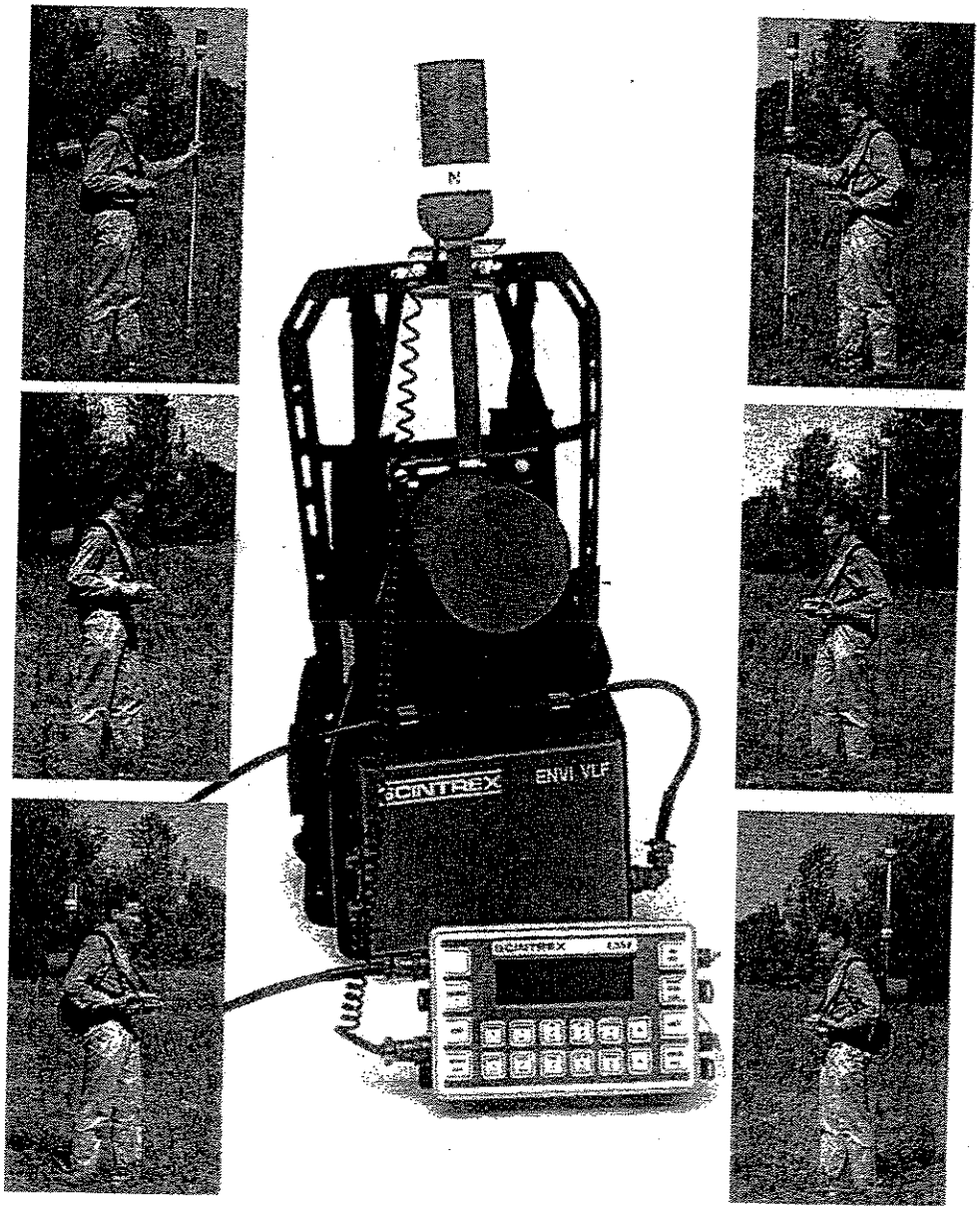
SCINTREX

ENVI GEOPHYSICAL SYSTEM OPERATIONS MANUAL



Caution: You need to consider your travel direction while surveying when you attach the magnetic sensor. The magnetometer's performance is a function of the sensor's orientation with respect to the earth's magnetic field. Therefore, you must ensure that the **N** mark on the sensor faces either magnetic north (or south—either is allowed due to symmetry). Please see "Orientation" on page 6–2 for more details.

VLF Sensors

Connecting the VLF sensor module

The VLF sensor module consists of three sections:

- the VLF sensor,
- the circuitry
- and the back pack panel.

The VLF sensor consists of three orthogonal coils mounted in a cylindrical housing with pre-amp signal circuitry. The coils consist of copper wire wound on a non-ferrous frame. The sensor has two coils mounted horizontally and one mounted vertically. The sensor housing is made of a rugged plastic material.

The VLF circuitry is housed in a rugged, rectangular, metal or plastic housing and consists of three circuit boards.

The circuit boards contain a microprocessor, CPU circuitry, a tilt correction meter and signal filtering circuitry. For the standard ENVI VLF System configuration, the circuitry housing has one KPT-type connector which allows for interfacing with the console. For the VLF Resistivity Option, additional KPT-type connectors are installed for connecting the resistivity probes.

Both the VLF sensor and circuitry housings are attached to a rigid polyethylene panel. The back of this panel has a permanently attached neoprene foam padding that allows for comfortable field usage. The foam is closed-celled and will not absorb water or perspiration.

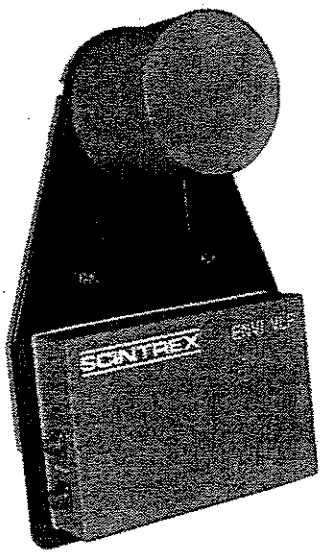


Figure 11 VLF sensor assembly on it's own backpack assembly.

Resistivity Option

The ENVI System with the Resistivity Option functions the same as the standard ENVI System combined magnetometer/VLF system. The main difference is that when resistivity probes are plugged into the VLF electronics module, then the ENVI System will automatically measure and calculate an apparent resistivity and phase angle for the VLF frequencies.

The resistivity option is offered in two configurations: two-probe resistive/capacitive or three-probe resistive/capacitive. The two-probe configuration can be used to speed up survey logisitics when the direction of the transmitter is greater than ±20°. See page "VLF Resistivity Option operation" on page 6–26 for more details.

Attach the resistivity probes to the VLF sensor module that is worn on the operator's back. For the two-probe configuration, plug the cable (SCINTREX P/N 793 044) into the 10-pin KPT connector, located on the left side of the module with the word RESISTIVITY noted below the connector.

For the three-probe system, use the 10-pin KPT connector as above, and attach the single electrode to the 6-pin KPT connector located above the 10-pin connector, using SCINTREX cable P/N 793 045. If you have the three-probe system, you can use the system in a two-probe configuration by not connecting the third, single electrode. See page "VLF Resistivity Option operation" on page 6–26 for more details.

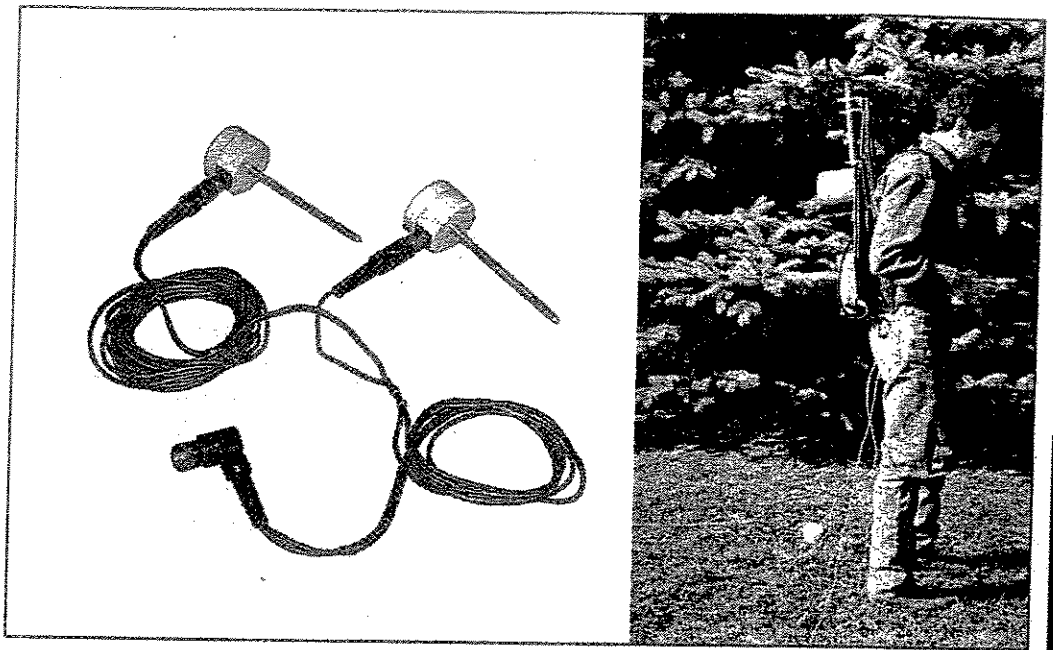


Figure 12 Resistivity probes (left) and attached in field use (right).

Cable Connectors

There are two cable connectors located on the left side of the ENVI console. When the console is chest-mounted, the one nearest the operator (designated by the number J102) connects the magnetometer sensor.

The connector farthest away from the operator (designated by the number J101) is for connecting the console with the VLF sensor.

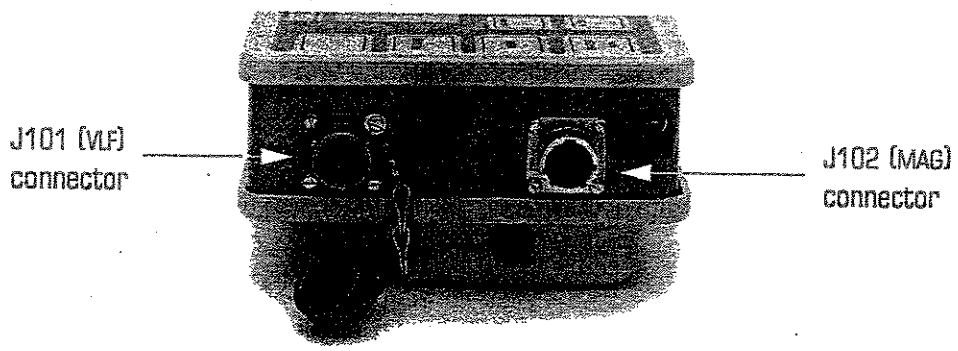


Figure 13 ENVI console sensor connectors.

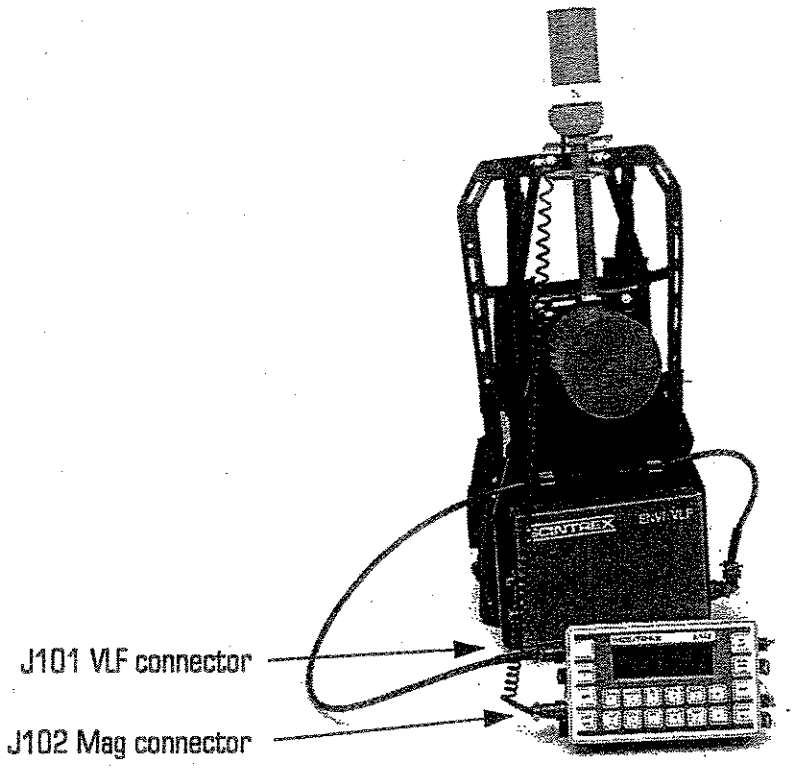


Figure 14 The ENVI MAG/VLF System showing the MAG and VLF sensors connected to the console's J102 and J101 connections, respectively.

Note: If the connecting cable becomes unusable, the data-transfer cable may be used where the base-station connector is attached to the console and the field connector is attached to the VLF sensor.

Warning: Do *not* plug the magnetometer cable into the J101 connector, nor plug the VLF cable into the J102 connector. Even though they could each fit into the wrong connector, to do so would give random and erroneous results.
MAY RESULT IN DAMAGE TO THE CONSOLE

Connecting the VLF sensor to the harness

The VLF sensor backpack connects to the standard ENVI harness assembly (P/N 788 023) by re-installing the straps to run through the slots provided on the sensor backpack.

Hint: If you will be using both the magnetic and VLF sensors, then it is highly recommended that the optional BACK PACK be used (see below). This is much more convenient when changing sensor configurations and provides a more stable and comfortable platform for the operator.

BACK PACK installation

A multi-functional BACK PACK (P/N 788 040) can be purchased as an option. This may be used with or without the VLF module or magnetometer sensor. It has been designed to be durable yet comfortable.

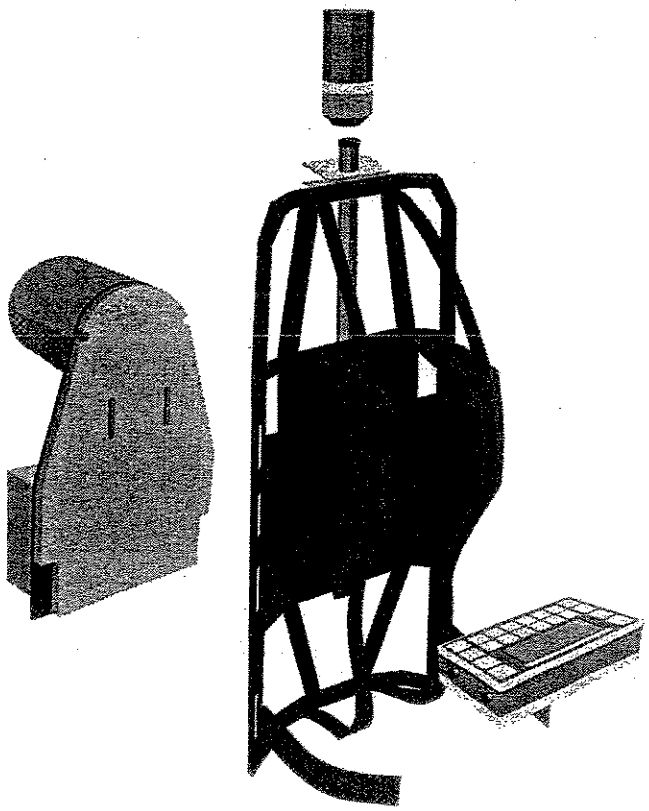


Figure 15 How to attach components of the ENVI System to the optional BACKPACK

BATTERY INSTALLATION/EXCHANGE

The ENVI system is shipped *without* the battery installed. This is the proper procedure, while shipping and storing the instrument, to prevent *deep discharge* of the battery. Deep discharge can possibly cause permanent damage to the battery and will always shorten the battery life. This situation will occur because a small current is being drawn even if the instrument is turned *off*.

The following steps outline the battery installation:

1. **Turn** the instrument face down on a clean and even surface.
2. **Unscrew** both knurled screws on either side of the battery cover and lift the cover off.
3. **Place** the battery into the recess in the rear panel of the instrument.
4. **Connect** it carefully to the MAIN BATTERY connector. It is not important which side of the plug is up, as long as the connector pins are properly aligned.
5. **Replace** the cover and tighten both knurled screws.
6. If this is the first time installation proceed with battery charging.

The small size and low cost of the battery makes it convenient to carry an additional battery along as a spare.

Warning: An internal battery keeps the memory and the internal clock alive for about **10 minutes.**

It is strongly advised that the switching to the spare battery be done *quickly*, **TO PREVENT THE LOSS OF YOUR DATA!**

Note: You need not worry about a low battery causing data loss, since the memory power requirements are much less than those needed to make a valid reading of the magnetic or VLF-EM fields. The memory will be maintained for hours.

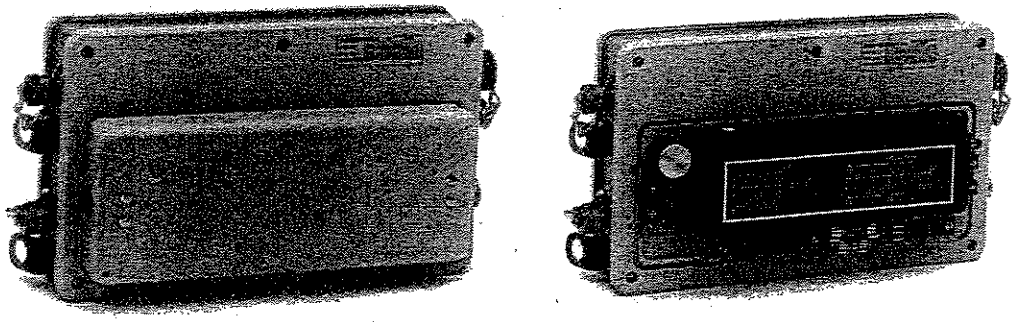


Figure 16 ENVI system battery pack

Using the external battery pack

Cold weather use and extended WALKMAG surveys may require more power than the standard battery together with a spare can provide. To satisfy this additional requirement, the *External Heavy Duty Battery Pack* (SCINTREX P/N 788 026) is available. It provides about *three* times as much power as the standard battery. This battery pack can be carried by the strap or attached to a belt.

To connect the external battery you must proceed as follows:

1. **Turn** the instrument face *down* on a clean and even surface.
2. **Unscrew** both knurled screws on either side of the battery cover.
3. **Lift off** the cover and *store* it somewhere convenient for future use with the standard battery configuration.
4. **Remove** the standard battery.
5. **Connect** the connector in the dummy battery cover carefully to the MAIN BATTERY connector. It is not important which side of the plug is up, as long as the connector pins are properly aligned.
6. **Place** the *new* cover on to the console by gently pushing it into its place and **tighten** the knurled screws on both sides.

7. Please check the battery voltage condition at this stage and charge the battery, if it is required.

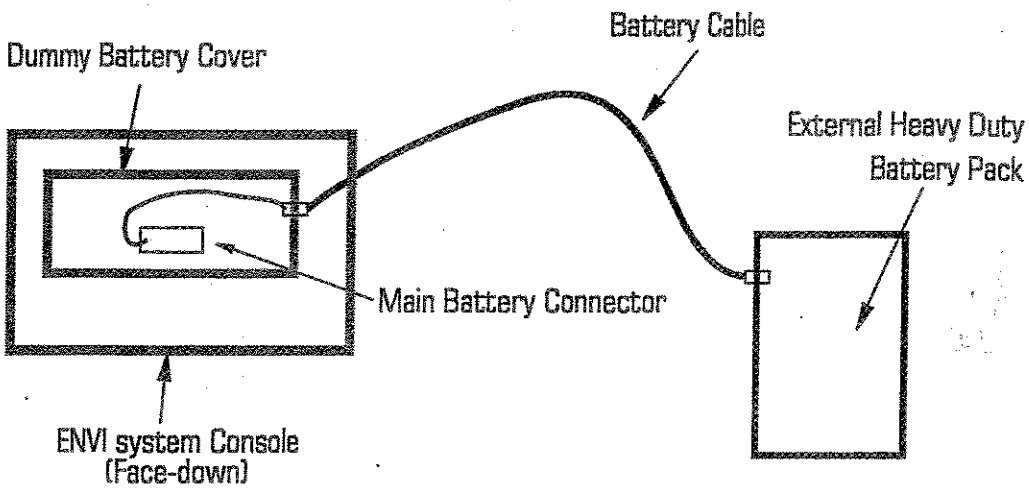


Figure 17 External heavy duty battery connection

Using an external power supply

More demanding applications, such as an extended base-station operation, may require more power than can be provided with the either of the SCINTREX supplied battery packs. In this case you have two options:

a) AC-power

If a source of AC-power is available, the instrument can be run while the charger is connected to it. You will also be charging the standard internal battery, if it is installed, at the same time.

Note: Please be aware of possible magnetic noise from generators, and ensure that all cabling and sensors are *as far away as possible* from the generator as possible.

b) 12-volt battery (car or marine)

A 12-volt car battery may be more appropriate for other applications. The special *External Power Cable* (SCINTREX P/N 788 029) should be used for this purpose.

1. The standard internal battery may be left in place.

2. **Plug in** the end of the cable with the single plug into the Charger Connector at the right-rear side of the ENVI system console. (See item 6 in Figure 18 on page 3–2.)

3. **Connect** the end with the clips to the battery terminals. The *red* cable-clip goes to the *positive* battery terminal. The *black* cable-clip goes to the *negative* battery terminal.

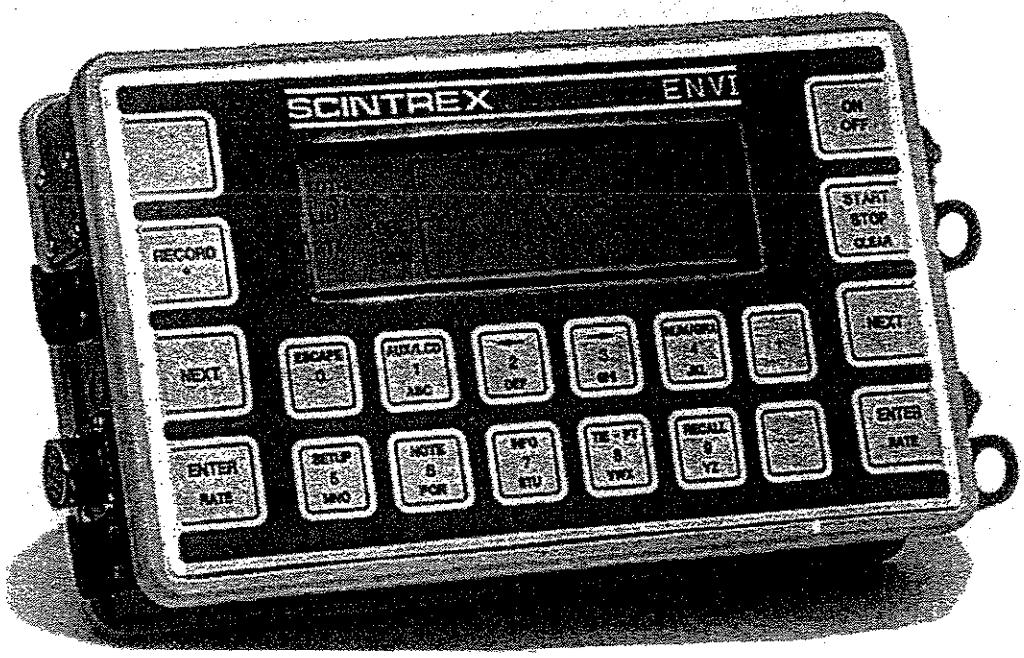
Caution: The correct polarity must be used for the instrument to operate properly.

THE ENVI CONSOLE

This chapter is about the ENVI console and describes:

- the various components of the console
- the keypad functions,
- the various basic console screen display menu types,
- the display formats that you will encounter.

The next chapter will describe the console screen displays in detail for each of the various configurations available for the ENVI System.



CONSOLE DESCRIPTION

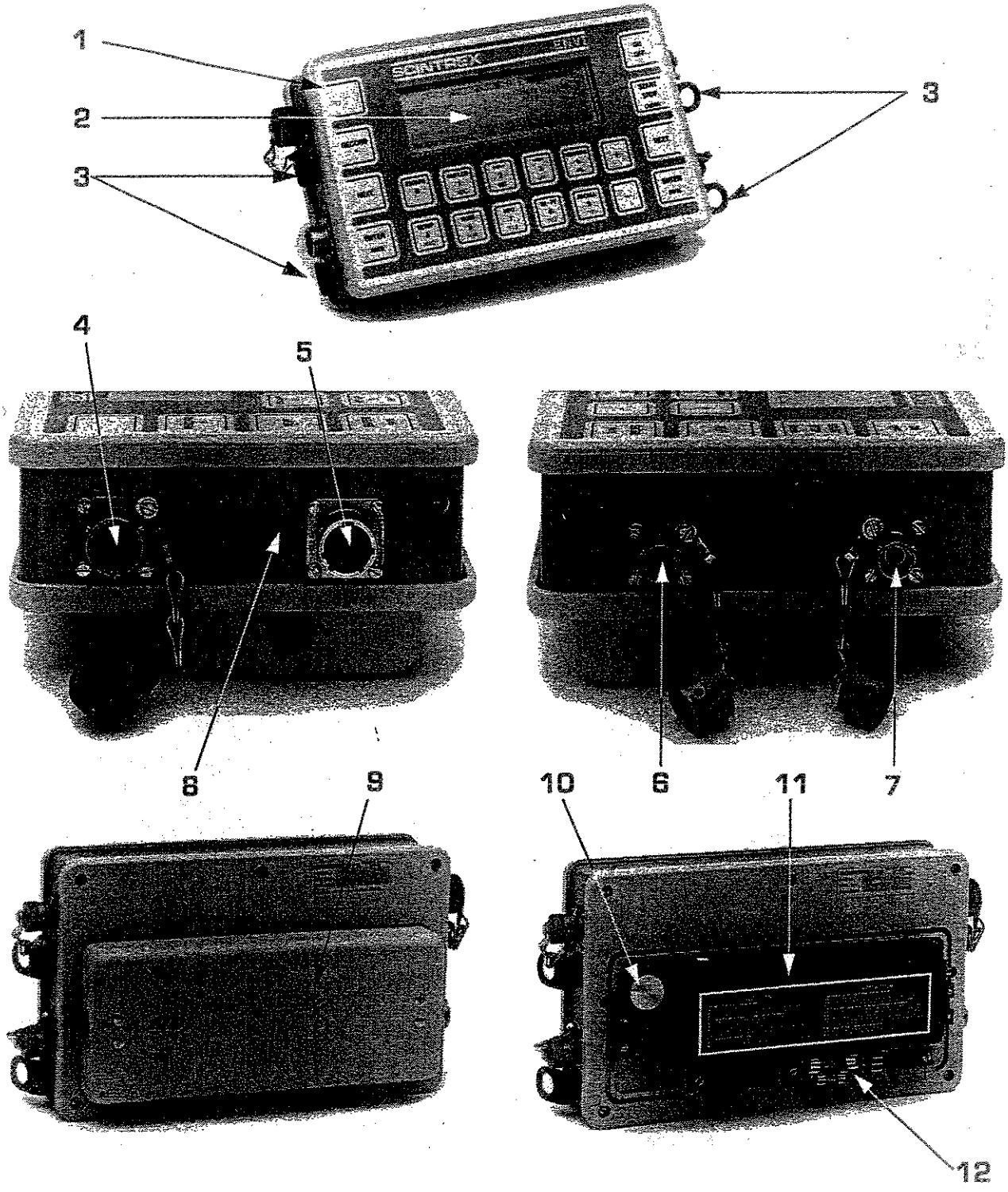


Figure 18 The ENVI system console.

#	Item	Description
1	Keypad	The fully sealed Keypad has 19 keys and a sound port.
2	Liquid Crystal Display (LCD)	The large 8 line by 40 character (64 x 240 dots) Supertwist LCD (with a wide temperature range) presents status and data in a numeric or graphic format.
3	Carrying Strap Attachment	Four rings at the side of the console that allow attachment of the carrying harness.
4	VLF Sensor Connector	The J101 VLF sensor connector.
5	Mag Sensor Connector	The J102 Mag sensor connector for either the MAG or GRAD sensors.
6	Data Interface Connector	The data interface connector receives or transmits data through a RS-232 cable for three functions: 1. Outputs dat to a PC. 2. Connects to a base station unit for correcting data. 3. Outputs data to an analog strip chart recorder. It has the following pin assignments: **A** - common (ground), **B** - RS-232 receive data, **C** - RS-232 transmit data. **D** - analog out 0 – 1 Volt,
7	Charger/ External Power Connector	This connector accepts the charger to recharge either the standard battery or the external heavy-duty battery pack. It also accepts external, well filtered, 11 to 16 Volt DC input. The center pin is negative (–). The shell is positive (+).
8	Charging Light	The charging light (visible through a window on the left side) indicates that the battery is charging at a high rate.
9	Battery Compartment	The battery compartment is located at the back of the console and contains one rechargeable lead-acid battery, the desiccant cartridge and the fuse. The battery cover is replaced with another cover with a cable attached when the external battery is used.
10	Desiccant Cartridge	The desiccant cartridge is a cylindrical re-usable capsule filled with a drying agent. It absorbs any moisture that may get inside the instrument.
11	Battery	A rechargeable lead-acid battery in the standard ENVI system configuration.
12	Fuse	The standard 1.5A fuse to use with the standard battery.

KEYPAD DESCRIPTION

The keypad has 19 keys. Two of the most used keys are duplicated on the right and left sides of the console for easy access. Some keys have up to three separate functions assigned to them. The response of these multi-function keys depends upon the operation in progress.

