCO × LRO ≤ 500)
LRO	Rows	RW	1 to 500 (LCO × LRO ≤ 500)
LTP	Type	RW	"XY-ROW, XY-COL, PRINT, CLEAR"
CLR	Defaults the Report	X	None
HDC	Clear Report Line Number	W	0 to 17
HDN	Report Line Number	RW	0 to 17
HDR	Report Line String	RW	Maximum of 39 characters

Table 16 Conductivity—Alarms commands

CODE	FUNCTION	RWX	RANGE
CAU	Conductivity Alarm Upper	RW	(CAL + 0.1 %) to 110.0 %, 0.1 % IACS steps ((CAL + 0.1) to 63.80) MS/m, 0.1 MS/m steps
CAL	Conductivity Alarm Lower	RW	0.9 % to (CAU – 0.1 %), 0.1 % IACS steps (0.52 to (CAU – 0.1)) MS/m, 0.1 MS/M steps
CAE	Conductivity Al Polarity	RW	"OFF, NEGATIVE, POSITIVE"
LAU	Lift-off Alarm Upper	RW	((LAL + 0.1) to 25.0) mils, 0.1 mil steps ((LAL + 0.01) to 0.64) mm, 0.01 mm steps
LAL	Lift-off Alarm Lower	RW	(0.1 to (LAU – 0.1)) mils, 0.1 mil steps (0.00 to (LAU – 0.01)) mm, 0.01 mm steps
LAE	Lift-off Al Polarity	RW	"OFF, NEGATIVE, POSITIVE"
HRN	Alarm Horn Volume	RW	"OFF, 1, 2, 3, 4, 5, 6, 7"

Table 17 Conductivity—Setup commands

CODE	FUNCTION	RWX	RANGE
CNU	Conductivity Units	RW	"%IACS, MS/M"
LNU	Lift-off Units	RW	"MIL, MM"
LAN	Language	RW	"ENGLISH, FRENCH, GERMAN, SPANISH, ITALIAN"
PCM	Radix Point	RW	. (period) , (comma)
MIN	Minutes	RW	0 to 59
HR.	Hours	RW	0 to 23
DAY	Day	RW	1 to 31
MON	Month	RW	1 to 12
YR.	Year	RW	1970 to 2104
TIM	Clock Time	R	Format is HH:MM:SS
SEC	Seconds	RW	0 to 59
DAT	Clock Date	R	Format is M/D/YYYY

Table 18 Key presses commands

CODE	FUNCTION	RWX	RANGE
IS1	Imm Exec Key 1 Keypress	X	None
IS2	Imm Exec Key 2 Keypress	X	None
IS3	Imm Exec Key 3 Keypress	X	None
IS4	Imm Exec Key 4 Keypress	X	None
IS5	Imm Exec Key 4 Keypress	X	(Only works with bluetooth)
MS1	Menu Key 1 Keypress	X	None
MS2	Menu Key 2 Keypress	X	None
MS3	Menu Key 3 Keypress	X	None
MS4	Menu Key 4 Keypress	X	None
MS5	Menu Key 5 Keypress	X	None
MS6	Menu Key 6 Keypress	X	None
KS1	Softkey 1 Keypress	X	None
KS2	Softkey 2 Keypress	X	None
KS3	Softkey 3 Keypress	X	None
KS4	Softkey 4 Keypress	X	None
KS5	Softkey 5 Keypress	X	None
KUA	Smartknob CW	X	None
KDA	Smartknob CCW	X	None
NUL	Nulls frequency 1 and 2	X	None
ERS	Erase Display	X	None
LOG	Stores Data	X	None
FRZ	Toggles Freezing Display	X	None

Table 19 PowerLink commands

CODE	FUNCTION	RWX	RANGE
DSC	PowerLink Probe Description	R	
LNS	PowerLink Status	R	"NO, YES"
MPC	PowerLink Probe Class	R	
MPD	PowerLink Probe Mode	R	
MPS	PowerLink Probe Serial #	R	
PTP	PowerLink Probe Type Str	R	

Table 20 Miscellaneous commands

CODE	FUNCTION	RWX	RANGE
ALC	Alarm Status—Decimal	R	Bit 0 - Box 1, Bit 1 - Box 2, Bit 2 - Box 3 Bit 3 - Polar, Sweep, Conductivity, & lift-off, Bit 4 - Or'd
AVA	Signal Average	R	−8183 to 8183 counts
BAT	Predicted Battery Capacity	R	0% to 100% (0% indicates no battery)
BMP	Bitmap of current display	X	none
CSK	Current Soft Key	R	0 to 4
CND	Conductivity	R	%IACS: (0.90 to 110.00) %, 0.01 % steps (% not req on write) MS/M: (0.52 to 63.80) MS/m, 0.01 MS/m steps
ICP	Instrument Capabilities	R	NUL –> 0x00 (Empty String)
LFT	lift-off	R	(0.1 to 25.0) mils, 0.1 mil steps (0.01 to 0.64) mm, 0.01 mm steps
MCP	Module Capabilities	R	Conductivity 0x21, Scanner 0x22, Dual Frequency 0x24 (or'd)
NAM	Instrument Name	R	NORTEC500
PCF	Program XPC850	W	Address where program is to be loaded. Used internally with program Download.
PCX	Program XC2S150	W	Address where program is to be loaded. Used internally with program Download.
PKF	Program MSP430	W	Address where program is to be loaded. Used internally with program Download.
PRT	Printer Type	R	(only works with Bluetooth)
RDI	Instrument Battery Current	R	0.000 A to 2.000 A (0.000 A—no battery or fully charged)
RDV	Instrument Battery Voltage	R	0.000 V to 12.750 V (0.000 V indicates no battery)

Note: Ranges with " " indicate strings—the entire string must be entered.
On ranges without " ", the trailing character(s) is optional: 1.5% or 1.5 are both acceptable.