Note: The *function* mode of the keys has precedence over the *alpha-numeric* mode of the keys

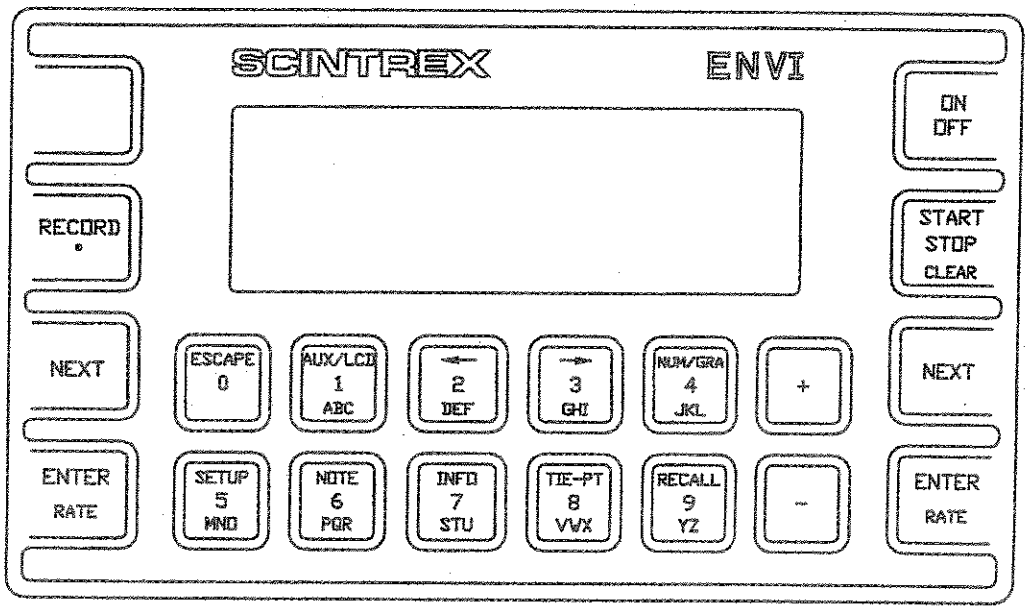


Figure 19 The ENVI system keypad.

KEY FUNCTIONS

Key	Description
	Turns the instrument on and off. Turning the instrument off during a reading abruptly terminates a reading and loses the current data.
	Starts or stops an operation, such as data acquisition, data dumping, data recall, etc. * When the instrument is in the Notes operation, this button acts as a "backspace" key to delete entries.
	* Accesses the various setup displays. The actual setup menu that will be displayed depends upon the display screen in which this key is pressed.
	* Accesses the Auxiliary Functions display allowing: ▲ setting of the LCD intensity, ▲ data output, ▲ locking of the setup parameters ▲ reprogramming of the main system software (Flash EPROM).
	Moves the cursor to the left or up; to the right or down.
	Two identical keys: ▲ opens and closes the parameter fields during setups ▲ opens and closes the scaling option field for the graphics display ▲ toggles the sample rate in the walking type survey.
	Allows you to escape from a menu level to the previous level. The top level is always the Main operating display. Aborts a data dump.
	* Accesses the Info. Display, which has different functions in the three ENVI MAG modes: Basic and Search mode: Accesses the HELP feature * Advanced mode: ▲ setting of data and time, ▲ entering of serial and job numbers, and operator identification, ▲ observation of memory availability.

Key	Description
	Two identical keys: ▲ scrolls sequentially through numeric data display pages, ▲ scrolls sequentially through graphic data display pages, ▲ moves the cursor from one sub-page to the next sub-page, ▲ moves the cursor to the next character location during note entry, ▲ advances the station number by the station separation in the walking mode.
	* Accesses the Note Entry display, which allows: ▲ the entry of five common notes (macros) to be recorded repeatedly with selected readings ▲ the entry of unique notes to be recorded with a particular reading.
	Toggles the data display between numerical and graphic data presentation during data acquisition only.
	* Presents the Recall display for selection of: ▲ data item to be recalled ▲ setting of the starting location or time of the recall.
	* Manually records measured data and notes in internal memory.
	Acts as the START key at a Tie-point. This is used for the Tie-point line and loop mode corrections.
	Facilitates the scrolling forward or backward through a list of items: ▲ allows sign entry to numbers, ▲ allows panning along a line of data during recall, ▲ allows selection of the graph scale in the Graph Display ▲ increments or decrements the line and station number in the Stop-and-Go mode.
1-9, ., A-Z	* Allows alpha-numeric entry for setups and notes.

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Printed and bound in Canada

Table of Contents

Reference information 9–1

PREFACE

Congratulations on purchasing the ENVI Geophysical System from SCINTREX Ltd! You are in possession of one of the most versatile and advanced magnetometer/gradiometer and VLF/VLF Resistivity systems for environmental, geotechnical, archaeological and mineral exploration uses of today.

The ENVI System consists of an inexpensive, lightweight console having a large alphanumeric display and a high capacity memory. Included with each system are the appropriate sensors, sensor staff and/or backpack, a rechargeable battery, battery charger, RS-232 cable and transit case. A complete ENVI System is an inexpensive, lightweight, portable, proton precession magnetometer/gradiometer with VLF capabilities which enables you to survey large areas quickly and accurately.

The ENVI System can be designed to suit your own unique requirements. This customized approach gives you the ability to select from the following options:

- portable field and base-station magnetometer;
- true simultaneous gradiometer;
- VLF electromagnetic receiver;
- VLF resistivity option.

A complete ENVI System can calculate and record four VLF magnetic field parameters from three different transmitters, as well as, take a magnetic total field and simultaneous magnetic gradient reading. With the VLF resistivity option added, it can also measure and record two VLF electric field parameters from the same three different transmitters.

SYSTEM CONFIGURATIONS

As the ENVI System is based upon a modular design, you can start with only the surveying equipment that you need for now and upgrade your system at any time, as your surveying needs grow.

The following are the available system configurations for the ENVI System:

- ENVI MAG
- ENVI GRAD
- ENVI VLF
- ENVI MAG/VLF
- ENVI GRAD/VLF

ENVI MAG

The ENVI MAG is a portable total-field magnetometer that can be operated in the traditional *stop-and-go* mode, or in the continuous acquisition *WALKMAG* mode. The magnetic sensor can be either back-pack mounted (as shown in the photograph to the left) or staff-mounted. This mode is ideal for geotechnical, archaeological and environmental surveys where small near surface magnetic targets may be the object of the survey.

The ENVI MAG also operates as a base-station magnetometer and can be used to correct diurnal variations that other *envi* units may have encountered during your survey.

The ENVI MAG can also operate as a self-correcting magnetometer using the built-in *TIE-LINE* feature.

ENVI GRAD

The ENVI GRAD is a true simultaneous gradiometer that provides you with an accurate means of measuring both the total field and the gradient of the total field. Both sensors are read simultaneously by the ENVI console to provide a true gradient measurement. This also cancels the effects of any diurnal variations allowing you to survey even during magnetic storms and not lose valuable survey time.

The photograph to the left shows a back-pack mounted vertical gradiometer. This mode is ideal for geotechnical, archaeological and environmental surveys where small near surface magnetic targets may be the object of the survey.

ENVI VLF

The ENVI VLF unit allows you to simultaneously measure the vertical in-phase, vertical quadrature (or out-of-phase) secondary component of the induced field and total field strength of the VLF signal from up to three different VLF transmitter stations. The unique three-coil sensor is omni-directional. Therefore, you do not have to do any special orientation of the sensor with respect to each station. This simplifies field procedures and greatly speeds up your survey time.

The photograph to the left shows the ENVI VLF unit in operation.

VLF Resistivity Option

The ENVI System also supports the use of either a two-probe (orientation required) or three-probe, non-orienting set of resistive or capacitive electrodes to measure the VLF induced electric field. The ENVI console calculates the apparent resistivity and phase angle.

The photograph to the left shows the ENVI VLF being used in a three-component resistivity mode using resistive electrodes.

ENVI MAG/VLF

This configuration combines the MAG and VLF sensor packages into a single instrument. The magnetic sensor can be either mounted on the VLF back-pack or carried on a staff as shown in the photos to the left.

ENVI GRAD/VLF

This configuration combines the MAG and VLF sensor packages into a single instrument. The magnetic gradient sensors can be either mounted on the VLF back-pack or carried on a staff as shown in the photos to the left.

ENVI MAP SOFTWARE

The ENVI MAP software is supplied with the MAG or GRAD options of the ENVI System. It is a custom designed, easy to use menu driven data processing and mapping system for magnetic data. The software allows you to:

- download your data from the ENVI console
- post the survey values to a line map
- grid and contour the data
- build a standard map surround and title
- output the results in a standard, auto-scaled page-size format to a variety of printers

A complete description of the software and its use can be found in the accompanying ENVI MAP Software Manual (SCINTREX part no. 759 705).

The ENVI MAP software is fully compatible with the GEOSOFT suite of processing, mapping, modeling and interpretation programs. More advanced software is available from SCINTREX.

Note: The ENVI MAP software was *not* designed to process VLF data.

ABOUT THIS MANUAL

This manual is part of a documentation set consisting of up to four manuals, depending upon your systems configuration:

1. *ENVI Geophysical System Operations Manual* (part no. 788 700)
2. *Magnetic Applications Guide* (part no. 759 700)
3. *VLF Interpretation Manual* (part no. 788 714)
4. *ENVI MAP Software User's Guide* (part no. 759 705)

PAGE NUMBERING

The page numbering scheme used consists of two parts; the *chapter number* and *page number*. For example, **3-1** would refer to Chapter **3**, page **1**.

For your convenience, each chapter has a thumb-tab on the right-hand side allowing you to quickly locate a chapter of interest. The thumb-tabs are arranged in descending order, with Chapter 1 always starting at the top.

TYPE STYLES

The following typeface conventions will be used throughout the manual.

Convention	Use
Bold	1. An action you are required to perform 2. A proper name.
Italic	1. A new term is being introduced 2. An item of importance is being emphasized.
`Dot Matrix`	1. A prompt on the ENVI System console 2. Text that you are required to input to the console.
ALL CAPS	1. A display or key on the ENVI System console 2. The name of a method, item or mode.

SYMBOLS

The following symbols will be used to highlight specific sections of text throughout the manual.

Symbol	Meaning
▲	Indicates an item in a list/grouping or a single-step procedure
	**Note:** Indicates specific information that you should read.
	**Hint:** Indicates a tip, new idea or helpful hint.
	**Caution:** Indicates a note of caution. You should pay special attention to this section.
	**Warning:** Indicates a warning. You should read this section very carefully.
	**Important:** Please read this! Indicates a very important message.

SAMPLE INSTRUMENT SCREENS AND BUTTONS

Where possible, representations of the actual buttons and screens from the ENVI console will be used throughout this manual. The buttons that you are required to press will be shown along the left side of the page, while the text will mention the button, as shown in the following example:

Example: Press the "SETUP+ON" keys simultaneously...

The ENVI console screen is an eight line by 40 character Super-twist LCD display that also allows 64x240 addressable dots in a graphics mode. The screen representations may have actual numbers or stylized (e.g. characters substituted for numbers, such as `sssssd` for `101 N`) representations for the parameters shown, depending upon the context and relevance. A sample set of screens appear as follows:

Stylized representaion

```
              -*MAG*-                      hh:mm:ss
TOTAL       NOISE       GRADIENT     LN:    11111d
mmmmm.m     9.99         gggggg.g    ST:    sssssd
mmmmm.m     9.99         gggggg.g           sssssd
mmmmm.m     9.99         gggggg.g           sssssd
mmmmm.m     9.99         gggggg.g           sssssd
                                     MEMF: nn%
                                     BATT:bbb
```

Actual representation

```
              -* MAG *-                    12:20:25
TOTAL       NOISE                    LN:       0 E
57800.71     0.05                    ST:     100 N
57800.70     0.04                            101 N
57800.72     0.05                            102 N
57800.71     0.06                            103 N
                                     MEMF: 95%
Reading..                            BATT: 119
```

HELP-LINE

In order to provide a high-degree and quality of technical support, a special HELP-Line is available for ENVI System users. If you need any help with the instrument, applying the instrument to a particular problem or help with the ENVIMAP software, please contact SCINTREX ENVI support at the following numbers:

In Canada:

Telephone:	(905) 669-2280
Fax:	(905) 669-6403 (Sales Department)
	(905) 669-9899 (Customer Service)
Telex:	06-964570

In the U.S.A.:

Telephone:	(918) 438-9255
Fax:	(918) 438-9226

In Australia:

Telephone:	61(9) 321-6934
Fax:	61(9) 481-1201

Internet:

World-wide web:	http://www.scintrexltd.com

INTRODUCTION

This manual is divided into nine chapters with the information flow from chapter to chapter following a natural progression, as shown in the following table:

Chapter	Description
1. Introduction	outlines what the instrument can do.
2. Preparation	describes the assembly of the system with the appropriate sensors in preparation for use.
3. Console	describes the physical parts of the ENVI console, keypad and display menus. It also describes the function of each key and the various modes and parameters shown on all the display screens.
4. Screens	describes all of the individual console display screens that you can encounter.
5. Setting up	gives step-by-step instructions on how to set up the instrument as either: a Total Field Magnetometer, a Gradiometer, a Magnetic Base Station, a VLF EM system, a VLF EM resistivity system, a Magnetometer/VLF unit or a Gradiometer/VLF unit.
6. Operations	guides you through typical instrument operation using basic, search and advanced configurations in a WALKMAG and a Stop-and-go type of survey, as well as VLF and resistivity modes.
7. Data Output	shows examples of data output formats and explains how to dump the acquired data.

Chapter	Description
8. Maintenance	describes basic maintenance, trouble-shooting and repair.
9. Reference	contains the technical specifications, instrument parts list and warranty information.

COLD BOOT

Note: *Please* read the section "First time operation" on page 5–1 so that you will know how to do a *cold boot* of the instrument. This is needed the first time you use it or after the batteries have been removed for more than 10 minutes.

INSTRUMENT OVERVIEW

The SCINTREX ENVI system is an easy-to-use, lightweight, battery-powered, portable magnetometer and/or VLF-EM system. The magnetometer is a total-field instrument using the proton-precession technique to measure the local magnetic field. Optional magnetometer upgrade kits allow the instrument to be used as a gradiometer or as a base-station. The standard configuration has the sensor mounted in a backpack mode permitting rapid data acquisition in the trademarked *WALKMAG* mode.

The ENVI VLF unit measures the vertical in-phase and quadrature components of the induced field, the total-field strength, dip angle, and primary field direction. With the VLF resistivity option, you can also measure the apparent resistivity and phase angle. The VLF sensor is mounted on a backpack and consists of a unique three-coil design that does not require orienting the sensor head toward the transmitter station. This greatly simplifies field procedures and saves considerable survey time.

The ENVI VLF can record measurements from up to three VLF transmitter frequencies concurrently. The console display shows the signal to noise ratio for each frequency, giving you an immediate indication of the quality of the signal from a given transmitter. You also have the option of automatically scanning the VLF spectrum from 15 kHz to 30 kHz to determine the most usable stations in your survey area. By using the full three frequency capability, you will be optimizing conductor coupling, even in the most complex geologic environments.

Measured data is stored in the ENVI console memory along with the coordinates where the measurement took place. In the advanced configuration modes, you can also enter descriptive notes of up to 32 characters at any station. The data can be displayed either numerically or graphically for quick inspection of the data quality and spotting of anomalies. Data can also be recalled from memory for visual inspection, dumped either to the serial port (RS-232) of a computer or directly to a printer. In addition to this, the base-station data can be recorded on a strip-chart recorder. You can also automatically correct your magnetic or VLF total-field data for diurnal variations when another similarly equipped ENVI system is used as a base-station or when you conduct your survey in the TIE-LINE or TIE-POINT modes.

To make the ENVI MAG easy to use for magnetic surveying, there are several preset configurations for site characterization, drum location, archaeology, general search, ground water, mineral, oil and gas exploration. These configurations fall into three categories: *basic* and *search* (for which you need to set only a few parameters) and *advanced* (in which you have complete control over all operating modes). The ENVI VLF setup operates similar to the advanced mode of the ENVI MAG, in that you have complete control over all of the operating parameters.

The operating modes of the ENVI System can be manual, semi-automatic or fully automatic. In the WALKMAG (*walk*ing *mag*netometer) mode, data are acquired and recorded at rates of up to two readings per second, as you walk at a steady pace along the survey line. At desired intervals, you *trigger* a station marker by pressing a single button and the co-ordinates are automatically assigned to the recorded data. You can even introduce delays in the automatic recording to compensate for walking over rugged terrain.

PREPARING THE ENVI SYSTEM

This chapter describes:

- how the ENVI system is packaged,
- how to connect the components to get an operational unit,
- the various options you may have for powering the unit.

The following three photographs show the basic components (less packing materials) of the standard ENVI MAG, ENVI GRAD and ENVI VLF system.

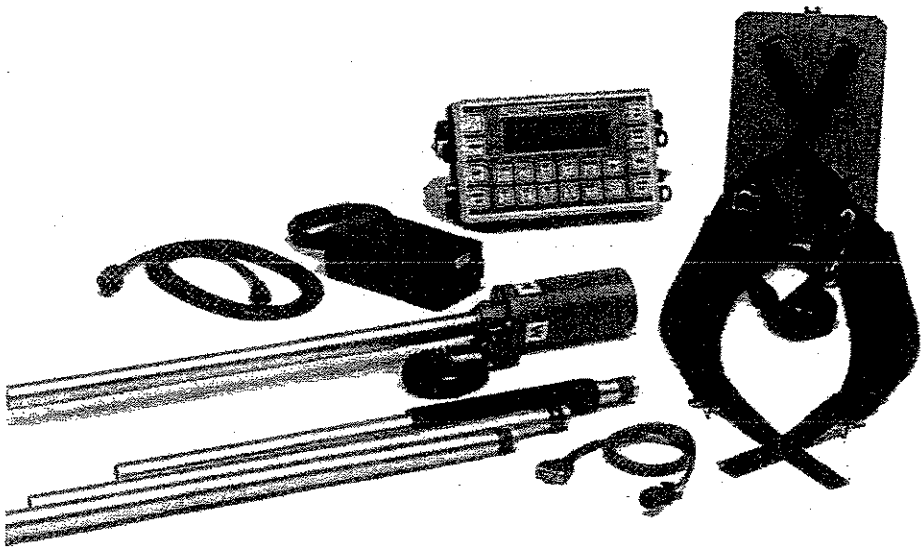


Figure 1 The basic ENVI MAG kit.

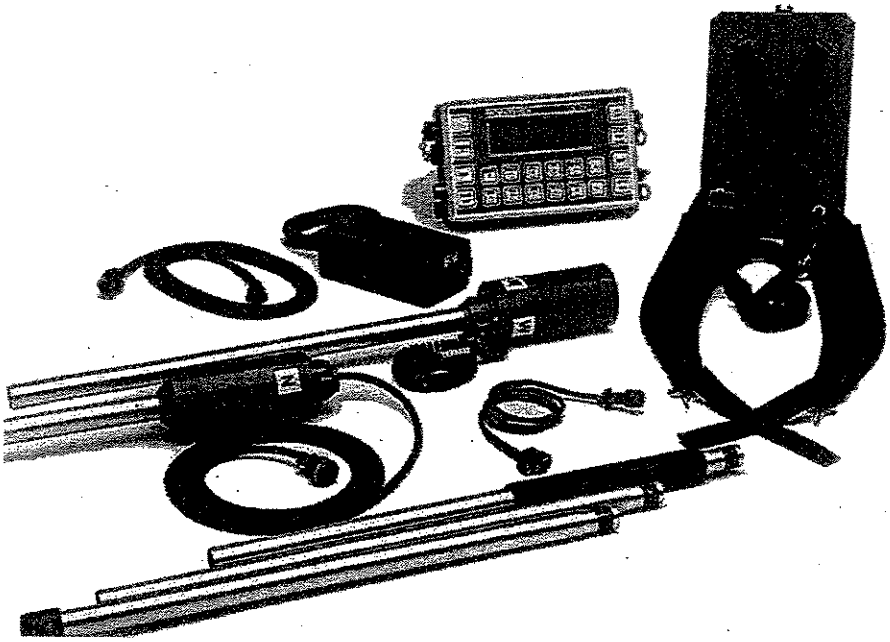


Figure 2 The basic ENVI GRAD gradiometer kit.

Figure 3 The basic ENVI VLF kit.

PACKING AND SHIPPING

Depending upon which system configuration you have ordered, your ENVI System will come in one of two types of transit cases. The following two photographs show the transit cases for the ENVI MAG/GRAD and the ENVI MAG/VLF or GRAD/VLF with the optional BACK PACK.

Warning: The batteries must be *removed* from the ENVI console prior to shipping or storage.
FAILURE TO DO SO MAY RESULT IN DAMAGE.

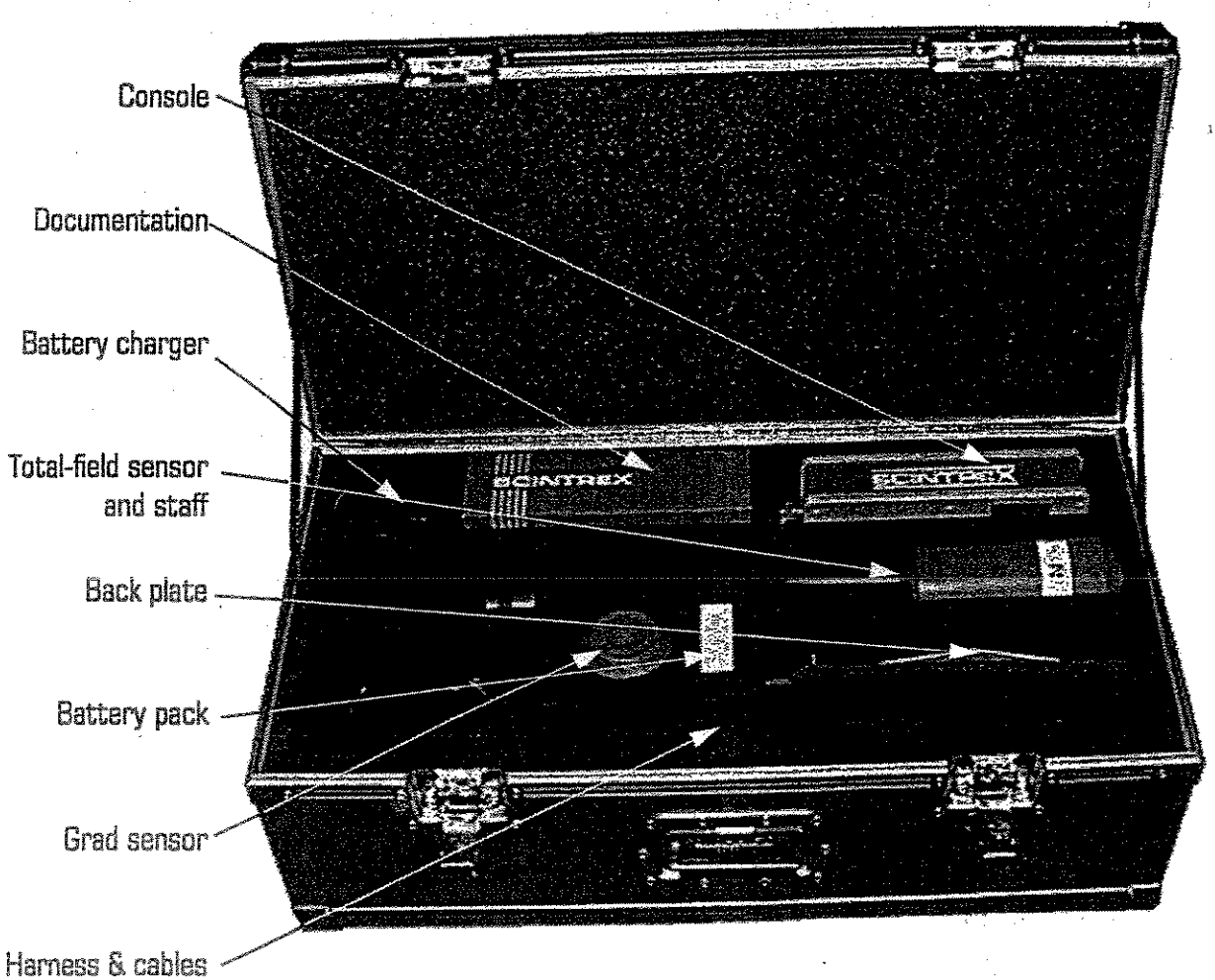


Figure 4 The ENVI MAG/GRAD transit case (SCINTREX P/N 788 507) showing the location of all components.

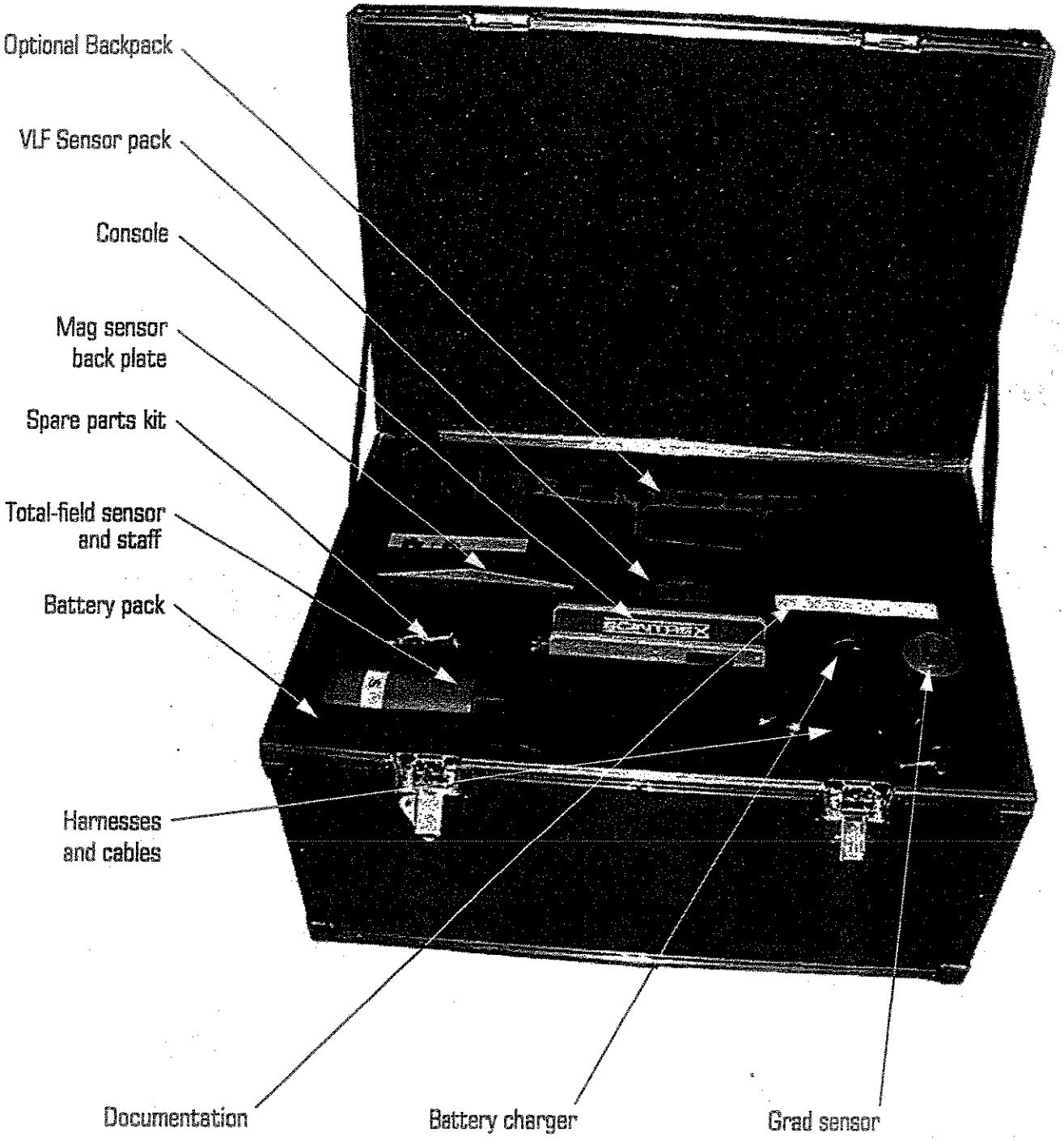


Figure 5 The ENVI VLF transit case (SCINTREX P/N 788 508) with complete GRAD kit and optional BACK PACK.

ASSEMBLY

In order to make the system as compact as possible for shipment and storage, and considering the various sensor configurations available, the ENVI MAG/GRAD System requires you to connect up the external components. The VLF sensor module is already assembled as a single unit, but it is not connected to the console. This section will describe the steps required to completely assemble your instrument.

MAGNETIC SENSORS

Connecting the magnetic sensor(s) to the cable

In the event that the magnetic sensors are not connected to the cables (for example, you may have just received a replacement sensor), the following sections provide you with step-by-step instructions and illustrate the proper cable connections for each of the different magnetic sensor configurations. The view of the sensors (in Fig. 6 to Fig. 8) is from the bottom looking at the screw terminals.

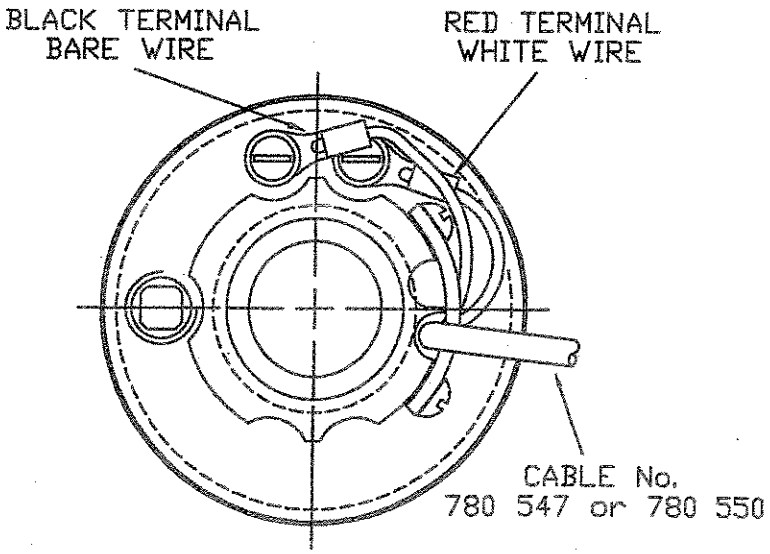
Note: You may also have to remove the terminal protective cover. Please see "Installing the terminal protective cover" on page 2–10 and reverse the steps of the procedure.

Caution: All parts near the sensor are *non-magnetic*. It is highly recommended that you use only the *brass* screws and wire connectors supplied by SCINTREX. There are additional screws for the terminals and cable hold-down in the minor spare parts kit (SCINTREX P/N 788 030).

If you ever need to replace any of these parts under field conditions, please ensure that they are made of *non-magnetic* materials.

Total-field sensor

1. **Orient** the sensor so that as you look at the bottom of the sensor (the end with the terminals), the large square plug is at the 9 o'clock position.
2. **Use** either SCINTREX cable number 780 547 (the shorter one) for the backpack configurations or cable number 780 550 for the staff configuration.
3. **Remove** the cable hold-down plate by unscrewing the screws at the 2 o'clock and 4 o'clock positions.
4. **Connect** the *black* spade-lug on the *bare* wire of the cable to the terminal at the 11 o'clock position.
5. **Connect** the *red* spade-lug on the *white* wire to the terminal at the 1 o'clock position.
6. **Place** the cable in the *smaller* slot just *below* the 3 o'clock position.
7. **Re-attach** the cable hold-down plate.



TOTAL FIELD SENSOR

Figure 6 Total-field sensor cabling

Base-station sensor

1. **Orient** the sensor so that as you look at the bottom of the sensor (the end with the terminals), the large square plug is at the 9 o'clock position.
2. **Use** SCINTREX cable number 780 546.
3. **Remove** the cable hold-down plate by unscrewing the screws at the 2 o'clock and 4 o'clock positions.
4. **Connect** the *black* spade-lug on the *black* wire of the cable to the terminal at the 11 o'clock position.
5. **Connect** the *red* spade-lug on the *white* wire to the terminal at the 1 o'clock position.
6. **Place** the cable in the *larger* slot just *above* the 3 o'clock position.
7. **Re-attach** the cable hold-down plate.

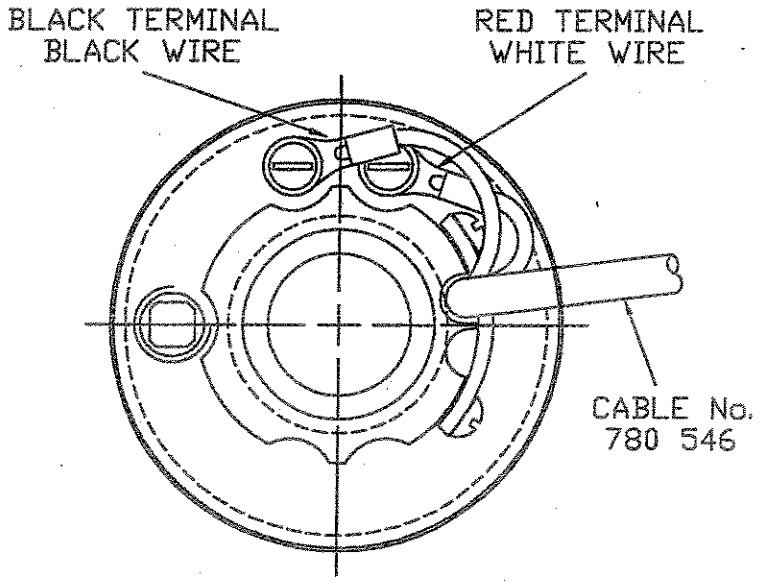


Figure 7 Base-station sensor cabling

Gradiometer sensors

Lower sensor

1. **Orient** both the sensors so that as you look at the bottom of the sensors (the end with the terminals), the large square plug is at the 9 o'clock position.
2. **Use** SCINTREX cable number 788 028—it has four conductors.
3. **Select** the *lower* sensor—it has pairs of terminals at the 12 o'clock and 6 o'clock positions, as well as an attached cable to the terminals at the 6 o'clock position. (See Figure 8 on page 2–9)
4. **Remove** the cable hold-down plate by unscrewing the screws at the 2 o'clock and 4 o'clock positions.
5. **Connect** the *red* wire of the cable to the terminal at the 1 o'clock position.
6. **Connect** the *black* wire of the cable to the terminal at the 11 o'clock position.
7. **Connect** the *green* wire of the cable to the terminal at the 5 o'clock position. Please ensure that the already attached *bare* wire of the smaller two-conductor cable remains attached.
8. **Connect** the *white* wire of the cable to the terminal at the 7 o'clock position. Please ensure that the already attached *white* wire of the smaller two-conductor cable remains attached.
9. **Place** the smaller two-conductor cable into the *smaller* slot just *below* the 3 o'clock position.
10. **Place** the larger four-conductor cable into the *larger* slot just *above* the 3 o'clock position.
11. **Re-attach** the cable hold-down plate.

Upper sensor

12. **Select** the upper sensor—it only has a pair terminals at the 12 o'clock position. (Figure 8 on page 2–9)

13. **Attach** the upper sensor to the lower one by placing the shaft of the lower sensor into the socket of the upper one while rotating slightly *counter-clockwise*. When they are fully engaged, firmly twist them *clockwise* against each other.

Warning: Both sensors must have their *directional marks* aligned in the same manner, i.e. the N on the top sensor must be in-line with the N on the bottom sensor.

14. **Remove** the cable hold-down plate of the upper sensor by unscrewing the screws at the 2 o'clock and 4 o'clock positions.
15. **Connect** the *white* wire of the two-conductor cable coming from the lower sensor to the terminal at the 1 o'clock position.
16. **Connect** the *black* wire of the two-conductor cable coming from the lower sensor to the terminal at the 11 o'clock position.
17. **Re-attach** the cable hold-down plate.

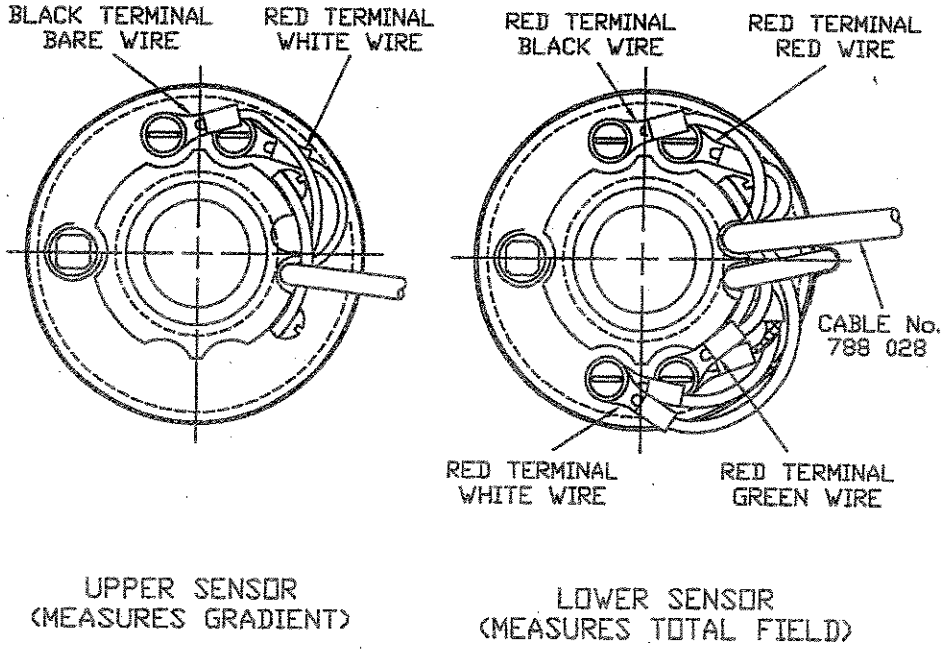


Figure 8 Gradiometer sensor cabling

Installing the terminal protective cover

A plastic cup-like assembly is included to slide over the base of the sensor(s) to protect the terminal connections from the elements.

To install the cover:

1. Slide it over the sensor shaft with the widest end pointing towards the sensor.
2. Slide the supplied *O-ring* into the grove on the shaft to lock it into place.

To remove the cover, just reverse the above procedure. First remove the O-ring and slide the cup away from the sensor.

Assembling the sensor staff

You can disregard this section if you are going to be using the ENVI system in the backpack mode.

The sensor staff is shipped in four sections. These sections are located in the shipping case slot labelled Sensor and staff in either Figure 4 on page 2–3 or Figure 5 on page 2–4. You should note that one of the sections has a sealed bottom, and you should start assembling the staff with this section.

Staff sections are assembled individually and connected to the sensors as follows:

1. Insert the male end partially into the female end and rotate *counter-clockwise* while gently pushing the two parts together.
2. When they are fully engaged firmly twist them *clockwise* against each other.

Note: The lower sections of the staff are interchangeable with those of the SCINTREX MP–3/4 magnetometers. The section nearest to the sensor, however, must be a section supplied with the ENVI MAG. These sections can be distinguished by their black ends.

Hands-free installation

A backpack mounting configuration is the most convenient, providing a hands-free operation for the WALKMAG or WALKGRAD modes.

ENVI MAG

To assemble the unit for the ENVI MAG back plate (SCINTREX P/N 788 024):

1. **Select** the back plate and the carrying harness—from the appropriate slots of the carrying case (see Figure 4 on page 2–3 or Figure 5 on page 2–4). You can also use the optional BACK PACK (SCINTREX P/N 788 040).
2. You may need to attach the foam cushion for the back plate. **Fit** the four buckles at the back of the harness through the slots in the cushion and the back plate to secure both to the harness.
3. **Attach** the total field sensor to the connector at the top of the back plate. About a quarter-turn *clockwise* will secure the sensor to the back plate.

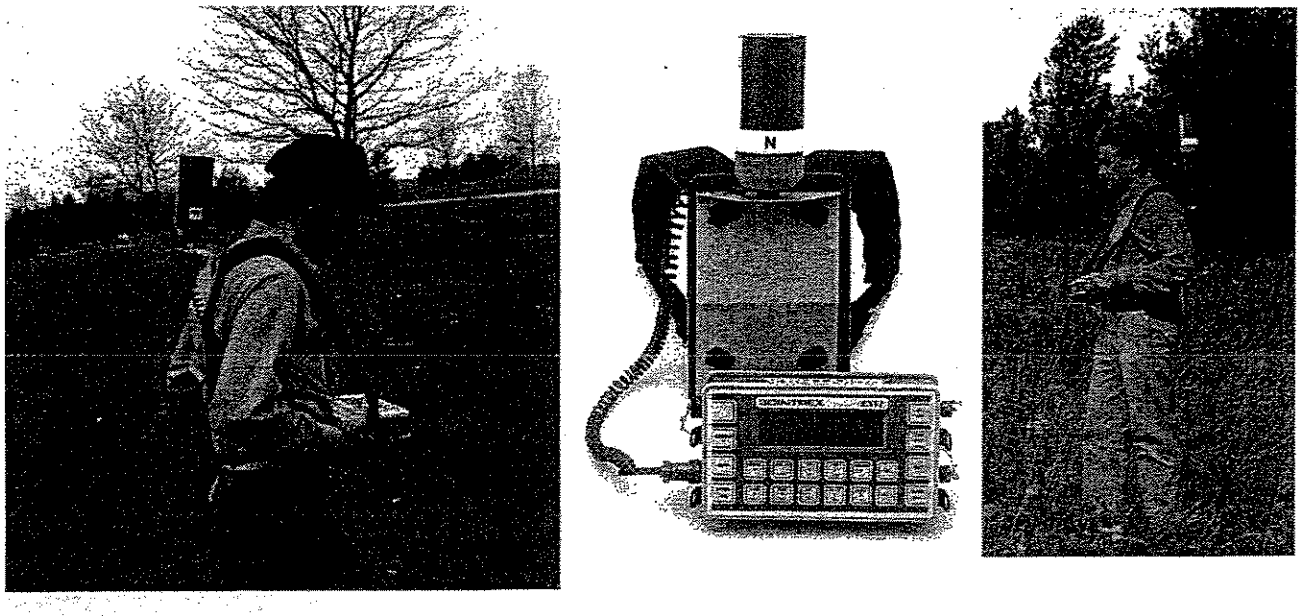


Figure 9 Total-field sensor installed in the *Backpack* mode on the standard (left & centre) back plate and optional frame (right) BACK PACK.

ENVI GRAD

You can install the gradiometer sensors on either the ENVI MAG back plate (SCINTREX P/N 788 024) or the optional general-purpose BACK PACK frame (SCINTREX P/N 788 040).

Caution: It is *not recommended* that you use the ENVI MAG back plate (SCINTREX P/N 788 024) with the gradiometer sensors, as the upper sensor will be prone to operator induced movement. This will tend to give noisy and inaccurate readings. Instead, please use the optional BACK PACK frame (SCINTREX P/N 788 040), as this keeps the sensors at a lower centre of gravity and they are less likely to suffer from motion induced noise.

The following steps are required to install the gradiometer sensor to the recommend optional BACK PACK.

1. **Select** the WALKGRAD back pack from the carrying case (see Figure 5 on page 2–4 and Figure 10 below).
2. **Select** the *assembled* gradiometer sensors (see "Gradiometer sensors" on page 2–8).
3. **Attach** the lower gradiometer sensor to the red connector rod at the top of the backpack frame. About a quarter-turn clockwise will secure the sensor assembly to the BACK PACK.

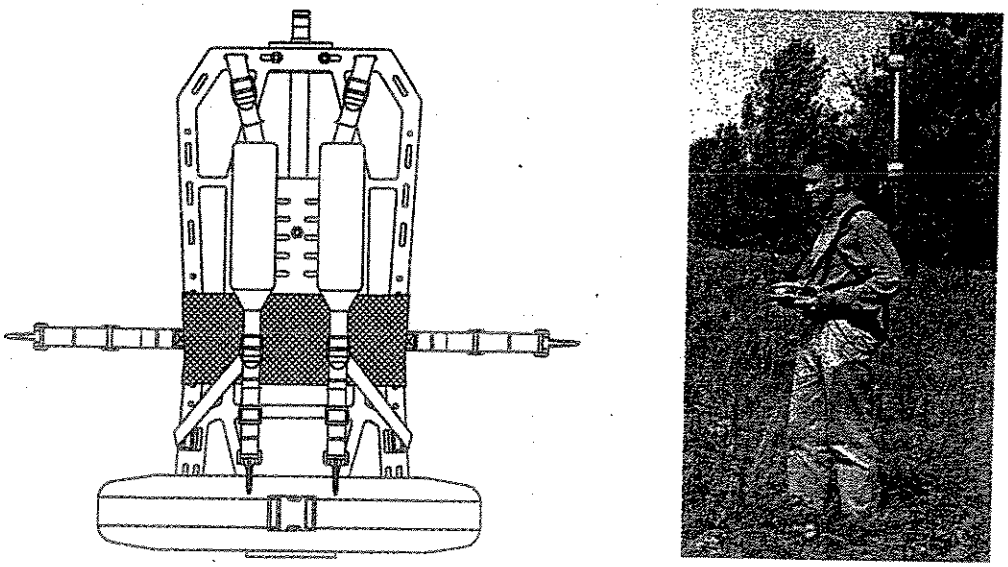


Figure 10 Optional general-purpose BACK PACK and gradiometer sensors attached.

Key	Description
BEEPER PORT	This blank "key" in the upper left corner of the console is not actually a key, but a flexible membrane to enhance the loudness of the beeper.
ON OFF + AUX/LCD 1 ABC	Pressing the "ON" and "AUX/LCD" keys simultaneously performs the COLD BOOT operation, resetting the instrument to factory defaults.
ON OFF + SETUP 5 MNO	Pressing the "ON" and "SETUP" keys simultaneously allows you to: ▲ select between MAG only, VLF only and MAG & VLF console configurations ▲ select between Basic, Search or Advanced modes when in a MAG only console configuration.

* These items/key functions are only operational when you select the *Advanced* operating modes from the initial configuration menu.

CONFIGURATIONS

The ENVI console can be configured to operate as either a magnetometer, a VLF-EM or both. You make the selection from the applications menu that is always displayed immediately following a *cold-boot* or by pressing the "SETUP + ON" keys simultaneously. Once the configuration has been selected, there may be additional modes of operation that you can choose from depending upon your configuration. Details are provided in the next chapter.

ENVI MAG OPERATING MODES

For ease of use, the ENVI MAG/GRAD system a menu of seven pre-defined configurations, in three modes, to choose from. The menu to select one of these modes is obtained by pressing the "SETUP + ON" keys simultaneously and selecting the MAG only mode.

Basic mode

- used for site characterization, drum location and archaeology
- operates in the WALKMAG mode (continuous reading)
- does not have on-line data recall features; you have to dump the data to a computer to inspect it—you can still see a graphical display of the data
- data correction is from a base-station or the TIE-PT loop mode only

Search mode

- operates in a continuous reading mode, but the data is *not* stored in memory
- you can see a graphical display of the data as it is collected

Advanced mode

- used for ground water, mineral, oil and gas exploration or detailed site characterization, drum location, archaeology, etc.
- allows you to adjust *all* possible parameters of the ENVI system

ENVI VLF OPERATING MODES

- used for environmental, geotechnical and mineral/water exploration applications
- can obtain data from as many as three VLF transmitting stations, providing complete coverage of an anomaly
- measures up to three VLF frequencies, optimizing conductor coupling
- unique three-coil sensor can be used in any orientation, simplifying operation
- can obtain repeatable readings from weak signals, thereby extending use of VLF to more countries, and increasing the number of usable frequencies
- VLF Resistivity Option offers either a two-probe or three-probe (non-orientating) configuration

DISPLAY SCREENS

The ENVI MAG system currently has seven preset configurations while the ENVI VLF has only one. Depending upon which of the configurations you choose to survey with, you may not see all of the various types of displays:

- configuration selection menus
- help screens
- confirmation screens
- parameter selection screens
- note entry screens
- numeric data displays
- graphical data displays
- pop-up options and confirmations

GENERAL INFORMATION

Most of the screens consist of three bands of information as shown below:

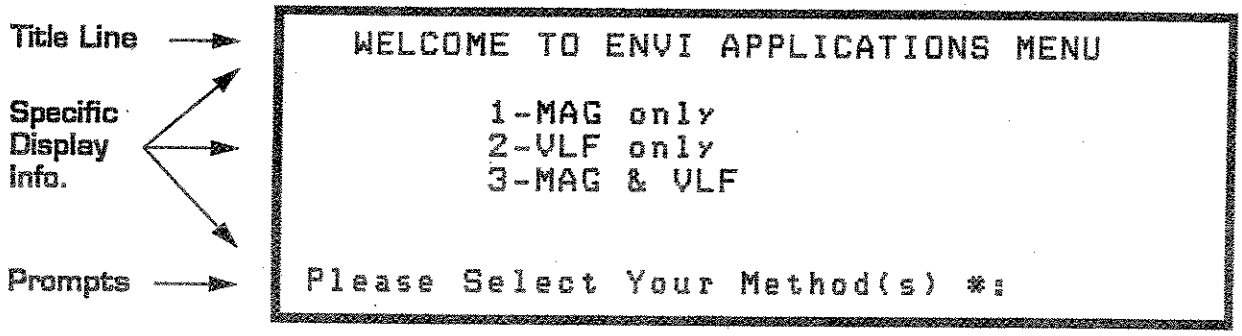


Figure 20 General display information bands

1. The **Title Line** at the top indicates the current operating functions.
2. The middle six lines contain specific display information consisting of either instrument and survey parameters or data.
3. The bottom line usually contains prompts for actions, such as pressing the key required to start an operation. Miscellaneous messages may also appear here. The battery voltage (values between 100 and 140) is also shown on the right-side of this line.

Note: The instrument automatically turns off (blank display) to conserve battery power, if there is no reading or key stroke detected for one minute.

Cursor

A large, blinking *cursor* (▮) indicates the specific parameter that can be altered to change setups, starting station value, station or line spacing, and so on. The cursor is moved from parameter to parameter or line to line by pressing the arrow (← →) keys to move in the desired direction. The prompt on the bottom line will let you know which key to press to make any changes.

Display blocks

Some displays are divided into two or more *blocks* or sub-panels. The blocks are separated by solid partition lines as shown in the following figure.

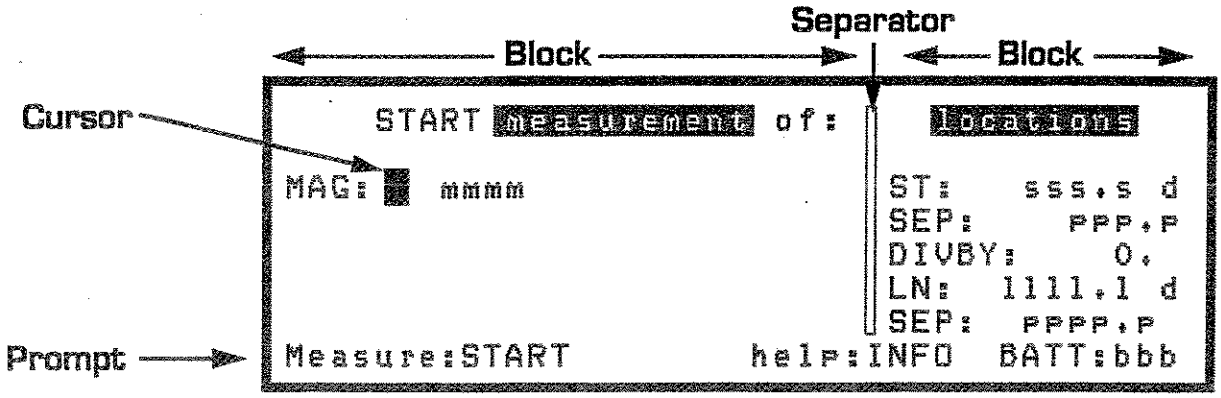


Figure 21 Instrument display showing information blocks (sub-panels)

To move the cursor from one block to another, press the "NEXT" key.

Some measured data is displayed on more than one *page* (display screen). Switching between pages is also done by pressing the "NEXT" key. The display screens are designed so that these multi-page displays do not have separate sub-blocks. All of this is discussed in detail under "Advanced mode data displays" on page 4–21.

Pop-up windows

Some displays will have pop-up windows (either on the right or left side of the main display) that will contain:

- prompts for selecting or changing parameters
- confirmations and warnings of impending operations requiring a Y (yes) or N (no) entry from the keypad
- status indication of an operation under way, such as data output

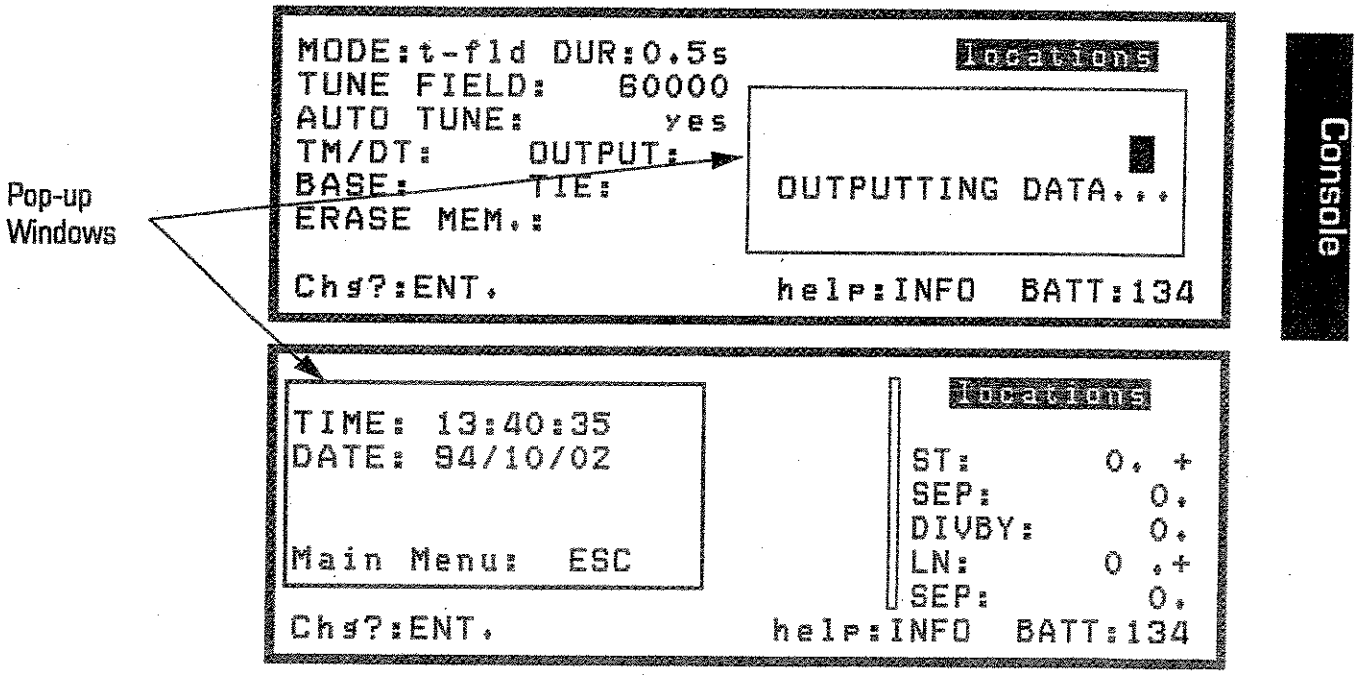
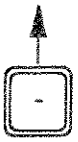


Figure 22 Sample pop-up windows

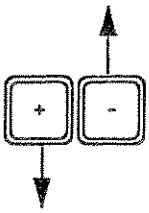
Help screens

On-line help is also available. There are three screens of information providing a quick reference on how to do most operations and which buttons to push. The screens are as follows:



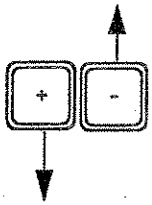
```
Cold Boot:AUX-ON simult.
Follow setup inst. bottom left line
To change application:SETUP-ON simult.
Switch Window:NEXT
Read:START/STOP..Tie point read:TIE
On-line, NEXT to tag station

Main Menu: ESC ▌  V4.3F      more +-
```



```
On-line, rate than 1,2,5,0=10 read/sec
Read end:NUM/GRA, NEXT to view data
On graph:ENTER recall,+-Scale, 0 center
On num, beep on=+, off=-
Appl. 1-3 Base Fld. default to 50000
To reprogram system:Appl.*5,6,7 AUX/LCD

Main Menu: ESC ▌  V4.3F      more +-
```



```
HOT/MENU KEYS: (appl. 5,6,7)
 SETUP:  Main instrument, method setup
 NOTE:   Define notes,macros
 RECALL: Off-line data recall
 INFO:   tm/dt,oper,Job#,ser#,batt,mem
 AUX:    lcd intens,output,look,REP,OS

Main Menu: ESC ▌ V4.3F      more +-
```

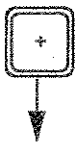
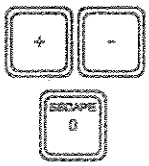


Figure 23 Help screens available

The help screens are displayed when you press the "INFO" button. Whenever you see the text `help:INFO` in the bottom prompt line of a display, you can activate the help screens.



To toggle to the another help screen, press the "+" or "–" key. The screens change in a cyclical manner as shown in the above figure.

To return to the MAIN OPERATING menu, press the "ESC" key.

OPERATING DISPLAYS

The various displays screens will be discussed in groups according to the methods (MAG only, VLF only, or MAG & VLF). The parameters for these screens will be summarized and explained in a table format.

CONSOLE CONFIGURATION

To configure the console for the appropriate instrument usage, you will need to bring up the CONSOLE CONFIGURATION menu by simultaneously pressing the "SETUP+ON" keys. The menu appears as follows:

```
  WELCOME TO ENVI APPLICATIONS MENU

         1-MAG only
         2-VLF only
         3-MAG & VLF


Please Select Your Method(s) *:
```

Figure 24 Console configuration menu

Select the instrument mode you wish to use by pressing either the "1", "2" or "3" keys.

MAG ONLY

This mode is selected by pressing the "1" key from the console configuration menu (Figure 24 on page 4–1). You will now be presented with the magentometer configuration mode selection menu. This menu continues across two screen displays and you mujst press the "+" or "–" keys to toggle between the screens.

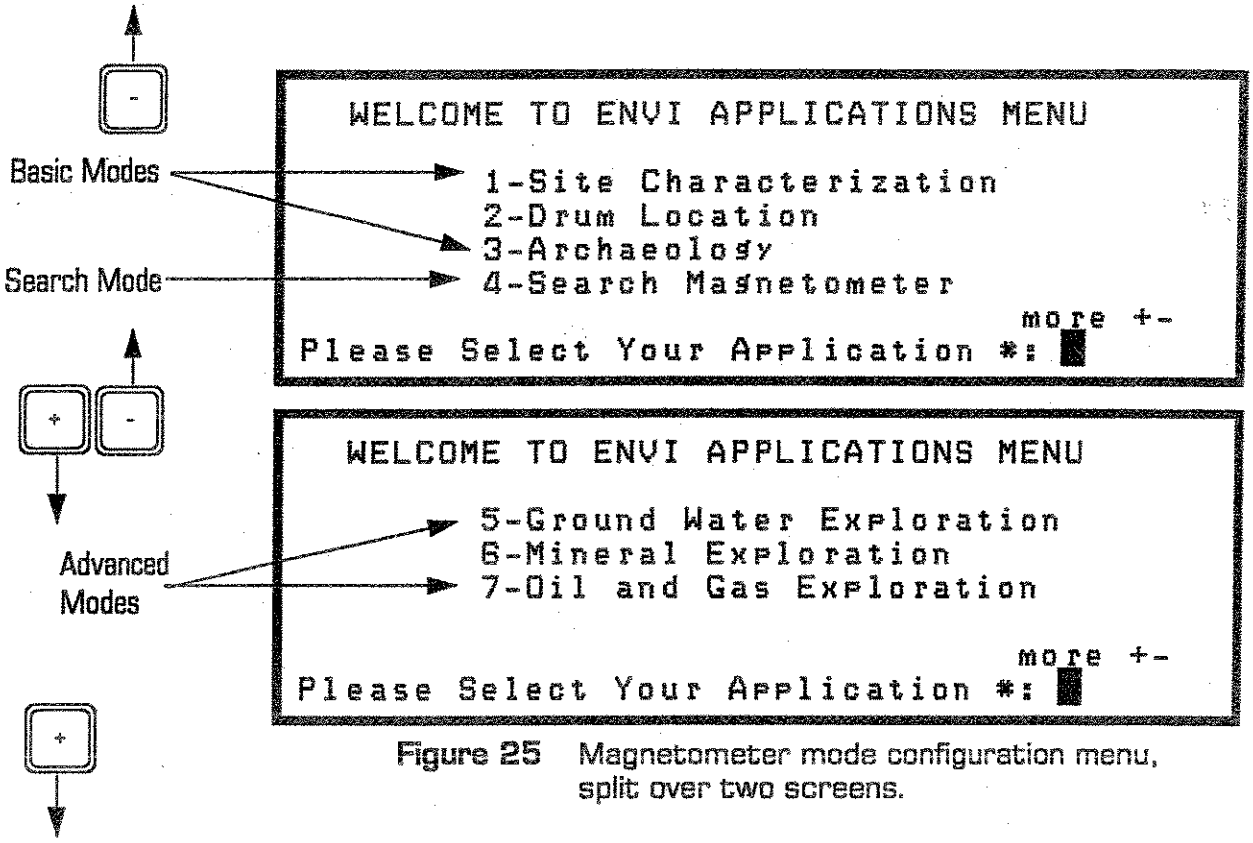


Figure 25 Magnetometer mode configuration menu, split over two screens.

This magnetometer mode configuration can be obtained at any time by pressing the "SETUP" and "ON" keys simultaneously.

The various display screens for the magnetometer configuration will be discussed in groups according to the configuration modes:

- basic
- search
- advanced.

BASIC MODE CONFIGURATION DISPLAYS

The basic mode of operation is in effect when you select either of the first three configuration options after pressing the "SETUP+ON" keys simultaneously:

1. Site Characterization
2. Drum Location
3. Archaeology

The following is the general layout of the MAIN OPERATING display in the BASIC mode:

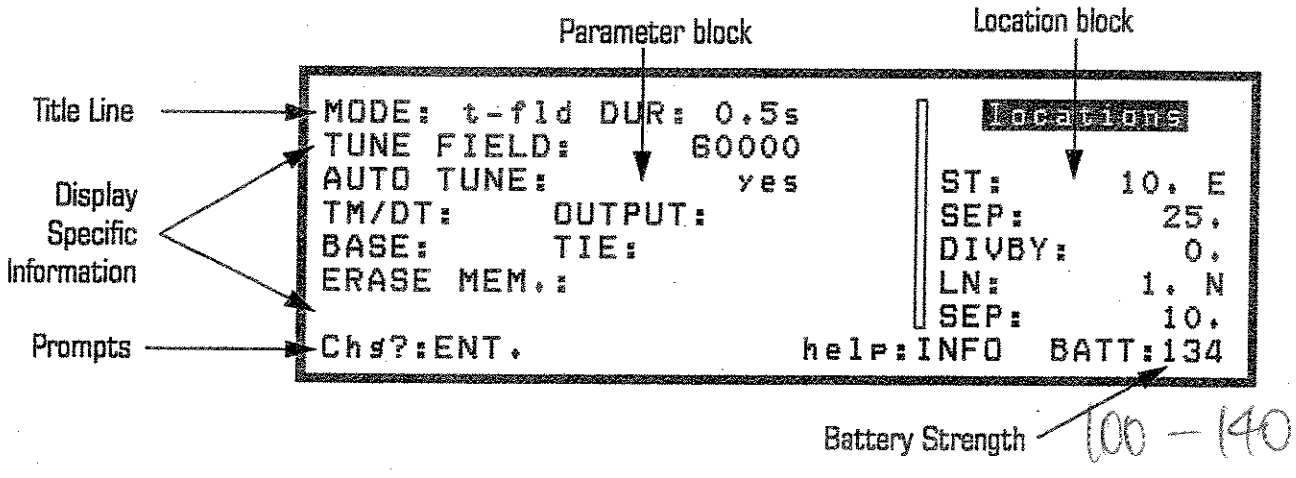


Figure 26 General display layout

The following table describes all of the parameters in the two blocks of the MAIN OPERATING displaymenu in the BASIC mode:

Parameter	Description
MODE	Allows you to select the ENVI-MAG operating mode: ▲ total-field magnetometer ▲ gradiometer ▲ base-station You must press the "+" or "–" keys to toggle between the modes.
DUR	The measurement duration. You have a choice of 0.5, 1 or 2 seconds. The selection depends upon the accuracy you want and the speed at which you will collect data. The longest duration gives the highest precision, but you will have to survey at a slower pace.
TUNE FIELD	The value of the Earth's ambient magnetic field in the survey area. For best performance the tuning field should match the ambient field as closely as possible, at least to within +/– 1000 nT. A map showing the approximate field intensity on the Earth's surface can be found in the ENVI MAG Applications Guide, Figure 4 on page 5. The values shown can be used as a starting point, and applied equally to the Total-field sensor or the Gradiometer sensor. See also AUTO TUNE below.
AUTO TUNE	A "yes/no" toggle that controls the automatic tuning function. It is independent for the Total-field sensor and the Gradiometer sensor. The tuning value is updated after each reading in preparation for the next one. Auto tuning is particularly applicable if large variations of the ambient field are encountered over longer distances. Fixed tuning may be more appropriate in areas of large cultural electrical noise, or very narrow, unwanted, but large amplitude, anomalies. These may pull the tuning away from the desired frequency to that of the interfering frequency or to tuning field values greatly different from the background values. As the setting of this parameter depends upon your particular survey conditions, it is not possible to suggest the best setting. The mode should therefore be established by experimenting. However, in general, it is more applicable to use fixed tuning for the *site characterization* and *drum location* configurations.

Parameter	Description
TM/DT	This option allows you to set the time and date of your ENVI system. You must press the "ENTER" key. A pop-up window will be displayed showing the current values of TIME and DATE in your instrument. Use the arrow keys to move the blinking cursor to the field you wish to change. Press "ENTER" again and enter the value from the keypad. Finish the entry by pressing "ENTER" one more time. To get back to the main menu, press the "ESC" key. NOTE: If you will be using a base-station to correct the data, you must ensure that the date and time of both units are the same BEFORE you start collecting data.
OUTPUT	This option dumps your data to a computer via the serial port. The communications mode is fixed to 9600 baud, 8 bits, 1 stop bit and no parity. The format will be XYZ+. You must press the "ENTER" key. An information pop-up will be displayed telling you to press the "START" key when you are ready. You must have a computer connected using the supplied RS-232 cable (SCINTREX part no. 745 081) and you should be running the ENVIMAP software (*Prepare the Data:Dump instrument data* menu option)
BASE	This option applies a BASE-STATION correction using data supplied from a base-station ENVI system. You must press the "ENTER" key. You need to have the base-station connected as described in "Using base-station data (Mag only)" on page 6–35. A request for confirmation will be displayed in a pop-up window before your data is corrected. You must press the "9/YZ" (Yes) key to begin or the "5/MNO" (No) key to abort. NOTE: The original raw data is changed. To retain the raw data, you will have to dump it either a computer or printer before you correct your data.

Parameter	Description
TIE	This applies the LOOP mode correction to collected data. You must press the "ENTER" key. A request for confirmation will be displayed in a pop-up window before your data is corrected. You must press the "9/YZ" key to begin or the "5/MNO" key to abort. NOTE: The original raw data is changed. To retain the raw data, you will have to dump it either a computer or printer before you correct your data.
ERASE MEMORY	Allows clearing of the data memory. You must press the "ENTER" key. A request for confirmation will be displayed in a pop-up window before the actual erasure takes place. You must press the "9/YZ" (Yes) key to begin or the "5/MNO" (No) key to abort. NOTE: The rest of the setup parameters remain intact.
ST	The station number for this measurement. It consists of the numeric part (s s s . s) and the directional part (d). The range is from 0 to 99999 with a decimal point as required The direction allows the entry of the geographical direction or the Cartesian co-ordinates. The allowed entries are: N,E,S,W, + or –.
SEP	The line or station separation. The range is from 0 to 99999 with a decimal point, as required, and can either be positive (+) or negative (–). It may not necessarily represent the reading separation. When the separation is positive, the station number gets incremented by the separation. When the separation is negative, the station number gets decremented by the separation. NOTE: a negative (W,S,–) station, when incremented, becomes less negative, and vice versa.
DIVBY	Trigger switch closure counter. See "ENVI Distance Trigger" on page 4-33.

Parameter	Description
LN	The line number, along which the measurements take place. It consists of the numeric part [1111.1] and the directional part [d]. The range is from 0 to 99999 with a decimal point as required. The direction allows the entry of the geographical direction or the Cartesian co-ordinates and is one of: N,E,S,W, + or –.
Chg?:+- ENTER	Depending upon which field the cursor is located in, you will see one of these prompts. Chg?:+- allows you toggle a selection from an internal list by pressing either the "+" or "–" keys. ENTER: Pressing "ENTER" will either pop-up a window for further operation or let you enter a numeric value (terminated by another press of the "ENTER" key)
help:INFO	This prompt indicates that the help screens are available when you press the "INFO" key.
BATT	The voltage of the main battery. The normal range is between 100 and approximately 140 when the charger is connected. The instrument may turn off without warning when the value drops below 100 and will not allow more measurements. The data however still remains intact in memory, as long as the main battery remains connected.

BASIC mode data collection displays

The display screen during data collection is as follows:

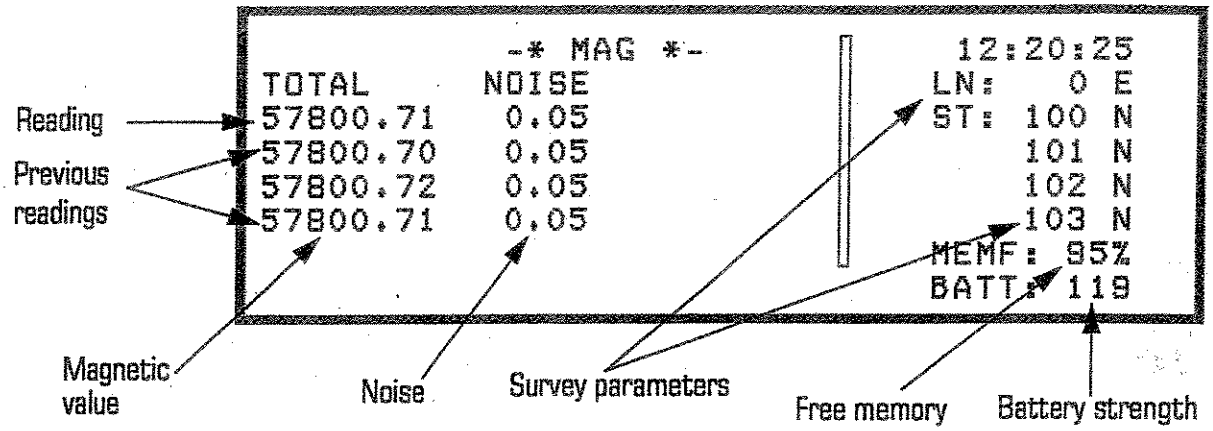


Figure 27 Data collection displays

If you stop or pause your survey (at the end of a line, for example), you can either review the data quality or see a graphical display of the data.

1. You can push the "NUM/GRA" key to display a profile of up to the *last* 178 data points collected along the line (LN). The display appears as follows:

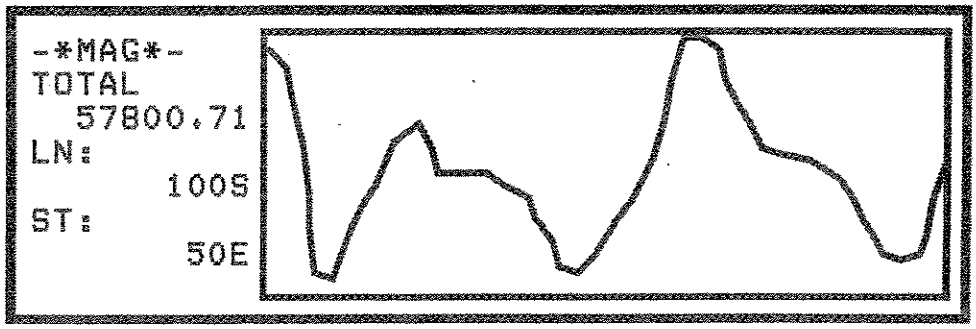


Figure 28 Graphical display of a survey line.

2. You can press the "NEXT" key to pop-up the graphical display of the precession decay signal of the *last* reading. Very sharp, rapid decays

indicate possible poor signal conditions. The display appears as follows:

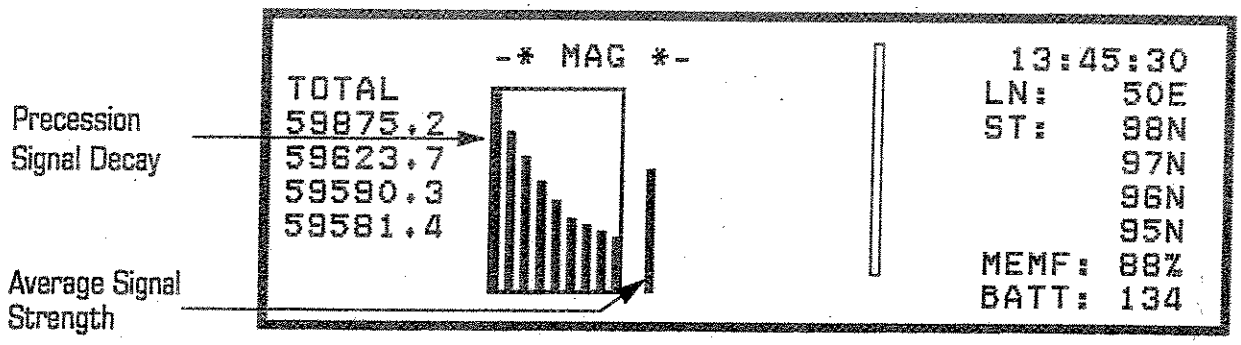


Figure 29 Graphical display of the last reading's signal quality.

SEARCH MODE CONFIGURATION DISPLAY

This mode is selected when you choose the following option from the configuration menu (available after pressing the "SETUP+ON" keys simultaneously):

4. Search Magnetometer

The MAIN OPERATING display in the SEARCH mode is as follows:

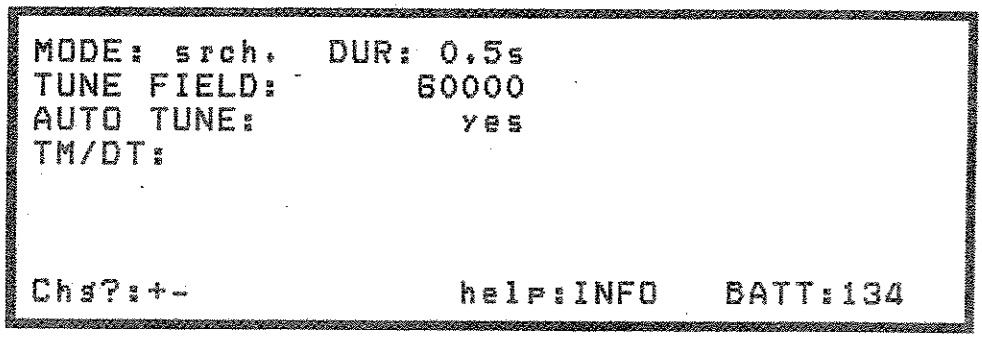


Figure 30 SEARCH mode main display screen

Parameter	Description
MODE	The mode is fixed to "search." The text `srch` is displayed as a reminder only.
DUR	The measurement duration. You have a choice of 0.5, 1 or 2 seconds. The selection depends upon the accuracy you want and the speed at which you will collect data. The longest duration gives the highest precision, but you will have to survey at a slower pace.
TUNE FIELD	The value of the Earth's ambient magnetic field in the survey area. For best performance the tuning field should match the ambient field as closely as possible, at least to within +/– 1000 nT. A map showing the approximate field intensity on the Earth's surface can be found in Section B: Applications, Figure B1-4: on page B-4. The values shown can be used as a staring point, and applied equally to the Total-field sensor or the Gradiometer sensor.
AUTO TUNE	A "yes/no" toggle that controls the automatic tuning function. It is independent for the Total-field sensor and the Gradiometer sensor. The tuning value is updated after each reading in preparation for the next one. Auto tuning is particularly applicable if large variations of the ambient field are encountered over longer distances. Fixed tuning may be more appropriate in areas of large cultural electrical noise, or very narrow, unwanted, but large amplitude, anomalies. These may pull the tuning away from the desired frequency to that of the interfering frequency or to tuning field values greatly different from the background values. As the setting of this parameter depends upon your particular survey conditions, it is not possible to suggest the best setting. The mode should therefore be established by experimenting. However, in general, it is more applicable to use fixed tuning for the *site characterization* and *drum location* configurations.

Parameter	Description
TM/DT	This option allows you to set the time and date of your ENVI system. You must press the "ENTER" key. A pop-up window will be displayed showing the current values of TIME and DATE in your instrument. Use the arrow keys to move the blinking cursor to the field you wish to change. Press "ENTER" again and enter the value from the keypad. Finish the entry by pressing "ENTER" one more time. To get back to the main menu, press the "ESC" key. NOTE: This is optional, since no data are recorded in the search mode.
Chg?+- ENTER	Depending upon which field the cursor is located in, you will see one of these prompts. Chg?:+- allows you toggle a selection from an internal list by pressing either the "+" or "-" keys. ENTER: Pressing "ENTER" will either pop-up a window for further operation or let you enter a numeric value (terminated by another press of the "ENTER" key)
help:INFO	This prompt indicates that the help screens are available when you press the "INFO" key.
BATT:	The voltage of the main battery. The normal range is between 100 and approximately 140 when the charger is connected. The instrument may turn off without warning when the value drops below 100 and will not allow more measurements. The data however still remains intact in memory, as long as the main battery remains connected.

SEARCH mode data collection displays

The display screen during data collection is as follows:

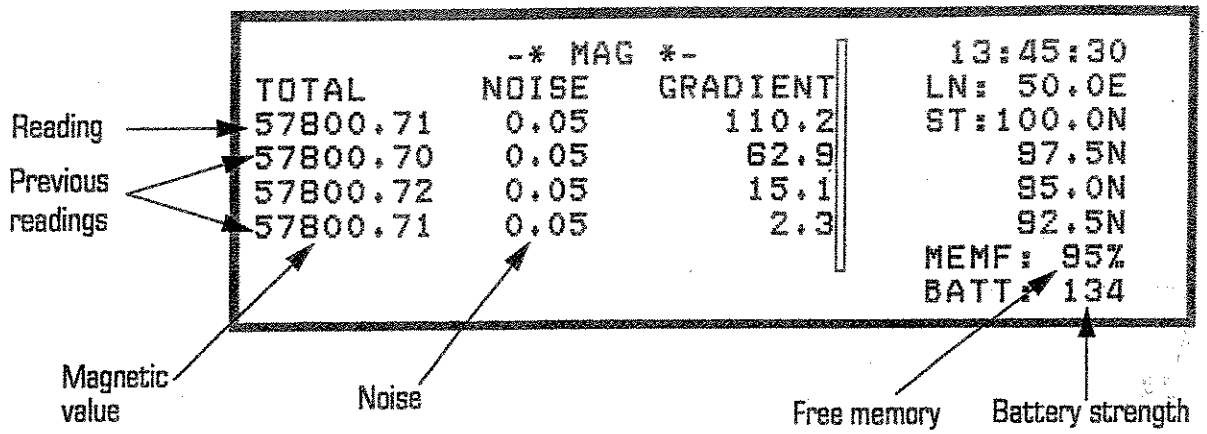


Figure 31 Numeric data collection display in SEARCH mode

You can push the "NUM/GRA" key to display a profile of up to the *last* 178 data points collected at any time in the SEARCH mode. The display is as follows:

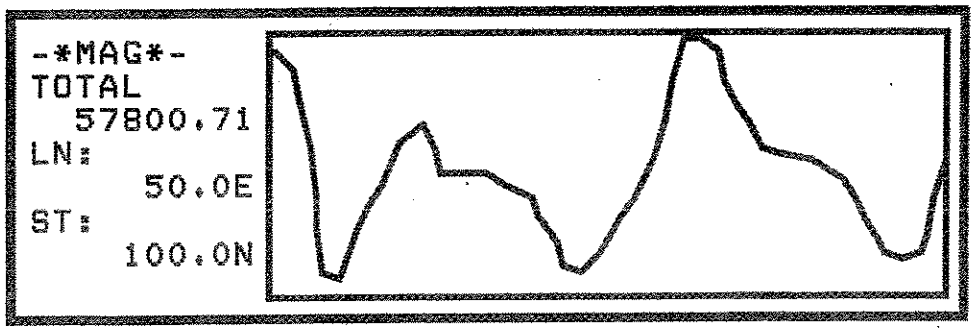


Figure 32 Graphical display during SEARCH mode.

If you stop the survey, you can press the "NEXT" key to pop-up the graphical display of the precession decay signal of the *last* reading. Very sharp, rapid decays indicate poor signal conditions. Please see Figure 29 on page 4–9 for an example of the signal quality display.

Note: The values that you see for the line and station in the numeric display are the last ones entered in a previous mode. The SEARCH mode does not use these for any purpose, so please ignore them.

ADVANCED MODE CONFIGURATION DISPLAYS

The ADVANCED mode of operation is in effect when you select either of these configuration options after pressing the "SETUP+ON" keys simultaneously:

5. Ground Water exploration
6. Mineral exploration
7. Oil and Gas exploration

MAIN OPERATING display

The ADVANCED mode MAIN OPERATING display appears as follows:

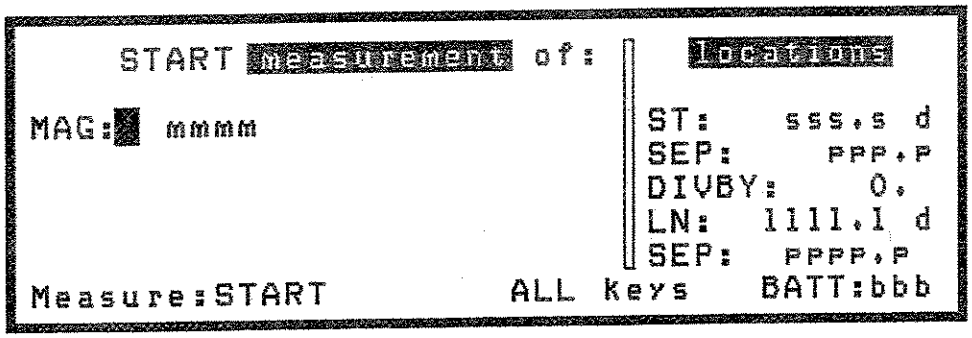


Figure 33 Main operating display in advanced mode

The configurable parameters of the MAIN OPERATING display are:

Parameter	Description
MAG	mmm shows which type of magnetometer measurement is currently enabled, and therefore ready to be started.
ST	The station number for this measurement. It consists of the numeric part (ssss.s) and the directional part [d]. The range is from 0 to 99999 with a decimal point as required. The direction allows you to enter the geographical direction or the Cartesian co-ordinates as one of: N,E,S,W, + or −.

Parameter	Description
SEP	The line or station separation. The range is from 0 to 99999 with a decimal point, as required, and can either be positive (+) or negative (–). It may not necessarily represent the reading separation. See the "NEXT" key and AUTO. St. INC. for more information. When the separation is positive, the station number gets incremented by the separation. When the separation is negative, the station number gets decremented by the separation. Note: a *negative* (W,S,–) station, when incremented, becomes *less* negative, and vice versa.
LN	The line number, along which the measurements take place. It consists of the numeric part [1111.1] and the directional part [d]. The range is from 0 to 99999 with a decimal point as required. The direction allows you to enter the geographical direction or the Cartesian co-ordinates as one of: N,E,S,W, + or –.
DIVBY	Trigger switch closure counter. See "ENVI Distance Trigger" on page 4–33.

Instrument setup display

This display enables you to configure the basic data acquisition portion of the ENVI system and is accessible with the "SETUP" key.

```
                Instrument Setup
MAG SETUP:[ ]->menu        AUTO ST.INC.:    yn
                           LINK REC/START:  yn
                           CYCLE REPEAT:    yn
                           CYCLE DELAY:     ddd
                           ERASE MEMORY:    yn
                           HEATER:          yn
Chg?:ENT.                                BATT:bbb
```

Figure 34 ENVI system instrument setup display.

Parameter	Description	Default
MAG SETUP	Displays the magnetometer specific setup menu. Pressing the "ENTER" key gets the next menu.	
AUTO ST.INC.	A "yes/no" toggle that controls the automatic station increment (decrement). no for the base station, walking or manual type of operation. yes for semi-automatic operation.	no
LINK REC/START	Link Record/Start This setting should be left at no for magnetometer only operation. (If this is enbled, i.e. yes, then the next measurement cycle will automatically start after the "RECORD" key is pressed.)	no
CYCLE REPEAT	Determines whether the magnetometer will take one reading only, or will continuously take readings at the time interval specified by the DURATION parameter in the Mag. Setup. This is **not** applicable for Base Station operation, which is set in the Mag Setup.	no
CYCLE DELAY	The delay between readings when the cycle repeat feature is enabled. It affects the total-field magnetometer or gradiometer only. The base-station repetition rate is controlled in the Mag. Setup under Cycle Time. The cycle delay is the time between the end of one reading to the beginning of the next reading. This delay is useful when the data density is thought to be too large, or in hilly terrain where the data density would increase when walking uphill.	0
ERASE MEMORY	Allows clearing of the data memory. A request for confirmation will be displayed in a pop-up window before the actual erasure takes place. NOTE: The setup parameters remain intact.	no

Parameter	Description	Default
HEATER	Enables or disables the LCD display heater. If the temperature is above –15° C, enabling this parameter has no effect.	no

Magnetometer setup display

This display provides access to the parameters affecting the operation of the magnetometer portion of the ENVI. This display is accessible from either the Instrument setup display, or from the Main operating display (by using the *short-cut*, i.e. pressing the "ENTER" key).

```
                    mag setup
MODE:          mmm   CYCLE TIME:     ttt
DURATION:      ddd   CHART SCALE:    sss
TUNE FIELD: fffff    AUTO TUNE:       yn
BASE CORRECT:   yn   BASE FIELD:   bbbbb
TIE CORRECT:    yn   TIE-MODE:       lll
REMOTE:         yn   AUTO RECORD:     yn
Chg?:+-                          BAT:bbb
```

Figure 35 Magnetometer setup display.

Parameter	Description	Default
MODE:	Allows the selection of: ▲ Total Field Magnetometer (*default*) ▲ Gradiometer ▲ Base Station ▲ Off (will disable the ENVI system).	t-fld

Parameter	Description	Default
DURATION	The measurement duration. A choice of 0.5, 1, or 2 seconds is available. The correct selection depends on the desired measurement accuracy and the spacing of the stations when using the WALKMAG mode of operation. The duration also controls the repetition rate if CYCLE REPEAT with a CYCLE DELAY of 0 (zero) was chosen in the ENVI Instrument Setup. The *longest duration* results in the *highest precision*.	0.5
TUNE FIELD	The value of the Earth's ambient magnetic field in the survey area. For best performance, the tuning field should match the ambient field as closely as possible, at least to within +/- 1000 nT. A map showing the approximate field intensity on the Earth's surface can be found in the ENVI MAG Applications Guide, Figure 4 on page 5. The values shown can be used as a starting point, and applied equally to the Total-field sensor or the Gradiometer sensor. See also AUTO TUNE: on page 4–4.	0
BASE CORRECT	A "yes/no" toggle that applies a BASE-STATION correction using data supplied from a base-station ENVI system. You must press the "+" key to toggle the `yes` on. You need to have the base-station connected as described in "Using base-station data (Mag only)" on page 6–35. A request for confirmation will be displayed in a pop-up window before your data is corrected. You must press the "9/YZ" (Yes) key to begin or the "5/MNO" (No) key to abort. NOTE: The original raw data is changed. To retain the raw data, you will have to dump it either a computer or printer before you correct your data.	no

Parameter	Description	Default
TIE CORRECT	A "yes/no" toggle that applies a tie-point correction using data collected in the TIE mode. Selecting this opens a window indicating which tie-point (loop or line) correction mode is in effect. You must enter "Y" to start the correction. NOTE: The original raw data is changed. To retain the raw data, you will have to dump it either a computer or printer before you correct your data.	no
REMOTE	A "yes/no" toggle that controls the RS-232 port for receiving commands from a data acquisition system, and for sending data after each reading.	no
CYCLE TIME	The reading interval of the base station. The allowable range is 0 to 9999 seconds. Entering 0 (zero) results in a reading interval equal to the reading time. The instrument goes to "sleep" between readings, for 4 seconds and up.	0
CHART SCALE	The full scale sensitivity for the analog output for the strip chart recorder. The following choices are available: 1, 10, 100, 1000, 10000 nT.	1

Parameter	Description	Default
AUTO TUNE	A "yes/no" toggle that controls the automatic tuning function. It is independent for the Total-field sensor and the Gradiometer sensor. The tuning value is updated after each reading in preparation for the next one. Auto tuning is particularly applicable if large variations of the ambient field are encountered over longer distances. Fixed tuning may be more appropriate in areas of large cultural electrical noise or very narrow, unwanted, but large amplitude anomalies. These may pull the tuning away from the desired frequency to that of the interfering frequency or to tuning field values greatly different from the background. As the setting of this parameter depends upon your particular survey conditions, it is not possible to suggest the best setting. The mode should therefore be established by experimenting. In general it is more applicable to use fixed tuning for the *site characterization* and *drum location* modes.	No
BASEFIELD	The base field is used in conjunction with the *base-station correction* procedure. The base-station correction technique removes variation in the ambient field during the time that the base station is running. However, variations taking place from day to day are not corrected. The base field value is used for this purpose. The actual value is not critical, as long as it is the same for all instruments in the survey. It is important that this value not be changed during the entire survey. A logical value is the first reading of the base-station on the first survey day.	0
TIE MODE	Allows to select either the Line or Loop type of tie-line correction. Note: The Tie-line correction method is substantially *less precise* than the base-station correction method.	Line

Parameter	Description	Default
AUTO RECORD	A "yes/no" toggle. This function is used in the semi-automatic mode to save you from having to press another key. Auto Record is always in effect in the base-station operation *or* if the Cycle Repeat function is selected in the ENVI system Instrument Setup.	no

ADVANCED MODE DATA DISPLAYS

Data is displayed on a page by page basis in either numeric or graphic form. There are up to two pages each. The "NUM/GRA" key toggles between the two display forms.

Numeric data display

Numeric displays are only available when the instrument is recording data, i.e. you cannot "recall" the data in a tabular format as shown in Figure 36 on page 4–21.

The displays shown in the examples that follow are *Pages 1* and *2* of the numeric data display for the gradiometer. The difference between the two display pages is that Page 2 shows the signal precession as a bar graph. This allows you to monitor the quality of each reading.

The total-field and the base-station displays *differ* in that the gradient column is absent.

The following table shows the availability of a numeric display after pressing the "NEXT" key.

	After "STOP" key & before "ESCAPE"key [a]	While reading	Base-station
Page 1	yes	yes	yes
Page 2	yes	no	no

a. You will have to use the "RECALL" function, if you have pushed the "ESCAPE" key.

```
                -*MAG*-                      hh:mm:ss
TOTAL       NOISE       GRADIENT      LN:    11111d
mmmmm.m      q.qq          g.g       ST:    sssssd
mmmmm.m      q.qq          g.g              sssssd
mmmmm.m      q.qq          g.g              sssssd
mmmmm.m      q.qq          g.g              sssssd
                                     MEMF: nn%
                                     BATT: bbb
```

Figure 36 Page 1 of the numeric data display.

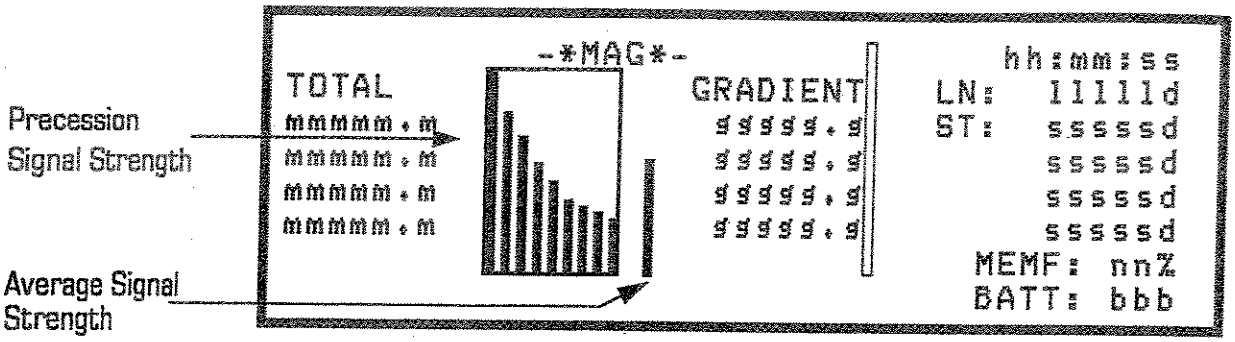


Figure 37 Page 2 of the numeric data display — signal strength.

Display Item	Description
TOTAL	The magnitude measured by the lower total-field sensor in nanoTeslas (nT). The most current reading is the *top* most followed by preceding readings.
NOISE	A number indicating the quality of the reading. It is based on the noisiness of the individual periods of the precession signal. The *smaller* the value the *better* the quality of the reading.
GRADIENT	The magnetic gradient between the two sensors. Expressed in nT/m.
TIME	The current time in hours:minutes:seconds. It is used to time stamp each reading.
LN	The line number on which this measurement took place. The value consists of the numeric and directional parts.
ST	The station number to which the respective magnetic data applies. The value consists of the numeric and directional parts.
MEMF	The percentage of free memory. Measurements can be made when the memory is full, however the data is no longer recorded.

Graphic data display

The display shown below is page two of the graphic data for the gradiometer. Page one appears identical, except that the word "GRADIENT" is changed to "TOTAL" and a plot of the total field is shown.

The following table shows the availability of graphic displays after pressing the "NEXT" keys.

NEXT	After "STOP" key & before "ESCAPE" key [a]	While reading	Base station
Page 1	yes[b]	no	yes
Page 2	yes[b]	no	yes

a. You will have to use the "RECALL" function, if you have pushed the "ESCAPE" key.
b. Depends upon the status before "STOP" was pressed

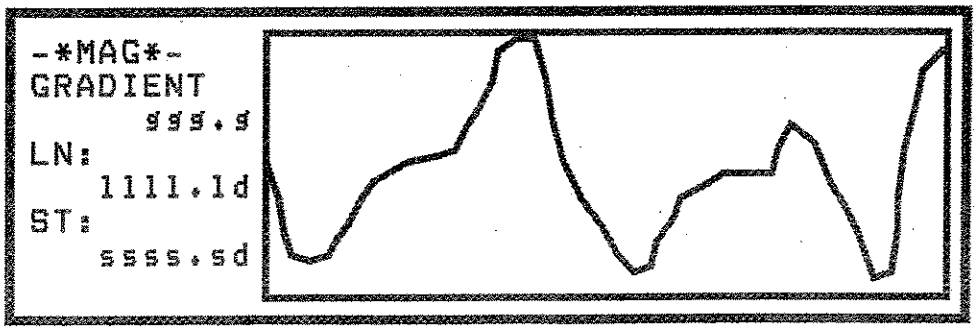


Figure 38 Graphic data display of page 2.

Display Item	Description
GRADIENT	The display title indicating the data shown by the graph. The numeric value indicated by gggg.g is the respective gradient, at the indicated Line and Station number.
LN	The line number along which this measurement took place, consisting of the numeric and directional parts.
ST	The station number, at the cursor position, to which the respective magnetic data applies (consisting of the numeric and directional parts).

RECALL DISPLAYS

The "RECALL" function is useful to view the collected and stored data.

RECALL SETUP display

This display allows you to select the type, location or time and date of the data. This display is accessed by pressing the "RECALL" key.

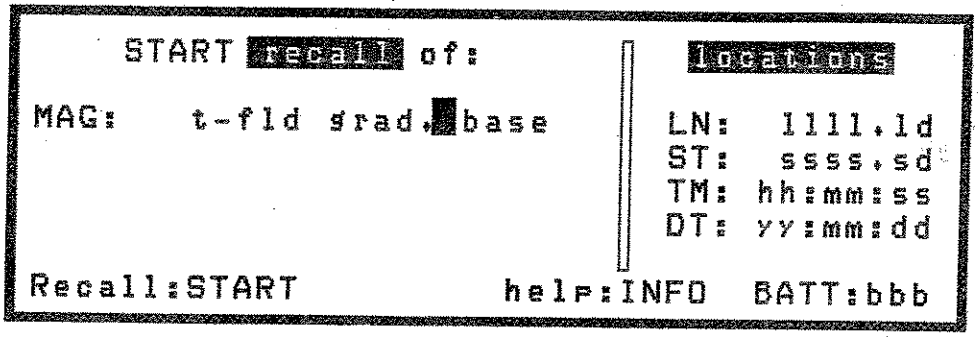


Figure 39 The RECALL SETUP display.

Display Item	Description
MAG	The mode of the data collected. Either one of Total Field, Gradient or Base Station.
LN	The line number whose data is to be recalled, consisting of the numeric and directional parts.
ST	The station number is the starting location for the recall, consisting of the numeric and directional parts.
TM	The starting time of the recall. This parameter is only present when the Base Station is selected.
DT	The date of the data to be recalled. This parameter is only present when the Base Station is selected.

Warning: Not only the Time and Date, but the Line and Station numbers must also be correct to successfully recall Base Station data.

RECALL DATA display

Data can be recalled only in *graphic* form. Up to 178 readings can be shown at one time. The display window can be moved sideways (called *panning*) in steps of one half of its width (i.e. up to 89 readings) to view adjacent data with the aid of the "+" or "–" keys. It is also possible to adjust the vertical scale and bring any point to the vertical center of the window.

Exact values can be read off the numerical section at the left hand side of the display.

The Total Field display is shown and explained. The Gradient display differs in title only. The Base Station display shows Time and Date instead of Line and Station. Note that there are *two* pages of data for the gradiometer.

START STOP CLEAR

These displays are accessible with the "START" key when in the RECALL SETUP display.

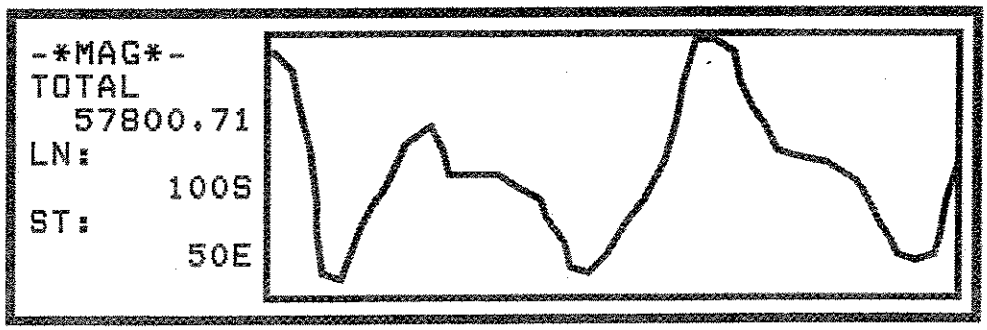


Figure 40 The RECALL DATA display.

Display Item	Description
TOTAL	The title of the display indicating the data shown by the graph. The numeric value indicated by mmmmm.m is the respective total-field value, at the indicated line and station number.
LN	The line number along which this measurement took place, consisting of the numeric and directional parts.
ST	The station number to which the respective magnetic data applies, consisting of the numeric and directional parts, at the *cursor position*. See the next page for more on cursor position.

Modifying the display window

The graph can be altered by changing the vertical scale or by centering any point vertically in the window. A smaller window can be opened up using the "ENTER" key to allow changes. The changes take effect after you next press "ENTER."

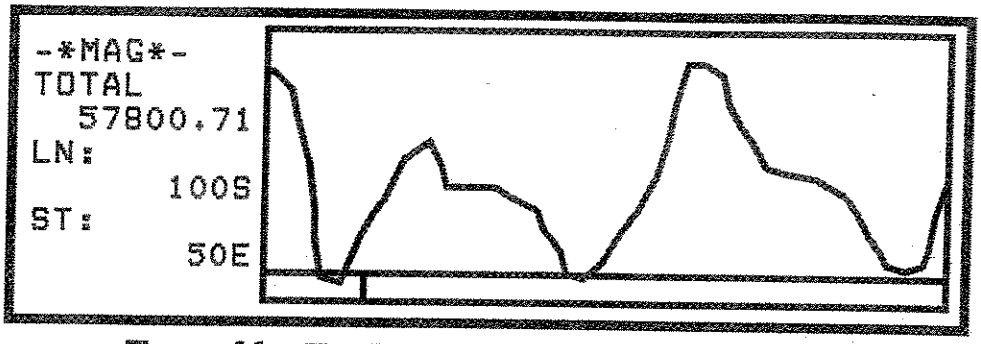


Figure 41 The Recall display ready for customizing

Display Item	Description
SCL	Shown after the "ENTER" key is pressed. It indicates the vertical full scale. Scrolling using the +/– keys allows the full scale values of 1, 10, 100, 1000, 10000 nT.
▮	This is the cursor, which is normally at the left edge of the window. It can be moved with the aid of the "←", "→" cursor keys. Numerical data at the left hand side of the display represents the data at the cursor position.

Pressing the "0" key, adjusts the display such that the point at the cursor position becomes the center value of the graph.

AUXILIARY FUNCTIONS DISPLAY

The AUXILIARY FUNCTIONS display is accessible by pressing the "AUX/LCD" key. It provides additional functions which are not directly accessible from the keyboard. You will need to press the appropriate key to get to the function.

```
                auxiliary functions

                (+- ESC) LCD Intensity
                (1) Data Output
                (2) Factory Test *
                (3) Lock                    OFF
                (4) Reprogram System
Select function
```

Figure 42 The auxiliary functions display.

Key pressed	Action under auxiliary functions
	These keys allow you to adjust the intensity of the LCD screen for better viewing under a variety of lighting conditions.
	This option allows you to access the Data Output menu to transfer information to your computer or printer.
	This function is reserved for production and service tests. It has no functions for you to use.
	The lock option allows you to lock the ENVI system setup parameters so that they are not accidentally changed. To make any changes, you will have to toggle this option first.
	This option allows you to update the EPROM in your ENVI system with more functionality. The software is supplied by SCINTREX.

DATA OUTPUT DISPLAY

This display allows the selection of:

- communication parameters between the ENVI console and the output device such as a computer or printer,
- the data format of the output,
- and possibly the Line number, if a line by line data dump is desired.

Data can be dumped in its entirety at once, or selectively on a mode basis.

This display is accessible from the AUXILIARY FUNCTIONS display.

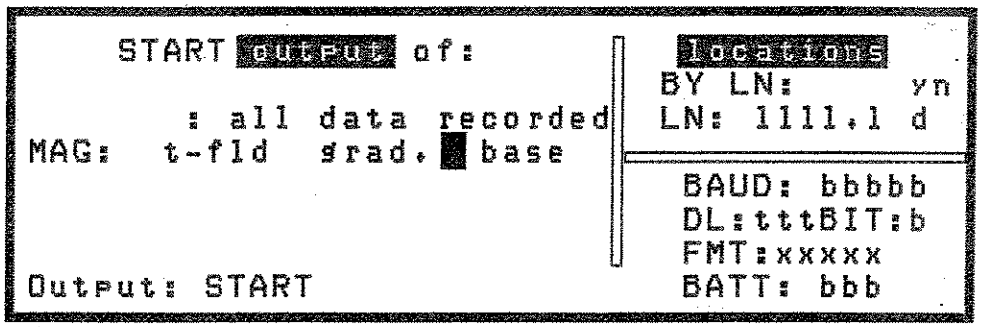


Figure 43 The data output display.

Parameter	Description	Default
: all data recorded	With the cursor placed after the colon, all the data in the instrument would be dumped sequentially into one, possibly very large file.	
MAG	Lists the modes available for the ENVI system. As shown, only the gradiometer data would be dumped as indicated by the cursor position	
BY LN	yes/no Directs the instrument to dump the data on a line by line basis, in addition to a method by method basis. This is usually left at no.	no

Parameter	Description	Default
LN	The line number whose data has to be dumped, consisting of the numeric and directional parts.	
BAUD	The Baud rate of communication with the output device. The following choices are available by scrolling: 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600 Baud.	9600
DL	A delay which may be added after each carriage return/ linefeed (CR/LF) to accommodate slow peripherals such as some printers. The range is 0 to 999 ms. This value is normally left at 0 for dump to computers. The proper setting has to be established experimentally for other equipment. Problems usually are indicated by the loss of a few characters.	0
BIT	The number of data bits. The default value is 8 bits, which usually works properly. The proper setting has to be established experimentally. For example, on some EPSON printers, 7 or 8 bits results in either normal or italic print.	8
FMT	The output data format. The formats are described briefly in the following table on page 4–30.	

Data output formats

The following table shows the available output formats for dumping the data to a computer or printer:

Data output format	Description
XYZ	XYZ is the simplest format, suitable for software packages such as ENVI-MAP. It contains no heading or comments. The individual data items are separated by a single space character. X and Y represent the cartesian coordinates (N and E are positive, while S and W are negative). Z is one or more items of magnetic data. There is one set of data per printed line, including the time of the measurement. CAUTION: Due to the lack of header information, you should label the files clearly.
XYZ+	XYZ+ is identical to XYZ, but a header and user entered NOTES are added.
XYZ++	XYZ++ is identical to XYZ+, but the data is now placed into columns.
PRN	PRN is a format used with software for the SCINTREX MP-3/4 Magnetometer.
NOTES	NOTES outputs a report of all user entered NOTES, cross-referenced with the Line and Station number.
BINARY	A binary dump for fast data transfer. The file will have to be post-procesed by the XFENVI program to provide the normal formats for the data.

NOTES DISPLAY

The notes display is useful for the entry of comments, which are stored with the data at the particular Line and Station number.

Macros (pre-recorded messages) provide a quick entry for repetitive notes which can be entered while measuring. This display is accessible with the "NOTE" key.

```
NOTES: *nnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnn

MACROS:
1: cccccccccccccc   2: cccccccccccccc
3: cccccccccccccc   4: cccccccccccccc
5: cccccccccccccc

Chg?:ENT.                        BATT:bbb
```

Figure 44 The NOTES display.

Parameter	Description
NOTES	Alpha-numeric characters, including "+","." and "–", up to 32 characters A note can be saved as one of five macros in a separate memory for re-use.
MACROS 1: . . . 5:	MACROS are pre-recorded messages of up to 15 characters. These are used to speed up note entry. It is most advantageous to enter frequently encountered items, such as *road*, *fence*, and so on.

INFORMATION DISPLAY

This display screen is used for the entry of ancillary information. You can also see how much free memory is available. This screen is accessed from the main display by pressing the "INFO" key.

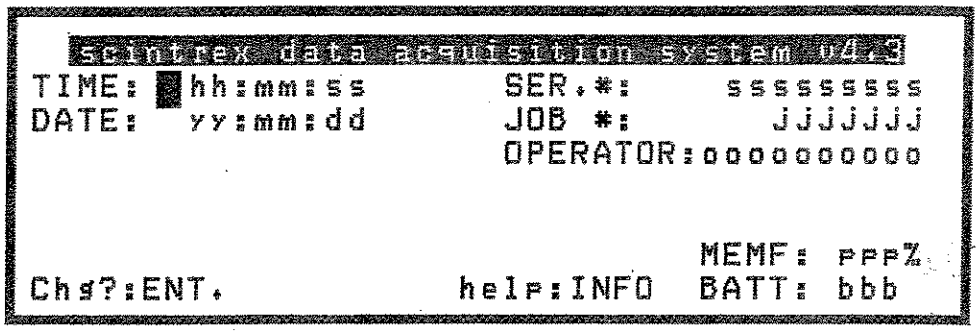


Figure 45 The INFO display.

Parameter	Description
Vx.x	The version number of the ENVI system internal software.
TIME	The current time of day.
DATE	The present date.
SER.#	This is usually the serial number of the instrument. No use is made of this number by the instrument, therefore it also could represent the users inventory number. Up to 8 digits are accepted.
JOB #	This may be the survey project number. Up to 6 digits are accepted.
OPERATOR	This is the operator's name or number. It can contain up to 10 characters.
MEMF	The percentage of free memory available for further use.

Warning: The TIME and DATE *must* match between the base-station and the portable magnetometer(s) for the base-station style of correction to work properly.

ENVI DISTANCE TRIGGER

The ENVI console external distance trigger is used in the WALKMAG mode in areas where no survey grid was placed ahead of time. The external trigger does not trigger a reading, but it triggers an increment in the station number by the station separation in the same manner as the NEXT key does.

The external trigger can be a measuring wheel or hip chain equipped with a normally open switch. A new menu item under '`locations`' called '`DIVBY`' is used to count trigger switch closures. If `DIVBY` is set to 150 for example, then the station will be incremented by the station separation after 150 switch closures of the external trigger switch.

Important: Set `DIVBY` to zero when not using the external trigger.

If the operator presses the NEXT key when using the external trigger, the station will increment by the station separation as usual, but this resets the trigger switch counter. The trigger switch counter will be reset whenever the NEXT key is depressed — no matter what menu you are in. So if you stop surveying in the middle of the count, and expect the counter to continue where it was after you restart — do not press the NEXT key.

If you are using a wheel, trigger switch closures should take place at 25 to 60 cm intervals, which means that a number of switch closures should take place per revolution of the wheel. The reason for this is to reduce the ambiguity at the start of the line.

Set `DIVBY` by the following formula:

DIVBY = (SEP/C) x n (wheel method)

DIVBY = (SEP/d) (hip chain method)

where: **SEP** is the station separation
C is the circumference of the wheel
n is the number of switch closures per revolution
d is the contact spacing of the hip chain

The station separation must be chosen as some multiple of the circumference of the wheel (if used).

For efficiency of memory usage, it is recommended that at least 25 readings take place in the time it takes to traverse the station separation. This rule of thumb then allows you to determine a minimum station separation:

minSEP = (25/rate) x speed

where: **minSEP** is the minimum station separation
rate is the number of sample per second
speed is the walking speed

So at 5 samples per second and a walking speed of 0.5 metres per second, the following minimum station separation is recommended:

minSEP = (25/5) x 0.5 = 2.5 metres

Of course, if a wheel is being used, the station separation must be a multiple of the wheel circumference and it must be greater than the minimum separation. For our example above (**minSEP** of 2.5 metres), if a one metre wheel is used, then **SEP** must be at least 3.0 metres, since 3.0 is the first multiple of 1.0 metre greater than 2.5 metres.

VLF ONLY

If you want to use the ENVI system in the VLF mode, you should choose the 2. VLF only option from the general ENVI display (please see Figure 24 on page 4–1).

MAIN OPERATING DISPLAY

The VLF MAIN OPERATING display appears as follows:

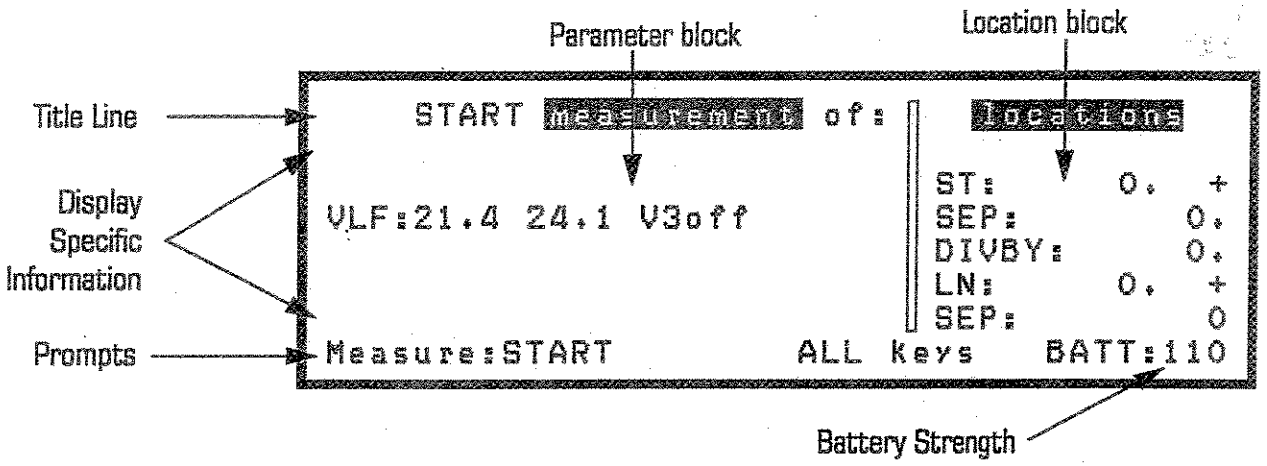


Figure 46 MAIN OPERATING display in VLF only mode.

The configurable parameters of the VLF MAIN OPERATING display are:

Parameter	Description
VLF	21.4 24.1 V3off indicates that the first two frequencies have been set to 21.4 and 24.1 kHz respectively. The third frequency (V3) has not been set.
ST	The station number for this measurement. It consists of the numeric part (sss.s) and the directional part (d). The range is from 0 to 99999 with a decimal point as required The direction allows the entry of the geographical direction or the Cartesian co-ordinates. The allowed entries are: N,E,S,W, + or –.

Parameter	Description
SEP	The line or station separation. The range is from 0 to 99999 with a decimal point, as required, and can either be positive (+) or negative (–). It may not necessarily represent the reading separation. When the separation is positive, the station number gets incremented by the separation. When the separation is negative, the station number gets decremented by the separation. NOTE: a negative (W,S,–) station, when incremented, becomes less negative, and vice versa.
DIVBY	Trigger switch closure counter. See "ENVI Distance Trigger" on page 4–33.
LN	The line number, along which the measurements take place. It consists of the numeric part [1111.1] and the directional part [d]. The range is from 0 to 99999 with a decimal point as required. The direction allows the entry of the geographical direction or the \Cartesian co-ordinates and is one of: N,E,S,W, + or –.
Chg?:+- ENTER	Depending upon which field the cursor is located in, you will see one of these prompts. Chg?:+- allows you toggle a selection from an internal list by pressing either the "+" or "–" keys. ENTER: Pressing "ENTER" will either pop-up a window for further operation or let you enter a numeric value (terminated by another press of the "ENTER" key)
help:INFO	This prompt indicates that the help screens are available when you press the "INFO" key.
BATT	The voltage of the main battery. The normal range is between 100 and approximately 140 when the charger is connected. The instrument may turn off without warning when the value drops below 100 and will not allow more measurements. The data however still remains intact in memory, as long as the main battery remains connected.

INSTRUMENT SETUP DISPLAY

This enables you to configure the basic data acquisition portion of the ENVI VLF. This display is accessible from the MAIN OPERATING display with the "SETUP" key.

```
                    Instrument Setup
                                    AUTO ST.INC.:    yn
                                    LINK REC/START:  yn
VLF SETUP:  ->menu                  CYCLE REPEAT:    yn
                                    CYCLE DELAY:     ddd
                                    ERASE MEMORY:    yn
                                    HEATER:          yn
Chg?:ENT.                                  BATT:bbb
```

Figure 47 ENVI VLF Instrument setup display.

Parameter	Description	Default
VLF SETUP	Displays the VLF-EM specific setup menu. Pressing the "ENTER" key gets the next menu.	
AUTO ST.INC.	A "yes/no" toggle that controls the automatic station increment (decrement). no for the base station, walking or manual type of operation. yes for semi-automatic operation.	no
LINK REC /START	Link Record/Start This setting should be left at no for VLF only operation. (If this is enbled, i.e. yes, then the next measurement cycle will automatically start after the "RECORD" key is pressed.)	no
CYCLE REPEAT	Not applicable in the VLF only mode.	
CYCLE DELAY	Not applicable in the VLF only mode.	
ERASE MEMORY	Allows clearing of the data memory. A request for confirmation will be displayed before the actual erasure takes place. NOTE: The setup parameters remain intact.	no

Parameter	Description	Default
HEATER	Enables or disables the LCD display heater. If the temperature is above –15° C, enabling this parameter has no effect.	no

VLF SETUP DISPLAY

This display provides access to the parameters affecting the operation of the VLF portion of the ENVI and is accessible either from the INSTRUMENT SETUP display or from the MAIN OPERATING display by pressing the "ENTER" key.

```
                vlf setup
FRQ1:           21.1     TIE-MODE:          line
FRQ2:           22.4     AUTO RECORD:         no
FRQ3:            0.0     FRQ.SCAN:
RES.PSEP.:        5m     TWO-PROBE:           no
%SCALE:
TIE CORRECT.: no
Chg?:ENT.                              BATT:   110
```

Figure 48 VLF setup display.

The %SCALE parameter is set as a pop-up window. This allows you specify a different vertical scaling in the graphical data display for each of the three frequencies being monitored. The pop-up window appears as follows:

```
                vlf setup
FRQ1:           21.1
FRQ2:           22.4   SF_1:              100.00
FRQ3:            0.0   SF_2:              100.00
RES.PSEP.:        5m   SF_3:              100.00
%SCALE:            ->
TIE CORRECT.: no       Main Menu: ESC
Chg?:ENT.                              BATT:   110
```

The configurable parameters for the VLF setup are:

Parameter	Description	Default
FRQ1	Use this to manually specify the first VLF frequency to be monitored. If any frequency is set to zero, it is disabled.	0.0
FRQ2	Use this to manually specify the next VLF frequency to be monitored.	0.0
FRQ3	Use this to manually specify the last VLF frequency to be monitored.	0.0
RES.PSEP.	This key enables or disables the VLF Resistivity Option. Use the "+" and "–" keys to select between 0, 5m and 10m. If you select 0, the Resistivity Option is disabled. Select 5m to select the resistivity option, if the pots are connected to the sensor with 5-metre long cables, or select 10m if the cables are 10 metres long.	5m
%SCALE	Use the "ENTER" key to view a pop-up window for changing the scale (vertical exaggeration) for the three VLF frequencies.	100.0
TIE CORRECT	A "yes/no" toggle that applies a tie-point correction using data collected in the TIE mode. Selecting this opens a window indicating which tie-point (loop or line) correction mode is in effect. You must enter "Y" to start the correction. NOTE: The original raw data is changed.	no
TIE MODE	Allows to select either the Line or Loop type of tie-line correction. Note: The Tie-line correction method is substantially *less precise* than the base-station correction method.	Line
AUTO RECORD	A "yes/no" toggle. This function is used in the semi-automatic mode to save you from having to press another key. Auto Record is always in effect in the base-station operation *or* if the Cycle Repeat function is selected in the ENVI system Instrument Setup.	no

Parameter	Description	Default
FRQ.SCAN	Use Frequency Scan to automatically select three VLF frequencies (from 15 to 30 kHz), as in Figure 33. It takes about 10 minutes for the instrument to scan from 15 to 30 kHz and select three frequencies. If you want you can override the automatically chosen frequencies. After the scan is complete, press the "ENTER" key to view Figure 50 on page 4–40. Then use the "+/–" keys to scroll from FRQ1 to FRQ2 to FRQ3, press the arrow keys to select a particular frequency, and press the "SETUP" key to enter it. Press "ENTER" and then "ESCAPE" to return to the VLF setup display.	No default
TWO PROBE	A "yes/no" toggle referring to the configuration of the probes when using the Resistivity Option. "Yes" indicates you are using two probes; "no" indicates you are using three probes.	no

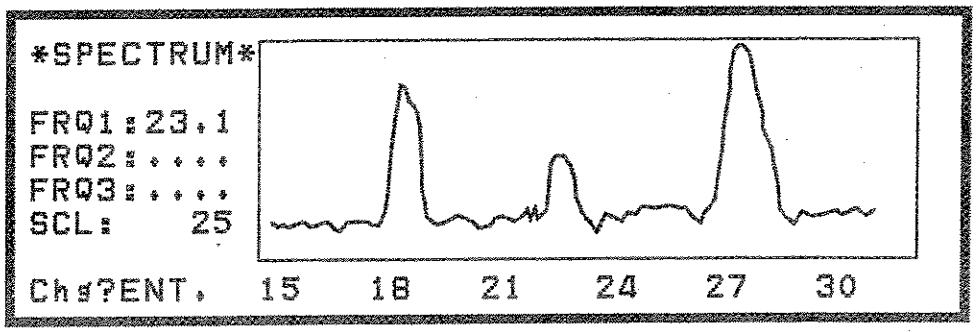


Figure 49 Frequency Scan display showing three VLF frequencies selected automatically.

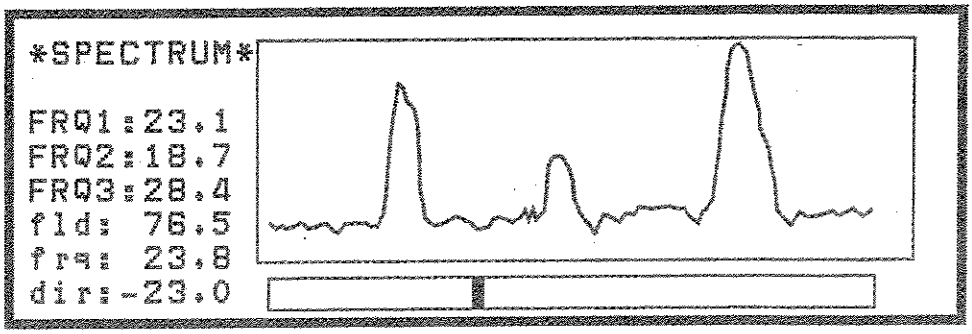


Figure 50 Display used to override the VLF frequencies chosen by Frequency Scan.

DATA DISPLAY

Data is displayed on a page-by-page basis in either numeric or graphic form. The "NUM/GRA" key toggles between the two forms.

Numeric data display

Numeric displays are available when the instrument is recording data, i.e., you cannot *recall* the data in a tabular format as shown in Figure 51 on page 4–41.

The first two displays below show the on-line menus for initializing the VLF and recording VLF data. From the main operating display, when you press the "START" key, the first display that appears is the VLF initializing display. Once the VLF mode is initialized, the display changes automatically to the recording display; the only difference is that the word `initializing` disappears.

Under each heading on the display, the most current reading is the topmost, followed by preceding readings.

```
VLF1: 21.4                                  12:25:44
In-Ph.   Quad.   T.fld   Tilt    LN:   100.0E
  77.9    23.6   178.4   6.67    ST:    25.0S
  78.6    24.0   178.5   6.68           26.0S
        Resis.   Phase   Dir.    Q
          45.7    -2.5   -10.    S
          46.8    -2.4   -10.    MEMF:   100%
Initilaizing..                  BATT:    110
```

Figure 51 VLF initializing display.

To view the data being recorded for the three VLF frequencies (specified during VLF setup), you can press the "1", "2" or "3" key for `FRQ1`, `FRQ2` or `FRQ3`, respectively to get the following displays:

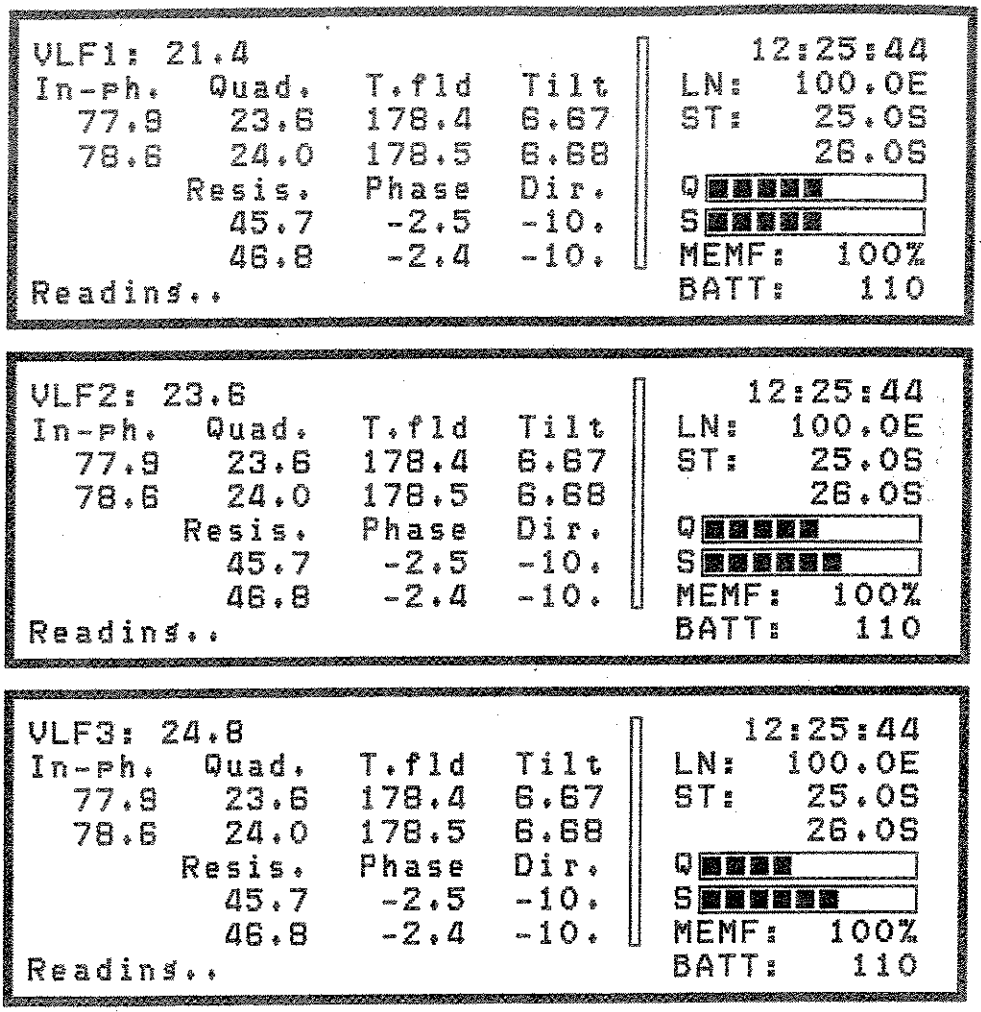


Figure 52 VLF recording displays for FRQ1 to FRQ3.

Display Item	Description
VLF1: 21.4	VLF frequency (1, 2 or 3) for which the data is displayed The assigned VLF frequency is shown in kHz for one of the three frequencies that may be set. If no frequency was set, the value is 0.
In-ph.	The in-phase component of the secondary field induced from the VLF transmitter's primary field. The value is in percent.

Display Item	Description
Quad.	The quadrature or out-of-phase component of the secondary field induced from the VLF transmitter's primary field. The value is in percent.
T.fld	The total field strength of the secondary field induced from the VLF transmitter's primary field. primary field. The value is in nA/m.
Resis	Displayed only when the Resistivity option is enabled. The resistivity is in ohm-metres.
Phase	Displayed only when the Resistivity option is enabled. The phase angle is in degrees.
Dir	Displayed only when the Resistivity option is enabled. The direction of the magnetic primary field lines from the transmitting station relative to the operator. The direction is in degrees.
Initializing	This is the status line. When the VLF system has just been turned on using the "START" key, the word Initializing appears here. It soon disappears, meaning that the instrument has begun to record VLF data.
TIME	The current time in hours:minutes:seconds. It is used to time stamp each reading.
LN	The line number on which this measurement took place. The value consists of the numeric and directional parts.
ST	The station number to which the respective magnetic data applies. The value consists of the numeric and directional parts.

Display Item	Description
Q	Operator Quality Number This is a relative measure of how well the VLF sensor was held in a vertical position and stationary by the operator. The number ranges from 0 to 9, with 0 being the worst and 9 the best. The graphical bar display will show up to 9 segments for the entire range. Under normal conditions the best results obtained by an operator are about 5 or 6. Consequently, you should strive to have about 5 segments of the bar displayed.
S	Signal-to-Noise Ratio Number This is an indicator of how well the signal is being received above the background level of noise. The signal-to-noise ratio ranges from 0 to 9, with 0 being the worst and 9 the best. The graphial bar display will show up to 9 segments for the entire range. A usuable total field value can be obtained with only one segment of the bar showing, however, the signal is marginal. It is recommended that several readings be taken at one location to see if they are repetitive.
MEMF	The percentage of free memory. Measurements can be made when the memory is full, however the data is no longer recorded.
BATT	The voltage of the main battery. The normal range is between 100 and approximately 140 when the charger is connected. The instrument may turn off without warning when the value drops below 100 and will not allow more measurements. The data however still remains intact in memory, as long as the main battery remains connected.

Graphic data display (profiles)

The display shown in Figure 53 below is the graphic display of the data for VLF Frequency. Use the "1" "2" or "3" keys to change to Frequencies 1, 2 or 3, respectively.

The "NUM/GRA" key lets you toggle between the numeric data display and the graphic data display for each frequency. Figure 53 shows the graphic display for data with the resistivity option enabled, whereas Figure 54 on page 4–45 shows the same type of display, but with the resistivity option disabled.

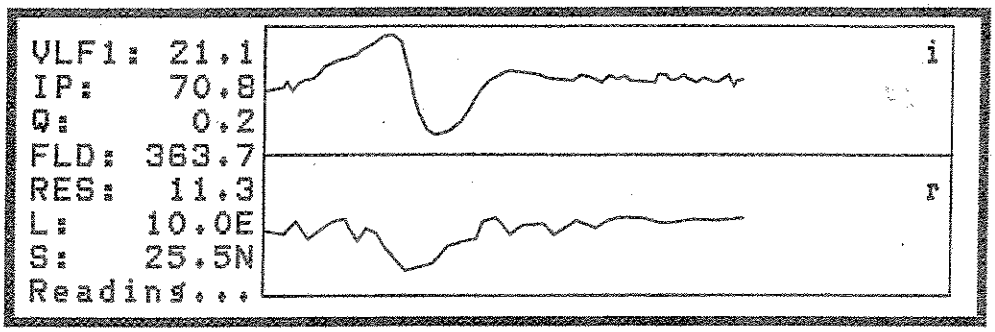


Figure 53 Graphic data display for VLF, with the Resistivity Option enabled.

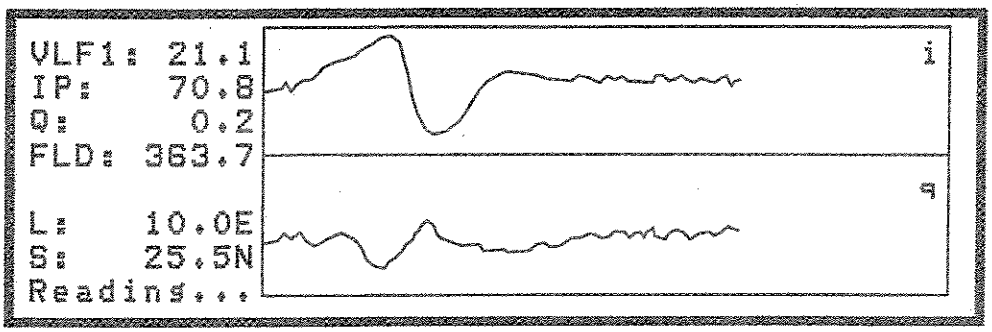


Figure 54 Graphic data display for VLF, with the Resistivity Option disabled.

Display Item	Description
VLF	The VLF frequency number (1, 2 or 3) and its value in kHz.
IP	The vertical in-phase component of the induced secondary field in percent.
Q	The vertical quadrature (or out-of-phase) component of the induced secondary field in percent.
FLD	The total field strength in nA/m.
RES	The apparent resistivity in ohm-m.
LN	The line number along which this measurement took place, consisting of the numeric and directional parts.
ST	The station number to which the respective VLF data applies, consisting of the numeric and directional parts, at the cursor position.

Recall displays for VLF

The Recall function is useful to view the collected and stored data.

Recall setup display

This display allows you to select the VLF frequency and location of the data. This display is accessed by pressing the "RECALL" key from the VLF setup display.

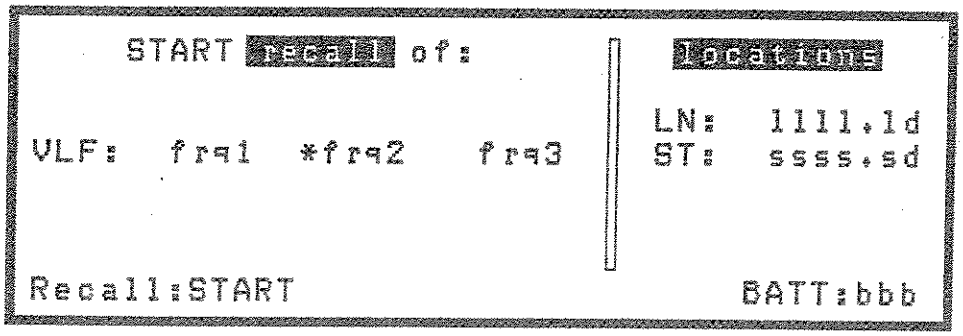


Figure 55 The Recall setup display for VLF data.

Display Item	Description
VLF	The VLF frequency of the data collected. Any one of Frequency 1, 2 or 3.
LN	The line number whose data is to be recalled, consisting of the numeric and directional parts.
ST	The station number is the starting location for the recall, consisting of the numeric and directional parts.

Recall data display

Data can be recalled only in graphic form. Up to 188 readings can be shown at one time. The display window can be moved sideways (called panning) in steps of one half of its width (i.e. up to 89 readings) to view adjacent data with the aid of the "+" or "–" key.

Exact values can be read off the numerical section at the left hand side of the display.

These displays are accessible with the "START" key when in the RECALL SETUP display. They appear exactly the same as Figures 53 and 54 for resistivity enabled and disabled, respectively.

Modifying the display window

The graph can be altered by opening a smaller window using the "ENTER" key. You can change the vertical scale using the "+" and "–" keys. You can also center any point vertically in the window. The changes take effect after you next press "ENTER."

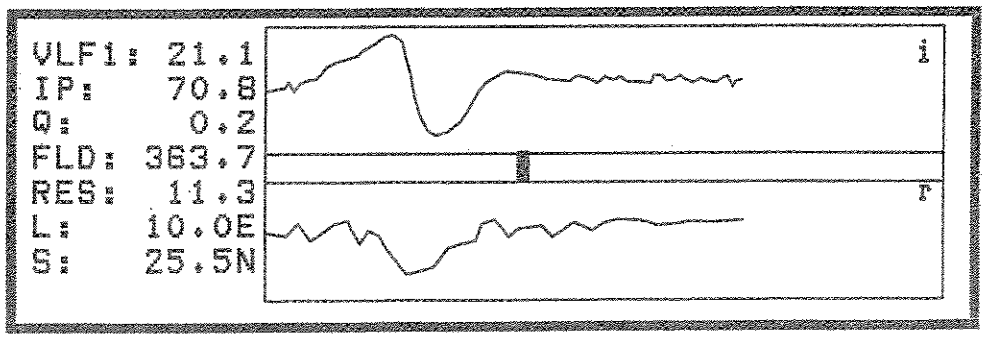


Figure 56 The VLF Recall display ready for customizing, with resistivity enabled.

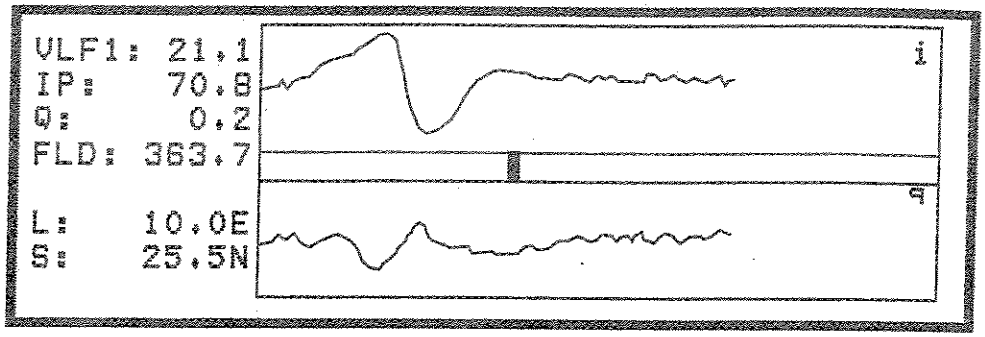


Figure 57 The VLF Recall display ready for customizing, with resistivity disabled.

Display Item	Description
SCL	Shown after the "ENTER" key is pressed. It indicates the vertical full scale. Scrolling using the +/– keys allows the full scale values of 1, 10, 100, 1000, 10000 nT.
▌	This is the cursor, which is normally at the left edge of the window. It can be moved with the aid of the "←", " →" cursor keys. Numerical data at the left hand side of the display represents the data at the cursor position.

Pressing the "0" key, adjusts the display such that the point at the cursor position becomes the center value of the graph.

AUXILIARY FUNCTIONS DISPLAY

This is the same for VLF as for the magnetometer (See "Auxiliary functions display" on page 4–27).

DATA OUTPUT DISPLAY FOR VLF

This display allows the selection of:

- communication parameters between the ENVI VLF and the output device such as a computer or printer,
- the data format of the output,
- and possibly the Line number, if a line-by-line data dump is desired.

Data can be dumped in its entirety at once, or selectively on a mode basis.

This display is accessible from the AUXILIARY display.

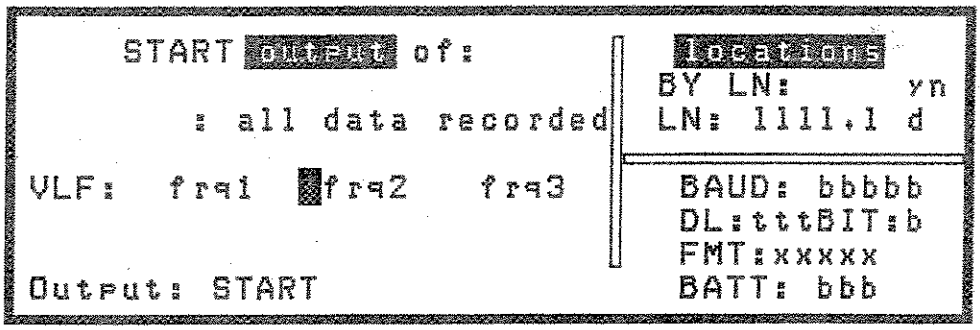


Figure 58 The Data output display for VLF

Parameter	Description	Default
: all data recorded	With the cursor placed after the colon, all the data in the instrument would be dumped sequentially into one, possibly very large file.	
VLF:	Lists the three frequencies available for the ENVI VLF. As shown, only the VLF Frequency 2 data would be dumped as indicated by the cursor position	
BY LN:	yes/no Directs the instrument to dump the data on a line by line basis, in addition to a method by method basis. This is usually left at no.	no
LN:	The line number whose data has to be dumped, consisting of the numeric and directional parts.	

Parameter	Description	Default
BAUD:	The Baud rate of communication with the output device. The following choices are available by scrolling: 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600 Baud.	9600
DL:	A delay which may be added after each carriage return/ linefeed (CR/LF) to accommodate slow peripherals such as some printers. The range is 0 to 999 ms. This value is normally left at 0 for dump to computers. The proper setting has to be established experimentally for other equipment. Problems usually are indicated by the loss of a few characters.	0
BIT:	The number of data bits. The default value is 8 bits, which usually works properly. The proper setting has to be established experimentally. For example, on some EPSON printers, 7 or 8 bits results in either normal or italic print.	8
FMT:	The output data format. The formats are described briefly in the following table on page 4–51.	

Data output formats

The following table shows the available output formats (using the "+" and "–" keys) for dumping the data to a computer or printer.

Data output format	Description
XYZ	XYZ is the simplest format, suitable for software packages such as ENVI MAP. It contains no heading or comments. The individual data items are separated by a single space character. X and Y represent the cartesian coordinates (N and E are positive, while S and W are negative). Z is one or more items of magnetic data. There is one set of data per printed line, including the time of the measurement. CAUTION: Due to the lack of header information, you should label the files clearly.
XYZ+	XYZ+ is identical to XYZ, but a header and user entered NOTES are added.
XYZ++	XYZ++ is identical to XYZ+, but the data is now placed into columns.
PRN	PRN is a format used with software for the SCINTREX MP-3/4 Magnetometer.
NOTES	NOTES outputs a report of all user entered NOTES, cross-referenced with the Line and Station number.
BINARY	A binary dump for fast data transfer. The file will have to be post-procesed by the XFENVI program to provide the normal formats for the data. This is the only method to get the VLF data.

NOTES DISPLAY

This is the same for VLF as for the magnetometer (See "Notes display" on page 4–31).

INFORMATION DISPLAY

This is the same for VLF as for the magnetometer (See "Information display" on page 4–32).

MAG & VLF

If you want to use both the magnetometer and VLF at the same time, you should choose the 3. MAG & VLF option from the general display (see Figure 24 on page 4–1).

MAIN OPERATING DISPLAY

The MAG&VLF MAIN OPERATING display appears as follows:

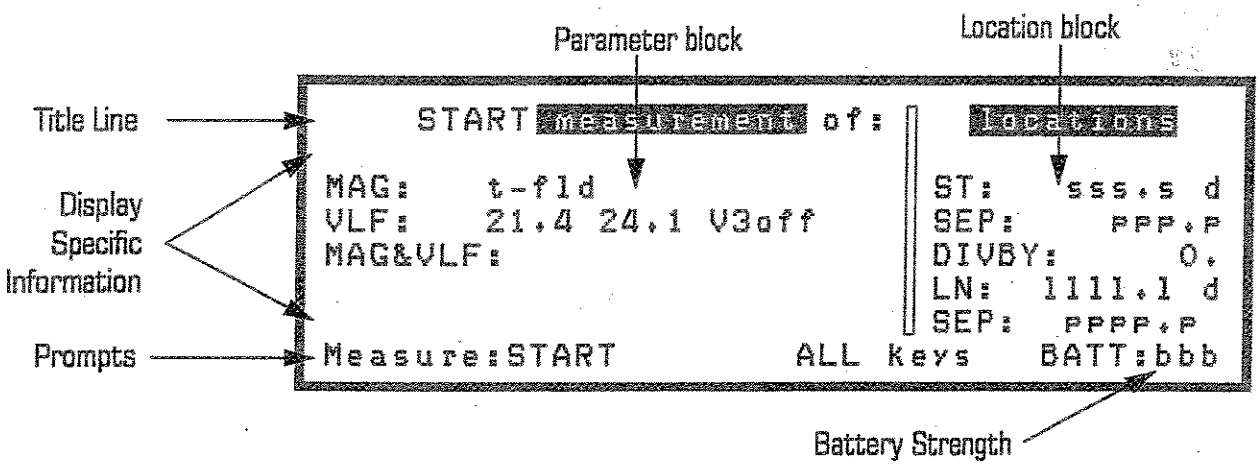


Figure 59 Main operating display in MAG&VLF mode.

The configurable parameters of the MAG&VLF MAIN OPERATING display are the same as for the MAG only (page 4–13) and the VLF only (page 4–35).

INSTRUMENT SETUP DISPLAY

This display is accessible from the main operating display with the "SETUP" key. It enables you to configure the basic data acquisition portion of both the ENVI MAG and ENVI VLF.

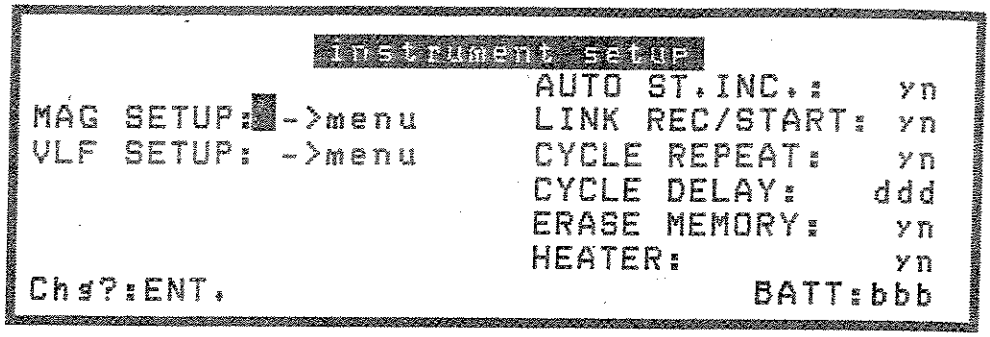


Figure 60 MAG&VLF Instrument setup display.

MAG & VLF

SETUP DISPLAYS

1. From the INSTRUMENT SETUP display choose the MAG setup by placing the cursor on `MAG SETUP: ->menu` and press the "ENTER" key.
2. Follow the instructions for setting up the magnetometer parameters (page 4–16).

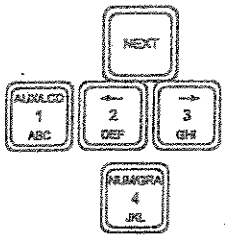
3. Once the magnetometer operation is set up, press the "ESCAPE" key to return to the MAIN OPERATING display.

4. Press the "SETUP" key to go to the INSTRUMENT SETUP display, and then choose the `VLF SETUP: ->menu` option.
5. Now set up the VLF operating parameters (page 4–38).

6. Press the "ESCAPE" key to return to the MAIN OPERATING display.

DATA DISPLAYS

1. From the MAIN OPERATING display, place the cursor at `MAG&VLF` and press the "START" key to begin the measurement.
2. The MAG data will be presented first, followed by the VLF data.
3. To view the data at the end of the measurement,



a. press the "NEXT" key to view to MAG and/or GRAD data,

b. or press the "1", "2" or "3" keys to view the three VLF frequencies.

4. In either the MAG or VLF modes, press the "NUM/GRA" key to toggle between the numeric and graphic data displays.

5. To automatically record both the MAG and VLF data, set AUTO RECORD to "yes" in the VLF setup display.

SETTING-UP THE ENVI SYSTEM

This chapter describes the process of how to:

- initialize the ENVI for first time operation,
- program it for the different modes of operation,
- enter line and station numbers
- enter survey specific information and notes.

Step by step procedures are given in Chapter 6: *Operating the ENVI System* on how to perform:

- a total-field survey in the WALKMAG mode (basic)
- a gradiometer survey in the stop-and-go mode (advanced)
- base-station operation (advanced)
- a vlf survey selecting the stations using the frequency scan feature
- a vlf survey using manually input frequencies
- a vlf resistivity survey

FIRST TIME OPERATION

A special procedure has to be followed to get the ENVI system software set up properly. This procedure is called a *cold boot*. This assures that all setup parameters are initialized properly and that the memory is cleared.

Caution: First time operation procedures (cold boot) have to be carried out every time the instrument has had its battery disconnected for more than 10 minutes. You may also need to cold boot if the screen stays blank or is scrambled.

COLD BOOT

To perform a cold boot, proceed as follows:

1. Press the "ON/OFF" key repeatedly and listen carefully to the beeper. Stop pressing this key after the display goes blank, or after the unit stops beeping. This is to ensure that the ENVI system is truly in the *OFF* state.

2. Press and hold the "AUX/LCD" key. Then press the "ON" key. Release both keys after the beep. The following message should appear:

```
COLD BOOT (Y/N)?
WARNING!

Setup parameters / data
will be erased.
```

3. Press the "9/YZ" key containing "Y" for *yes* to confirm the cold boot operation.

4. You are now ready to setup your ENVI system for surveying.

Important: The *default* configuration after a cold boot is the MAG & VLF mode with the magnetometer in the advanced mode (all parameters are manually entered).

CONSOLE CONFIGURATION MENU

The console configuration menu allows you to set the console to operate either as a magnetometer, VLF-EM unit or as a simultaneous combined MAG and VLF unit. To choose which instrument your console will be operating as:

1. **Press** the "ON/OFF" button until the display is blank.

2. **Press** the "SETUP" and "ON" keys simultaneously. You will now see the console configuration menu.

```
  WELCOME TO ENVI APPLICATIONS MENU

        1-MAG only
        2-VLF only
        3-MAG & VLF


Please Select Your Method(s) *:
```

3. Choose one of `1-MAG only`, `2-VLF only` or `3-MAG&VLF` by Pressing the corresponding number key.

   a. If you choose "1", you will be presented with a further set of menu screens allowing you to choose one of seven pre-defined magnetometer configurations in one of three operating modes (Figure 61 on page 5–4).

   b. If you choose "2" or "3", you will be presented with the MAIN OPERATING display for the VLF or MAG&VLF, respectively.

MAG only configuration

For ease of use, the ENVI MAG system has seven pre-defined configurations in three modes to choose from. Please also refer to "ENVI MAG operating modes" on page 3–7. To change your magnetometer configuration at any time:

1. **Press** the "SETUP" and "ON" keys simultaneously to get the main configuration menu and then press "1" for the MAG only option. You will now see the following menu:

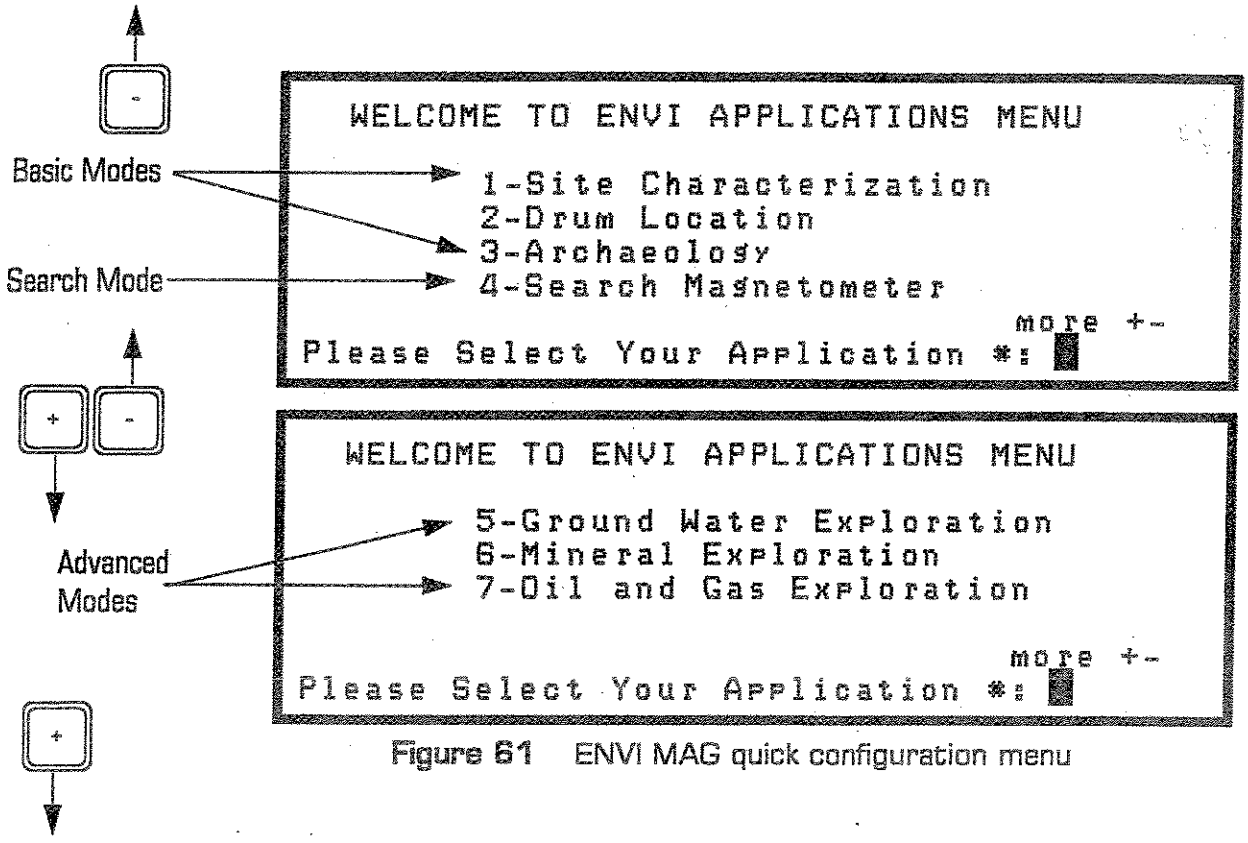


Figure 61 ENVI MAG quick configuration menu

2. To see the other menu display, **Press** either the "+" or "–" keys.

3. Select the appropriate configuration for the type of survey you wish to perform, by pressing the corresponding numeric key, i.e. "1" to "7". This configuration can be changed at anytime, while you are in the MAG only console configuration, by repeating step 1.

GENERAL SETUP PRINCIPLES

Setting up the ENVI system console consists of:

- bringing up the various display screens,
- moving the cursor to different parameter fields,
- then either selecting from a list, or entering appropriate values.

It is assumed that you have performed a console configuration selection (as shown on page 5–3) and have one of the following three MAIN OPERATING displays:

Basic mode (Config. 1–3)

```
MODE: t-fld DUR: 0.5s          |  Locations
TUNE FIELD:      60000         |
AUTO TUNE:         yes         |  ST:      10. E
TM/DT:    OUTPUT:              |  SEP:       25.
BASE:     TIE:                 |  DIVBY:     0.0
ERASE MEM.:                    |  LN:       1. N
                               |  SEP:      10.
Chg?:ENT.              help:INFO  BATT:134
```

Search mode (Config. 4)

```
MODE: srch.  DUR: 0.5s
TUNE FIELD:      60000
AUTO TUNE:         yes
TM/DT:




Chg?:+-              help:INFO   BATT:134
```

VLF or MAG Advanced mode (Config.5–7)

```
     START measurement of:     |  Locations
                               |
MAG:                           |  ST:    sss.s d
VLF:                           |  SEP:     ppp.p
MAG&VLF:                       |  DIVBY:     0.0
                               |  LN:   llll.l d
                               |  SEP:   pppp.p
Measure:START          help:INFO  BATT:bbb
```

Figure 62 Main operating displays for all ENVI MAG modes

HOW TO:

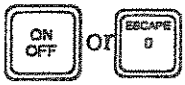
CHANGE ENVI SYSTEM CONFIGURATION

1. **Press** the "SETUP" and "ON" keys to get the CONSOLE CONFIGURATION menu.

2. Select the desired configuration by pressing the corresponding "1", "2" or "3" numeric key (see page 5–3 for more details).

   a. If you select the `MAG only` mode, you will have another menu that offers seven pre-defined magnetic survey configurations.

ACCESS THE MAIN OPERATING DISPLAY



The MAIN OPERATING display can be called up by simply pressing the "ON" key *or* by pressing the "ESCAPE" key one or more times.

ACCESS DISPLAY SUB-PANELS/BLOCKS

Some display screens have sub-panels or blocks that are separated by a vertical and/or horizontal line. These represent different logical sub-groups of information. To move the cursor into another block, you will have to press the "NEXT" key.

ACCESS THE PARAMETER FIELDS

To access a particular parameter field, move the cursor by repeatedly Pressing either of the cursor (← →) keys until the cursor is on the desired field.

CHANGE PARAMETERS

There are two types of parameters—those that are selected from a *list* and those that you must *fill-in* a value. The proper method for changing a particular item is indicated by the *prompt* at the left-hand, bottom corner of the display.

Changing the parameters requires you to either:

- select from a list when the prompt is `Chs?+-`, by pressing either the "+" or "–" keys. Please see also "Select!" in the next item.

or

- fill in the parameter fields via the keypad when the prompt is `ChsENT`, by first pressing the "ENTER" key. You will then need to follow the procedures as described for "Enter!" in the next item.

SELECT! AND ENTER!

To simplify the detailed descriptions that will be presented next, the keywords **Select!** and **Enter!** will be used to represent a series of actions that you will be required to do. These are defined as follows:

Select!

When the prompt `Chs?:+-` appears in the bottom left corner of the display, you have a *pre-defined* list of values to choose from. You will be required to make a selection as follows:

Press either the "+" or "–" key to scroll through two or more parameters.

Enter!

When the prompt `Chs?:ENT.` appears in the bottom left corner, the parameter field requires you to enter a specific value. To enter values, you will be required to do the following:

Step	Press	Action
1		This opens the field for data entry as indicated by a new prompt (>) at the start of the field.
2	 to 	Key in the desired value. If the field requires a *numeric* input, just **Press** the appropriate keys in sequence. If the field requires *alphanumeric* input, you may need to **Press** the same key several times to get the proper character to appear (similar to spelling on a telephone keypad). If you enter an incorrect value, use the "CLEAR" key to delete the incorrect character(s). (For more information on editing an entry, please refer to the section "Note entry" on page 5–37.)
3		**Press**ing the "ENTER" key again stores the value in memory and the prompt (>) disappears.

LINE AND STATION SETUP

Except for the Search mode magnetometer configuration, you will need to enter into the ENVI system the information about your survey grid. This includes:

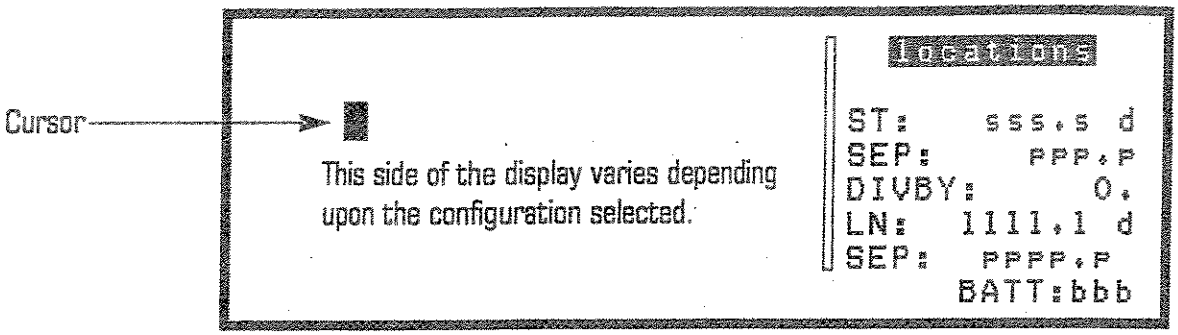
- your starting points on each line,
- how far apart each line is,
- how far apart each station on the survey line is.
- if you are using the optional ENVI external distance trigger unit (p/n xxx xxx), then you will also have to set the DIVBY parameter, which counts the number of switch closures specified for a station increment distance.

Note: In considering the co-ordinate system shorthand you will be using for a survey grid, you should be aware that the units of measure are not important, as no calculations are made by the console with respect to distance. Consequently, you can use single digits to represent values that may actually be in hundreds. However, you will need to specify the correct line and station spacing parameters when you process the data with the ENVI MAP software to get the correct scaling on your maps. Please also refer to "Laying out the grid" on page 27 of the *Magnetic Applications Guide* for more details on survey grids.

To show you the steps required to set the line station values, the following example will:

- set the Line Number (LN) to Line 16 East (sometimes marked on the grid survey pickets as 16+00E) with a Line separation (SEP) of 2,
- ensure that the external distance trigger is set to 0 (zero), since the external distance trigger unit is not being used,
- set the Station Number (ST) to 50 North (sometimes marked the grid survey pickets as 50+00N), with a Station separation (SEP) of *minus* 10. The *minus* indicates that the walking direction is to the south.

From the MAIN OPERATING display, proceed as follows:



1. **Press** the "NEXT" key to move the cursor to the right hand block/sub-page of the display. If the cursor is already in the `locations` block, go on to the next step.

ENTERING THE STARTING STATION

2. Move the cursor to `ST:`

3. **Enter!** `50.`

4. Move the cursor one step forward.

5. **Enter!** `n` (for north).

Tip: You could also enter "+" for north (or "–" for south).

6. Move the cursor to `SEP:`

7. **Enter!** `-10`. *Note*: The "–" causes the station number to *decrement*. This indicates that you will be travelling south and that stations are spaced 10 units apart).

ENTERING THE EXTERNAL DISTANCE TRIGGER COUNT RATE

8. Move the cursor to `DIVBY:`

9. **Enter!** `0` (zero)
   If you wish to use your external distance trigger unit, then please see "ENVI Distance Trigger" on page 4–33 and also refer to the notes that came with your unit.

Important: Set `DIVBY` to `0` (zero) when not using the external trigger.

ENTERING THE STARTING LINE

10. Move the cursor to `LN:`

11. **Enter!** `16`

12. Move the cursor one step forward.

13. **Enter!** `e` (for east).

Tip: You could also enter "+" for east (or "–" for west).

14. Move the cursor to `SEP:`

15. **Enter!** `2` (This indicates that you will be surveying successive lines 2 units apart and you will be moving in a easterly direction.)

To set your required starting point and separations, just substitute your specific values in the previous steps. Also, keep in mind that entering *negative* values for the separation parameters causes the respective line or station values to *decrement*.

BASIC MODE FOR MAGNETOMETER

The basic mode consists of configurations 1 to 3:

1. Site Characterization
2. Drum Location
3. Archaeology

Defaults These configurations require minimal setup and are set for:

- WALKMAG (continuous reading) type of survey
- fixed tuning for the ambient field
- base-station or tie-point *Loop* mode data correction only
- fixed output at 9600 baud with a XYZ++ format

SAMPLE TOTAL-FIELD SETUP

```
MODE: t-fld DUR: 0.5s          | Locations
TUNE FIELD:     60000          |
AUTO TUNE:          yes        | ST:      10. +
TM/DT:    OUTPUT:              | SEP:       25.
BASE:     TIE:                 | DIVBY:      0.
ERASE MEM.:                    | LN:        1. +
                               | SEP:       10.
Chg?:ENT.              help:INFO  BATT:134
```

1. Move the cursor to MODE
2. **Select!** t-fld from the list of t-fld, grad, base

3. Move the cursor to DUR
4. **Select!** 0.5 sec from the following list: 0.5 sec, 1 sec, 2 sec

5. Move the cursor to TUNE FIELD

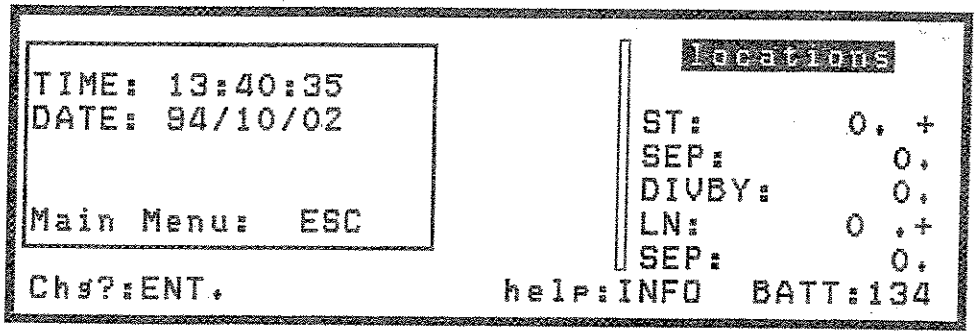
6. **Enter!** 60000 (or whatever value is appropriate for your survey area. Please refer to Figure 4 on page 5 of the *Magnetic Applications Guide*, if this value is unknown.)

7. Move the cursor to AUTO TUNE

8. **Select!** yes

9. Move the cursor to TM/DT

10. **Press** the "ENTER" key and window for the date and time values will pop-up on the right-hand side of the display.



11. **Enter!** the time and date (using the steps 2 to 13 on page 5–35).

Warning: If you are using a base-station, please make sure that the time and date are the same as your field unit. If the time is out, the corrections will be incorrectly applied. If the dates do not match, no corrections can be performed at all.

12. Enter your survey grid values as described in "Line and Station setup" on page 5–9

You are now ready to start surveying.

SEARCH MODE FOR MAGNETOMETER

The search mode is obtained (after pressing the "SETUP" and "ON" keys simultaneously) by selecting configuration `4-Search Magnetometer` from the ENVI Applications menu.

This mode does not store any data (that you can dump) in memory, but you can see a graphical representation of up to the last 178 readings. This mode is useful for rapid reconnaissance or location of magnetic objects in small areas where no permanent record of the data is required.

There are only two parameters that need to be set for this mode — the duration of the reading and the tuning (ambient) field value.

SAMPLE SEARCH MODE SETUP

```
MODE: srch.   DUR: 0.5s
TUNE FIELD:       60000
AUTO TUNE:          yes
TM/DT:


Chg?:+-              help:INFO    BATT:134
```

1. Move the cursor to `DUR`
2. **Select!** `0.5` sec from the following list: `0.5` sec, 1 sec, 2 sec

3. Move the cursor to `TUNE FIELD`
4. **Enter!** `60000` (or whatever value is appropriate for your survey area; Please refer to Figure 4 on page 5 of the *Magnetic Applications Guide*, if this value is unknown.)

5. Move the cursor to `AUTO TUNE`
6. **Select!** `yes`

You are now ready to start looking for magnetic objects.

ADVANCED MODE FOR MAGNETOMETER

The ENVI MAG system setup in the advanced mode, initializes parameters which are common to all three of the exploration (ground water, mineral, and oil & gas) configurations installed. This mode gives you *total control* over all the parameters of the ENVI system. You can also use this mode to run the types of surveys defined in the Basic mode, with the additional benefit of more features being available. Several examples will be given to show you how to setup:

- the instrument operating details (how long and how often a reading is taken)
- a total-field WALKMAG and/or WALKGRAD survey
- a gradiometer Stop-and-Go survey
- a base-station operation
- note entry
- other auxiliary functions

INSTRUMENT SETUP

The following setup prepares the instrument for a total-field or gradient survey in the WALKMAG or WALKGRAD modes respectively. This mode uses the cycle repeat feature of the measurement. A cycle delay can also be entered, so that the repetition rate is adjusted while walking uphill or downhill.

From the MAIN OPERATING display proceed as follows:

1. **Press** the "SETUP" key. The INSTRUMENT SETUP display appears:

```
                Instrument SetUP
MAG SETUP:_->menu       AUTO ST.INC.:    yn
                        LINK REC/START:  yn
                        CYCLE REPEAT:    yn
                        CYCLE DELAY:     ddd
                        ERASE MEMORY:    yn
                        HEATER:          yn
Chg?:ENT.                          BATT:bbb
```

2. Move the cursor to AUTO ST.INC: (automatic station increment)

3. **Select!** `no` (Since the ENVI system is reading continuously, you want the station value to change only when you reach a station — not with every reading!)

4. Move the cursor to `LINK REC/START:`

5. **Select!** `no` (If this is enabled, i.e. `yes`, then the next measurement cycle will automatically start after the "RECORD" key is pressed.)

6. Move the cursor to `CYCLE REPEAT:`

7. **Select!** `yes` (You want the instrument to continuously take readings at the rate specified by the `DURATION` parameter)

8. Move the cursor to `CYCLE DELAY:`

9. **Enter!** `250` (This value is in milliseconds, and pauses the reading cycling by 250 ms. This is useful when you are traversing uneven ground where your speed may vary. You should enter what ever is appropriate for the type of terrain you are traversing.)

10. Ignore `ERASE MEMORY:`

11. Move the cursor to `HEATER:`

12. **Select!** `no` (unless you are doing a winter survey and the ambient temperature is below –15° C.)

13. **Press** "ESCAPE" to return to the MAIN OPERATING display.

SAMPLE TOTAL-FIELD SETUP (WALKMAG OR WALKGRAD)

The following steps prepare the ENVI system for:

- a total-field survey in the WALKMAG or WALKGRAD modes,
- with a 0.5 second reading period (though 1 or 2 seconds can also be used),
- automatic tuning,
- manual station increment.

From the MAIN OPERATING display proceed as follows:

1. **Press** the "SETUP" key and the INSTRUMENT SETUP display appears:

```
                 instrument setup
MAG SETUP:->menu          AUTO ST.INC.:    yn
                          LINK REC/START:  yn
                          CYCLE REPEAT:    yn
                          CYCLE DELAY:     ddd
                          ERASE MEMORY:    yn
                          HEATER:          yn
Chg?:ENT.                              BATT:bbb
```

2. Carry out steps **2** through **9** (as shown on page 5–15) for setting up the instrument, if you have not already done so.

3. Move the cursor to MAG SETUP.

4. **Press** "ENTER" and the MAG SETUP display appears.

```
                   mag setup
MODE:          mmm      CYCLE TIME:      ttt
DURATION:      ddd      CHART SCALE:     sss
TUNE FIELD: fffff       AUTO TUNE:        yn
BASE CORRECT:   yn      BASE FIELD:   bbbbb
TIE CORRECT:    yn      TIE-MODE:        lll
REMOTE:         yn      AUTO RECORD:      yn
Chg?:+-                              BAT:bbb
```

5. Move the cursor to MODE:

6. **Select!** `t-fld` or `grad` from the following list:
   `off t-fld grad base.`

7. Move the cursor to `DURATION:`

8. **Select!** `0.5` sec from the following list:
   `0.5 sec, 1 sec, 2 sec.`

9. Move the cursor to `TUNE FIELD:`

10. **Enter!** the ambient magnetic field value of your survey area. Please refer to Figure 4 on page 5 of the *Magnetic Applications Guide*, if this value is unknown.

11. Ignore `BASE CORRECT:`

12. Ignore `TIE CORRECT:`

13. Move the cursor to `REMOTE:`

14. **Select!** `no` (Please refer to "Remote operation" on page 6–41 for more information on this feature.)

15. Move the cursor to `CYCLE TIME:`

16. **Enter!** `0` (This parameter is used in the base-station mode only and should be 0 for all other modes.)

17. Move the cursor to `CHART SCALE:`

18. **Select!** `10` from the following list: `1, 10, 100, 1000, 10000.` (This is the range in nT full scale.)

19. Move the cursor to `AUTO TUNE:`

20. **Select!** `yes` (This assumes that you will encounter large variations in the ambient field, without strong gradients. If you encounter strong cultural electrical noise or large variations in the ambient field, with very strong gradients, you may want to turn the automatic tuning off.)

21. Move the cursor to BASE FIELD:

22. **Enter!** the ambient magnetic field value, if known, of your survey area. Please refer to Figure 4 on page 5 of the *Magnetic Applications Guide*, if this value is unknown.

23. Ignore TIE-MODE:

24. Move the cursor to AUTO RECORD:

25. **Select!** no

26. **Press** "ESCAPE" to return to the MAIN OPERATING display.

SAMPLE STOP-AND-GO GRADIOMETER SETUP

The following steps prepare the ENVI system for a:

- gradient survey
- in the Stop-and-Go mode,
- with a 2 second reading period,
- and fixed tuning in the fully manual mode.

From the MAIN OPERATING display proceed as follows:

1. **Press** the "SETUP" key and the INSTRUMENT SETUP display appears.

```
                Instrument Setup
MAG SETUP:_->menu       AUTO ST.INC.:    yn
                        LINK REC/START:  yn
                        CYCLE REPEAT:    yn
                        CYCLE DELAY:     ddd
                        ERASE MEMORY:    yn
                        HEATER:          yn
Chg?:ENT.                          BATT:bbb
```

2. Follow the instructions for the INSTRUMENT SETUP, as shown on page 5–15, but substitute the following.

3. Move the cursor to CYCLE REPEAT:

4. **Select!** NO

5. Move the cursor to CYCLE DELAY:

6. **Enter!** 0

7. Move the cursor to MAG SETUP:

8. **Press** "ENTER". The MAG SETUP display now appears.

```
                    mag setup
MODE:          mmm      CYCLE TIME:      ttt
DURATION:      ddd      CHART SCALE:     sss
TUNE FIELD: fffff       AUTO TUNE:        yn
BASE CORRECT:   yn      BASE FIELD:   bbbbb
TIE CORRECT:    yn      TIE-MODE:         lll
REMOTE:         yn      AUTO RECORD:      yn
Chg?:+-                                BAT:bbb
```

9. Move the cursor to MODE:

10. **Select!** grad. from the following list: off t-fld grad. base.

11. Move the cursor to DURATION:

12. **Select!** 2 sec from the following list: 0.5 sec, 1 sec, 2 sec.

13. Move the cursor to TUNE FIELD:

14. **Enter!** the ambient magnetic field value of the survey area. Please refer to Figure 4 on page 5 of the *Magnetic Applications Guide*, if this value is unknown.

15. Ignore BASE CORRECT:

16. Ignore TIE CORRECT:

17. Move the cursor to `REMOTE:`

18. **Select!** `no` (Please refer to "Remote operation" on page 6–41 for more information on this feature.)

19. Move the cursor to `CYCLE TIME:`

20. **Enter!** `0`

21. Move the cursor to `CHART SCALE:`

22. **Select!** `10` from the following list: `1, 10, 100, 1000, 10000.` (This is the range in *n*T full scale.)

23. Move the cursor to `AUTO TUNE:`

24. **Select!** `no`

25. Move the cursor to `BASE FIELD:`

26. **Enter!** the ambient magnetic field value of the survey area, if known. Please refer to Figure 4 on page 5 of the *Magnetic Applications Guide*, if this value is unknown.

27. Ignore `TIE-MODE:`

28. Move the cursor to `AUTO RECORD:`

29. **Select!** `no`

30. **Press** "ESCAPE" to return to the MAIN OPERATING display.

SAMPLE BASE-STATION SETUP

The following steps prepare the ENVI system as a:

- magnetic base-station,
- with a 2 second reading period,
- and fixed tuning.

From the MAIN OPERATING display proceed as follows:

1. **Press** the "SETUP" key and the INSTRUMENT SETUP display appears.

```
                Instrument Setup
MAG SETUP:■->menu        AUTO ST.INC.:    yn
                         LINK REC/START:  yn
                         CYCLE REPEAT:    yn
                         CYCLE DELAY:     ddd
                         ERASE MEMORY:    yn
                         HEATER:          yn
Chg?:ENT.                                BATT:bbb
```

2. Follow the instructions for the INSTRUMENT SETUP, as shown on page 5–15, but substitute the following.

3. Move the cursor to `CYCLE REPEAT:`

4. **Select!** `no`

5. Move the cursor to `CYCLE DELAY:`

6. **Enter!** `0`

7. Move the cursor to `MAG SETUP:`

8. **Press** "ENTER".

The MAG SETUP display appears:

```
                    mag setup
MODE:          mmm      CYCLE TIME:      ttt
DURATION:      ddd      CHART SCALE:     sss
TUNE FIELD: fffff       AUTO TUNE:        yn
BASE CORRECT:   yn      BASE FIELD:    bbbbb
TIE CORRECT:    yn      TIE-MODE:        lll
REMOTE:         yn      AUTO RECORD:      yn
Chg?:+-                              BAT:bbb
```

9. Move the cursor to `MODE:`

10. **Select!** `base` from the following list: `off  t-fld  grad, base,`

11. Move the cursor to `DURATION:`

12. **Select!** 2 sec from the list: `0.5` sec, `1` sec, 2 sec.

13. Move the cursor to `TUNE FIELD:`

14. **Enter!** the ambient magnetic field value of the survey area. Please refer to Figure 4 on page 5 of the *Magnetic Applications Guide*, if this value is unknown.

15. Ignore `BASE CORRECT:`

16. Ignore `TIE CORRECT:`

17. Move the cursor to `REMOTE:`

18. **Select!** `no` (Please refer to "Remote operation" on page 6–41 for more information on this feature.)

19. Move the cursor to `CYCLE TIME:`

20. **Enter!** `0` (This sets the cycle time equal to the duration time to give the best base-station correction possible.)

21. Move the cursor to CHART SCALE:

22. **Select!** 10 from the list: 1, 10, 100, 1000, 10000
in nT full scale range, for your desired chart recorder sensitivity.

23. Move the cursor to AUTO TUNE:

24. **Select!** no

25. Move the cursor to BASE FIELD:

26. **Enter!** for now your ambient magnetic field value, if known. Please refer to Figure 4 on page 5 of the *Magnetic Applications Guide*, if this value is unknown.

27. Ignore TIE-MODE:

28. Move the cursor to AUTO RECORD:

29. **Select!** no

30. **Press** "ESCAPE" to return to the MAIN OPERATING display.

VLF APPLICATION

The ENVI VLF is for use as a VLF receiver or for measuring the apparent resistivity and phase angle using the VLF resistivity option. You can use the INSTRUMENT SETUP and VLF SETUP displays to give you total control over all the parameters of the ENVI VLF.

Note: The VLF can only be run in a stop-and-go mode, unlike the magnetometer's WALKMAG/WALKGRAD modes.

Three examples will be given to show you how to set up:

- the VLF operating mode using the Frequency Scan feature,
- the VLF operating mode inputting the frequencies manually.
- the VLF Resistivity Option mode.

Your choice of frequencies depends upon your location, the VLF stations that are transmitting at any given time, and the strike of the anomaly that you are investigating. If you know the strike of the anomaly is north-south, choose one frequency being transmitted from a station to the north or south; this will give you the best coupling. If you are not sure of the strike of your anomaly, choose two or three frequencies in very different directions (perhaps one to the north or south, and the other to the east or west of you).

The published lists of VLF transmitting stations is far from complete, and stations may not always adhere to their regular maintenance schedules. Please refer to page 8–13 for a list of some of the available VLF transmitter stations. The Frequency Scan feature, exclusive to ENVI VLF, allows you to obtain quickly all the information you need to determine the frequency(ies) that you should be receiving. You do not need to use Frequency Scan every work day; SCINTREX recommends that you use it when:

- you are starting work in a new region,
- you are starting to survey on a new grid
- you are uncertain of the maintenance schedules of the VLF station that is transmitting a frequency you want to use,
- the field strength drops below 2 units.

INSTRUMENT SETUP

The following instrument setup prepares the instrument for a VLF operating mode, or for measuring apparent resistivity and phase angle of the VLF frequencies measured.

From the MAIN OPERATING display proceed as follows:

1. **Press** the "SETUP" key.

The INSTRUMENT SETUP display appears:

```
                Instrument Setup
                                AUTO ST.INC.:    yn
VLF SETUP:_->menu               LINK REC/START:  yn
                                CYCLE REPEAT:    yn
                                CYCLE DELAY:    ddd
                                ERASE MEMORY:    yn
                                HEATER:          yn
Chg?:ENT.                                 BATT:bbb
```

2. Move the cursor to `AUTO ST.INC:`

3. **Select!** `yes` (Since the ENVI VLF is reading discretely, you want the station value to change when you reach a station.)

4. Move the cursor to `LINK REC/START:`

5. **Select!** `no` (If this is enabled, i.e. `yes`, then the next measurement cycle will automatically start after the "RECORD" key is pressed.)

6. Move the cursor to `CYCLE REPEAT:`

7. **Select!** `no`

8. Move the cursor to `CYCLE DELAY:`

9. **Enter!** `0`

10. Ignore `ERASE MEMORY:`

11. Move the cursor to HEATER:

12. **Select!** no (unless you are doing a winter survey and the ambient temperature is below –15° C)

13. **Press** "ESCAPE" to return to the MAIN OPERATING display.

SAMPLE VLF SETUP — FREQUENCY SCAN FEATURE

The following steps prepare the ENVI VLF for:

- in-field operation
- receiving two VLF station frequencies chosen automatically by Frequency Scan
- with the Resistivity Option disabled

The Frequency Scan feature scans the electromagnetic spectrum between 15 and 30kHz in steps of 100Hz and automatically supplies you with information about the field strength and direction of each frequency plus the field strength of background noise. Use the information from the scan to select the best one, two or three frequencies for your purposes.

From the MAIN OPERATING display proceed as follows:

1. **Press** the "SETUP" key for the INSTRUMENT SETUP display.

```
                  Instrument setup
                                AUTO ST.INC.:    no
VLF SETUP:  ->menu              LINK REC/START:  no
                                CYCLE REPEAT:    no
                                CYCLE DELAY:      0
                                ERASE MEMORY:    no
                                HEATER:          no
Chg?:ENT.                                BATT:110
```

2. Carry out steps 2 through 12 (as shown on the previous page) for setting up the instrument, if you have not already done so.

3. Move the cursor to VLF SETUP:

4. **Press** the "ENTER" key and the VLF SETUP display appears.

```
                 vlf setup
FRQ1:            21.1      TIE-MODE:          line
FRQ2:            22.4      AUTO RECORD:         no
FRQ3:             0.0      FRQ.SCAN:
RES.PSEP.:         5m      TWO-PROBE:           no
%SCALE:
TIE CORRECT.: no
Chs?:ENT.                                BATT:   110
```

5. The FRQ1, FRQ2 and FRQ3 parameters let you manually select up to three VLF station frequencies to use in making your VLF measurements. Since you will select your frequencies automatically using the Frequency Scan feature, ignore FRQ1, FRQ2 and FRQ3.

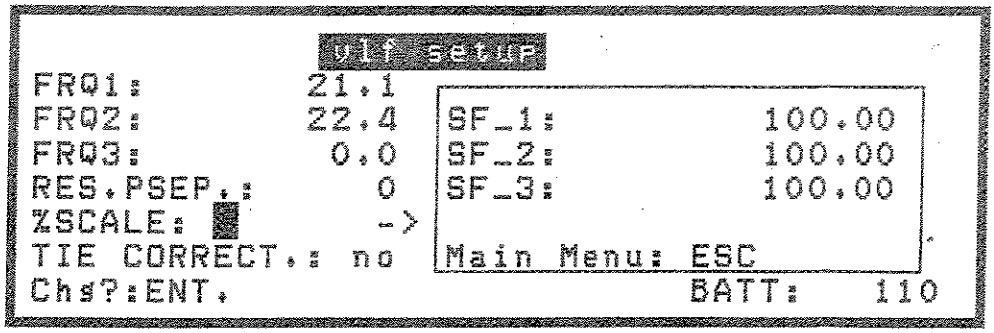
6. Move the cursor to RES.PSEP:

7. **Select!** 0 from a choice of 0 5m 10m. This selection disables the Resistivity Option.

Note: It is important that you disable the Resistivity Option if you are *not* using the resistivity probes. If the Resistivity Option is enabled (i.e. set to 5m or 10m), the graphic display will show the resistivity in place of the quadrature values. If the resistivity probes are not connected to the VLF sensor, then the resistivity values will all show as 0. If the Resistivity Option is disabled (set to 0), then the graphic display will correctly show the quadrature values.

8. Move to %SCALE:

a. **Press** the "ENTER" key to get the pop-up menu.



b. **Scroll** through the scales for Frequencies 1, 2 and 3 (`SF_1`, `SF_2` and `SF_3`, respectively).

c. **Enter!** the chosen scale for each frequency. (You should generally accept the default value of 100% for the scales for all frequencies.)

d. Press "ESCAPE" to continue.

9. Ignore `TIE CORRECT:`

10. Ignore `TIE-MODE:`

11. Move the cursor to `AUTO RECORD:`

12. **Select!** `no`

13. Move the cursor to `FRQ.SCAN` to automatically select three VLF station frequencies, between 15 and 30 kHz.

Note: SCINTREX recommends that the operator faces north with the VLF sensor module on their back during the scan. That way it is easier to understand the direction of the VLF transmissions displayed on the Frequency Scan spectrum.

14. **Press** the "ENTER" key to begin the scan. The scan will take about 10 minutes, and the ENVI will choose the three strongest frequencies as `FRQ1`, `FRQ2` and `FRQ3`.

Tip: The frequency scan will take *10 minutes*, so it is recommended that you are in a comfortable position for the duration.

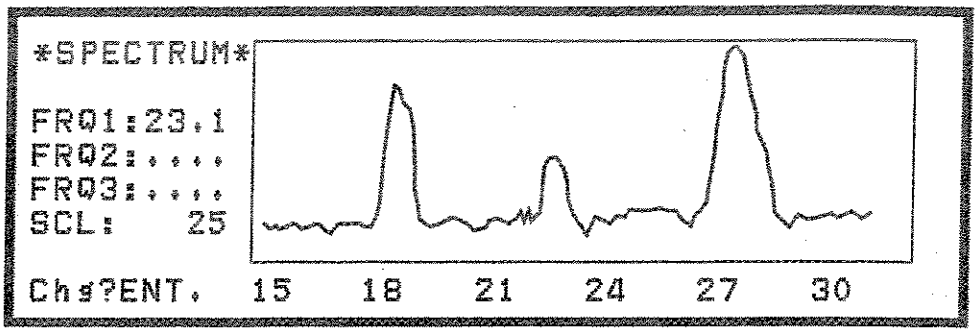
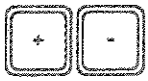


Figure 63 Frequency Scan automatically choosing three VLF stations for use in VLF measurements.

15. When the scan is done, **Press** the "ENTER" key to view the spectrum (field, frequency and direction).

Figure 64 Frequency Scan spectrum once Frequency Scan is complete.

16. You can, if you want, override the automatically chosen frequencies.



a. From the Frequency Scan spectrum as shown in Figure 64 on page 5–30, use the "+,–" keys to scroll between Frequencies 1, 2 and 3.

b. Use the arrow keys to move the cursor to a new frequency. To choose the best frequencies for your purpose, choose ones that

give a bell-shaped curve above the background, that have a field strength at least two to three times above background, and whose station is along the same azimuth from you as the strike of the anomaly you are investigating (if you know its strike).

c. Once you have chosen the best frequency, **Press** the "SETUP" key to enter it.

d. **Press** the "ENTER" key to return to the display as shown in Figure 63 on page 5–30.

17. From the Frequency Scan display, once the scan is completed, **Press** the "ESCAPE" key to return to the VLF SETUP display.

18. Ignore `TWO-PROBE:`, since the Resistivity option is disabled, this setting will have no effect anyway.

19. **Press** "ESCAPE" twice to return to the MAIN OPERATING display.

SAMPLE VLF SETUP — MANUAL FREQUENCY INPUT

The following steps prepare the ENVI VLF for:

- in-field operation
- using two VLF station frequencies input manually
- using the tie-correct procedure in the Line mode to collect data for correcting diurnal variations in the VLF total-field measured values
- with the Resistivity Option disabled

From the MAIN OPERATING display proceed as follows:

1. **Press** the "SETUP" key for the INSTRUMENT SETUP display.

2. Carry out steps **2** through **12** (as described under "Instrument setup" on page 5–15) for setting up the instrument, if you have not already done so.

```
                Instrument Setup
                                  AUTO ST.INC.:    no
VLF SETUP:  ->menu                LINK REC/START:  no
                                  CYCLE REPEAT:    no
                                  CYCLE DELAY:      0
                                  ERASE MEMORY:    no
                                  HEATER:          no
Chg?:ENT.                                 BATT:110
```

3. Move the cursor to VLF SETUP:

4. **Press** the "ENTER" key and the VLF SETUP display appears.

```
                  vlf setup
FRQ1:          21.1     TIE-MODE:          line
FRQ2:          22.4     AUTO RECORD:         no
FRQ3:           0.0     FRQ.SCAN:
RES.PSEP.:        0     TWO-PROBE:           no
%SCALE:
TIE CORRECT.: no
Chg?:ENT.                          BATT:    110
```

5. Move the cursor to FRQ1: (Frequency 1). The FRQ1, FRQ2 and FRQ3 parameters let you manually select up to three different VLF station frequencies to use in making your VLF measurements.

6. **Enter!** the frequency you have chosen, including a decimal point if necessary.

7. **Press** the "ENTER" key again.

8. Move the cursor to FRQ2 and enter your chosen frequency, as in step 6. Provided your first two frequencies are approximately 90° apart, you do not need to set a third frequency; leave FRQ3 blank.

9. Move the cursor to RES.PSEP.

10. Enter! 0

11. Move the cursor to %SCALE: and, if desired, set your vertical scaling as described in Step 8 on page 5–28.

12. Move the cursor to TIE CORRECT.

13. **Select!** no. (This function actually triggers the correction operation, so you do not want to enable it at this point)

14. Move the cursor to TIE-MODE.

15. **Select!** line

16. Ignore FRQ.SCAN:

17. Ignore TWO-PROBE:, since the Resistivity option is disabled, this setting will have no effect anyway.

18. **Press** "ESCAPE" twice to return to the MAIN OPERATING display.

SAMPLE VLF SETUP — RESISTIVITY OPTION

To set up the Resistivity Option, configure the INSTRUMENT SETUP and VLF SETUP as for VLF operation with the following exceptions:

1. In the VLF SETUP menu, move the cursor to `RES.PSEP:`

```
                vlf setup
FRQ1:          21.1     TIE-MODE:          line
FRQ2:          22.4     AUTO RECORD:         no
FRQ3:           0.0     FRQ.SCAN:
RES.PSEP.:      5m      TWO-PROBE:           no
%SCALE:
TIE CORRECT.: no
Chg?:ENT.                          BATT:    110
```

2. **Select!** `5m` or `10m`. These indicate the length of the cables from the resistivity probes to the VLF sensor module (which is on the operator's back). Select `5m` if your resistivity connector cables are each 5 metres long, or select `10m` if they are each 10 metres long.

Note: Selecting `0` will *disable* the resistivity option.

3. Move the cursor to `TWO-PROBE`. This is when you indicate whether you are using two or three probes to measure resistivity. The default setting `no` indicates you are using three probes, whereas `yes` indicates you are using two probes.

4. **Select!** `no`.

Note: It is easier to take resistivity measurements using three probes rather than two probes. See page 6–27 for information about connecting the VLF resistivity probes, and see page 6–29 for how to orient the electrodes during operation.

INFORMATION DISPLAY

The steps described below are used to set:

- the date,
- time,
- job number,
- serial number,
- operator identification.

From the MAIN OPERATING display proceed as follows:

1. **Press** the "INFO" key and the INFORMATION display appears:

2. Move the cursor to `TIME:`

```
   Sprintex data acquisition system V4.3
TIME: hh:mm:ss          SER.#:     sssssssss
DATE:  yy:mm:dd         JOB #:       jjjjjj
                        OPERATOR:oooooooooo


                                   MEMF: ppp%
Chg?:ENT.              help:INFO   BATT: bbb
```

3. **Enter!** the current *hour.*

4. Move the cursor one step →

5. **Enter!** the current *minute.*

6. Move the cursor one step →

7. **Enter!** the current *seconds* or set to zero.

8. Move the cursor to `DATE:`

9. **Enter!** the current *year.*

10. Move the cursor one step →

11. **Enter!** the current *month* (numeric entry **1** to **12**).

12. Move the cursor one step →

13. **Enter!** current *day* (numeric entry **1** to **31**).

14. Move the cursor to `SER # :`

15. **Enter!** the instrument serial number or other permanent identification.

16. Move the cursor to `JOB #:`

17. **Enter!** a *job number* or other unique identifier for the survey.

18. Move the cursor to `OPERATOR:`

19. See "Note entry" on page 5–37. for detailed instructions on how to enter alphanumerics.

NOTE ENTRY

This section describes the steps needed to:

- enter unique text to be recorded with the present measurement,
- or how to enter text to be used as macros for use as quick-entry notes.

Identical keystrokes are also used to enter the operator's name in the previous paragraph.

Notes or macros may contain all letters and numbers as well as +, ., -. Entry procedures are similar to the **Enter!** procedure for entering numbers only, as discussed in previous sections. The Number keys now offer also three letters, which can be accessed by subsequent keystrokes such as: 1 A B C 1 ...

The "CLEAR" key allows deletion of erroneous entries, whereas the "NEXT" key allows spaces between words. New macros can be entered by simply over-writing the previous ones.

The following steps enter the macro "fence 1" as Note 1. Other macros would be entered similarly, except that they would be saved with Note 2, Note 3 etc.

From the MAIN OPERATING display proceed as follows:

1. **Press** "NOTE" and the NOTE display appears.

```
NOTES: *nnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnn

MACROS:
1: ccccccccccccccc   2: ccccccccccccccc
3: ccccccccccccccc   4: ccccccccccccccc
5: ccccccccccccccc

Chg?:ENT.                          BATT:bbb
```

2. **Press** the "ENTER" key.

3. **Press** the "2" key repeatedly until ↑ appears.

4. **Press** the "NEXT" key. If the following character is on a different key, there is no need to **Press** the "NEXT" key.

5. **Press** the "2" key again until `e` appears.

6. Continue entering in the same way until '`fence`' is completed.

7. **Press** the "NEXT" key twice.

8. **Press** the "1" key.

9. **Press** "ENTER".

10. **Press** the "NOTE" key, followed by the "1" key. You should now see `fence 1` appear further down, under `MACRO: 1`

Unique notes, belonging to one reading only, are entered in the same way, with the exception that step **10** is omitted. The note will then be recorded along with the data. The note entry field is then cleared.

DISPLAY INTENSITY CONTROL

The display intensity gets pre-set at each cold boot and seldom needs to be adjusted. If it does, proceed as follows.

From the MAIN OPERATING display:

1. **Press** the "AUX/LCD" key, and the AUXILIARY FUNCTION display appears.

```
                auxiliary functions

                (+- ESC) LCD Intensity
                (1) Data Output
                (2) Factory Test *
                (3) Lock                    OFF
                (4) Reprogram System
Select function
```

2. **Press** the "+" or "–" key to adjust the intensity of the display to your satisfaction.

3. **Press** "ESCAPE" twice to return to the MAIN OPERATING display.

PARAMETER LOCK

The ENVI system `instrument setup` and `mag setup` parameters can be locked to prevent accidental change. To do so, proceed as follows.

From the main operating display:

1. **Press** the "AUX/LCD" key to get the AUXILIARY FUNCTIONS display.

```
                auxiliary functions

                (+- ESC) LCD Intensity
                (1) Data Output
                (2) Factory Test *
                (3) Lock                    OFF
                (4) Reprogram System
Select function
```

2. **Press** the "3" key to toggle the locking feature `ON`.

3. Do your work...

4. To unlock the instrument repeat steps 1 and 2, except that now the locking is toggled to `OFF`.

5. **Press** "ESCAPE" to return to the MAIN OPERATING display.

REPROGRAMMING THE OPERATING SYSTEM

The flash EPROM's (erasable, programmable read only memory) of the ENVI MAG can be updated from your computer using the software supplied by SCINTREX.

AT THE COMPUTER

1. Note the name of the upgrade program (usually DASPROM.SYS) written on the label of the supplied disk.

2. Insert the supplied disk into your floppy drive (A: or B:).

3. If you have an older ENVI unit (less than V. 4.2F), you will be supplied with the FLASHCOM program, otherwise you will have the FASTCOM program. The FASTCOM program will handle transmission speeds of 19200 and 57000 baud. However, ENVI units V. 4.2F must use 19200.

4. Start the program,
   e.g. enter [F][L][A][S][H][C][O][M][↵] or [F][A][S][T][C][O][M][↵].

   a. If you have FLASHCOM, then depending upon the type of display your PC has, enter one of:
      [K]— for monochrome display
      [C]— for CGA displays
      [V]— for VGA displays

5. You will then be asked to enter the name of the download program from step 1, i.e. DASPROM.SYS or what ever was on the disk.

6. The PC will display: "WAITING...". At this point it is waiting for the ENVI MAG console to come on line.

AT THE ENVI SYSTEM

Warning: Make sure you have dumped all of your data, otherwise it will be erased.

From the MAIN OPERATING display in the advanced mode:

1. **Press** the "AUX/LCD" key to get the AUXILIARY FUNCTIONS display.

```
auxiliary functions

(+- ESC) LCD Intensity
(1) Data Output
(2) Factory Test *
(3) Lock                    OFF
(4) Reprogram System
Select function
```

2. Make sure the *baud rate* under `Data Output` is set at 9600.

3. **Press** the "4" key to start the procedure.

4. You will now see a warning and confirmation screen as follows:

```
!!WARNING!!!

You are about to REPROGRAM your current
version of the operating system. This
process will also destroy all of your
stored data if any.

Do you want to proceed ? (Y/N)
```

5. **Press** the "Y" key to continue.

6. At this point the PC will start to display the activity of the download procedure showing the percentage that is complete.

7. When the download is finished, i.e. 100% complete on the PC, *wait* for about 10 to 15 seconds for the ENVI system to reprogram. The ENVI will then automatically perform a cold boot and you are ready to survey.

Note: If the download is interrupted (power shutdown at either the PC or ENVI end), you will have to repeat the above steps. If for some reason the ENVI system does not reboot, then you must power the unit off and on again. The screen may not be functional, but the bootstrap program will be running. Start the download from the PC again.

OPERATING THE ENVI SYSTEM

The information in this chapter is not intended to be a complete tutorial on magnetic or VLF-EM surveying, rather it highlights the unique features of the ENVI system. The *Magnetic Applications Guide* and the *VLF Interpretation Manual* cover the subject in more detail. This chapter will cover the following:

- guidelines for obtaining accurate, meaningful measurements,
- tips on field procedures with the ENVI system,
- a sample WALKMAG (automatic) mode of survey (basic mode),
- a sample Stop-and-Go (semi-automatic) mode of survey (advanced),
- base-station magnetometer operation (advanced),
- search-mode magnetic surveys,
- a sample VLF-EM survey
- a sample VLF-EM survey measuring apparent resistivity
- data correction procedures using the base-station, tie-line or loop survey modes,
- operating the ENVI MAG under the control of another host computer (Remote operation).

ACCURATE AND MEANINGFUL MEASUREMENTS

MAGNETIC

The quality of your measurements are greatly affected by the sensor orientation, magnetic gradients and any other source of noise near the sensor. Accurate, meaningful measurements can only be made by observing some simple guidelines as discussed in the following sections.

Orientation

Optimum performance can be achieved with proton magnetometers when the axis of the sensor coils (not the sensor itself) are aligned perpendicular with the Earth's magnetic field. Proper orientation is of utmost importance at the magnetic equator, where the field is horizontal. In polar regions, the field is vertical and orientation is not as critical.

The sensors have orientation marks. Care should be taken when assembling the gradiometer sensor to align both sensors with each other, such that the whole assembly can be oriented in both the vertical and horizontal modes.

If the sensor is properly oriented, the sensor coil axis points east-west. This also occurs if the sensor is mis-oriented by 180 degrees; that is the N mark points to the south etc. This means, that a properly oriented sensor, when mounted fixed onto the Back Plate, is suitable for surveying while walking up or down a survey line.

↑N ↓S

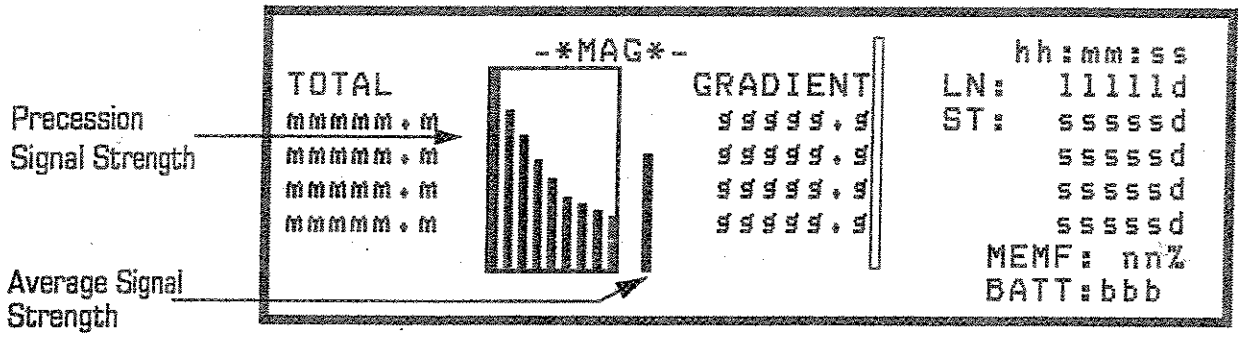
Effects of gradient

Many small items carried by the operator in addition to the magnetometer may be magnetic and therefore upset, locally, the magnetic field to be measured. Such items are notebooks, pencils, cigarette lighters, eyeglasses, dentures etc., just to mention a few.

The higher the magnetic gradient is at the sensor, the poorer the proton precession magnetometers operate, since the precession signal decays more rapidly. With an abrupt signal decay at very high gradients, measurements

are impossible to obtain. Also, the closer a sensor is to a highly magnetic object, the higher the gradient the higher the gradient that will be present at the sensor.

Display page 2 of the Numeric Data display (page 4–22) shows a bar graph indicating the decay and the average signal amplitude. It is good practice to get familiar with this feature as it is a useful tool in diagnosing difficulties.



Other sources of noise

Other sources of noise can be objects (such as belt-buckles, branches, etc.) striking the sensor, staff, or console while walking. These can introduce *microphonic noise* that typically appears as spikes in your data. It is a good practice to secure the sensor cable as much as possible to prevent this microphonic noise. It also is good practise (in the WALKMAG/GRAD modes) to walk gently, without swinging the shoulders unnecessarily, to prevent excessive agitation of the sensor fluid (which can result in increase noisiness of the data).

On the staff

Detectability of anomalies depends on its magnetic moment, the size and the distance from the sensor. The *stop-and-go* mode of operation, with the sensor on top of four staff sections, is usually used for large low intensity anomalies.

Very small anomalies are easiest detected using the *search* mode, with the staff held upside down, with the sensor near the ground.

Note: The sensor has to be oriented with respect to magnetic North for each reading.

On the back plate

The most convenient, hands free, configuration for surveying is a *back-pack* mounting and is referred to as the WALKMAG mode. The sensor has to be oriented once for a given area to suit the line direction. Since the sensor response is symmetric, you do not have to worry about reversing the orientation as you go up and down the survey lines.

Base-station

The Base-station is normally installed as close to the actual survey area as practical to minimize spatial differences in the magnetic field.

The base-station sensor is supported by the staff and secured with the aid of three cords and tent pegs, as shown in Figure 65 ("Typical magnetic base-station sensor setup") on page 6–4. In some situations, it may be more convenient to lash the sensor to a tree. You can also use the standard total-field sensor (Figure 6 on page 2–6) instead of the base-station sensor (Figure 7 on page 2–7) to operate in the base-station mode, depending upon your particular circumstances.

Note: The long sensor cable is particularly susceptible to interference. Please try to keep the sensor cable away from other cables and electrical equipment, especially portable electrical generators.

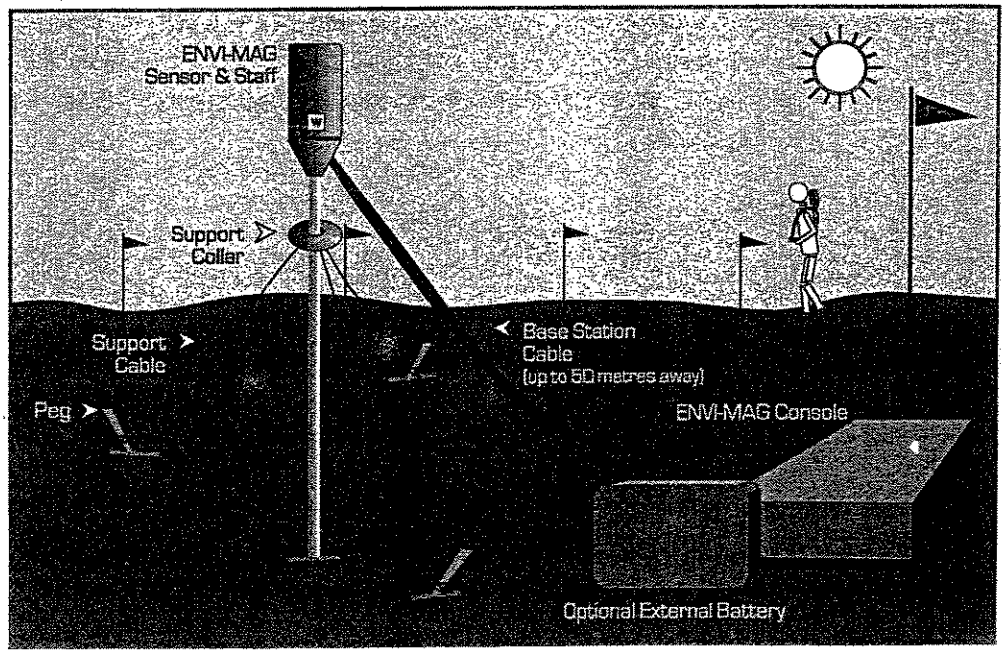


Figure 65 Typical magnetic base-station sensor setup

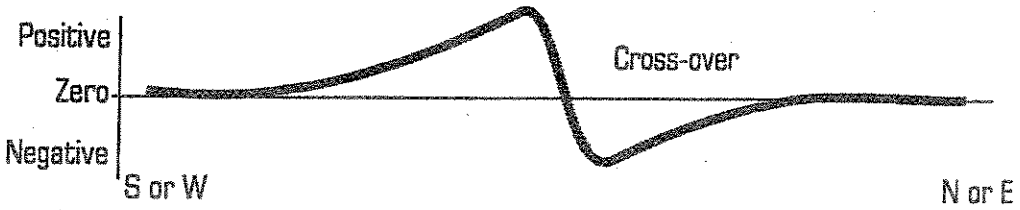
VLF

Orientation and Sensor motion

Due to the unique design of the VLF sensor, the quality of the VLF readings is not greatly affected by sensor orientation. However, any sensor motion will degrade the in-phase and tilt measurements. The optimum sensor configuration assumes that the sensor is within 10° of vertical and motionless. So it is quite important for you to *stand straight* and *be quite still* while the readings are being taken.

Sign convention

In typical VLF survey methods, a consistent direction is used to maintain a comparable sign convention (positive to negative) on all in-pahase, quadrature and tilt measurements relative to each other. The ENVI VLF is a no orientation system. Consequently, a convention that sets North and East as positive and South and West as negative was adopted. Therefore, for profiles plotted from south to north (looking east) or west to east (looking north) an anomaly cross-over will have a positive to negative sense, as illustrated in the following sketch:



Important: Always face the direction that you are walking while taking a VLF reading, regardless of the orientation of the transmitter, i.e. *do not face the transmitter.*

Sensor Operating Modes

The ENVI VLF system was designed as a no orientation system, consequently you should be aware of the convention used to maintain consistent sign designation. The sensor automatically initializes and selects one of two operating modes (Mode 1 or Mode 2) depending upon the orientation of the operator/VLF sensor with respect to the transmitter station(s) (see a & b in Figure 66 on page 6–6). This works well, as long as the transmitter stations are either at right angles or in-line with the survey line direction.

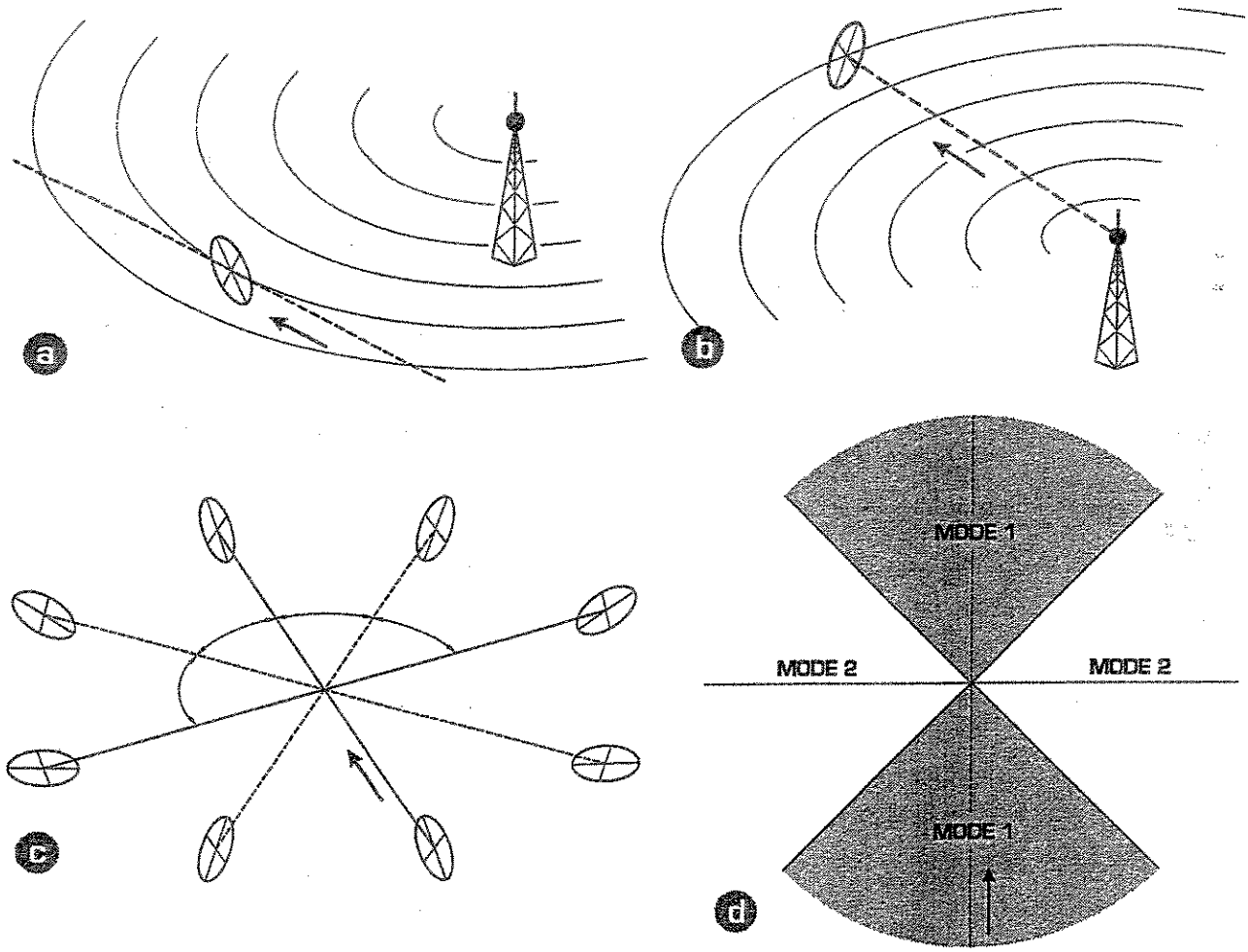


Figure 66 VLF operating modes showing the positive direction of tilt with respect to traverse direction (i.e. sign convention). a) Mode 1; b) Mode 2; c) Mode selection criteria; d) Zones showing modes used with respect to transmitter signal direction.

When the transmitting stations are at non-orthogonal angles to the survey line, then:

- if the primary field lines from the transmitting station are within ±0–45° of the survey line direction, MODE 1 is selected.
- if the primary field lines from the transmitting station are within ±45–90° of the survey line direction, MODE 2 is selected.

Note: If you change survey direction by more than 60° (i.e. from a survey line to a base-line or tie-line) then the system will automatically re-initialize itself. This does not cause any data loss.

The mode is then used to ensure that the sign convention of a VLF cross-over from positive to negative is maintained for any survey line using the console entered line, station and station separation parameters. All of these conventions assume that you are facing the direction that you are walking while taking readings.

For large grids with survey lines that are near 45° to the transmitting stations, you may encounter some inconsistencies in the sign conventions depending upon your orientation when the system initialized. If the survey takes several days to complete, please carefully examine your results and be aware that you may have opposite sign conventions for your cross-overs, if different modes were initialized on different days. The total field values will continue to peak over the cross-overs and this should help you sort out any problems with the sign convention.

VLF total field corrections

The VLF total field data is susceptible to diurnal variations caused by atmospheric effects or changes in the transmitter power output. To ensure that this data is usable, corrections for these variations are made similar to those used for the magnetometer (in the TIE-PT mode).

Note: The current version of the ENVI VLF does *not* support a base-station mode of correction as available for the magnetometer.

You can use the TIE-PT LINE or LOOP modes to correct your data. The corrected data are normalized by the appropriately interpolated tie values stored in your ENVI console and then multiplied by the selected scale factor (SF_x) for the frequency. By default the scale factor is set to 100%, so that a background reading should show as 100%.

Quality of Reading and Signal/Noise Ratio

The quality of the VLF reading and the signal-to-noise ratio are displayed graphically to provide you with a qualitative evaluation on the data that you are collecting. These are shown as horizontal bars on the VLF numeric data display (see Figure 67) labelled Q and S, respectively.

Q, the operator quality number ranges from a value of 0 (worst) to 9 (best). This number measures your ability to stand-still and keep the VLF sensor module in a perfectly vertical operation. There are 9 segments (representing 1.1 units) comprising the horizontal bar. A good reading is indicated by having at least 5 to 6 segments displayed on this bar (e.g. more than half of the bar is solid).

S, is the signal to noise ratio ranging from 0 (worst) to 9 (best). As for Q, the horizontal bar has 9 segments, each of 1.1 units. This bar indicates how well your signal is being received relative to the background noise. You should have at least one segment displayed on the horizontal bar, however the signal may be marginal at this point. It is recommended that several successive readings be taken at one location to see if the data are repeatable. You will get an error message (`Weak Signal`) displayed on the status line of the console if the signal strength falls below a usable level.

It is important to monitor these displays, as a VLF transmitter may go off the air without any prior warning. The cause of any sudden or large changes in the quality and strength of the signal should be investigated and identified in the field when it happens, rather than trying to figure it out later when processing your data.

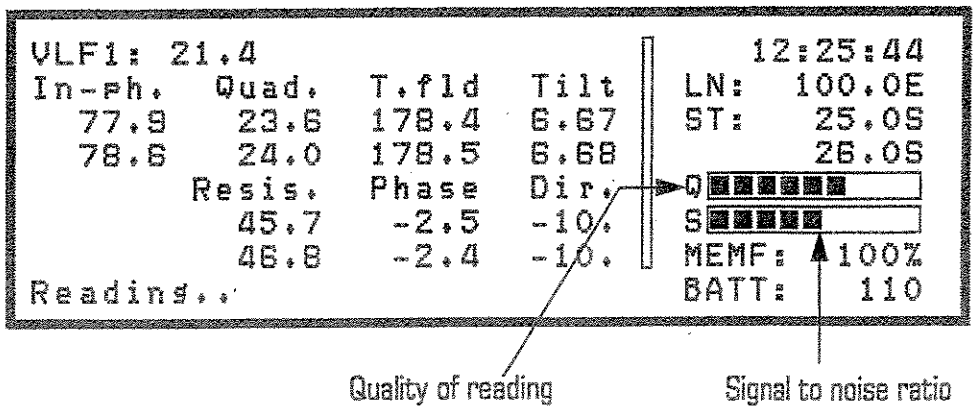


Figure 67 VLF signal quality and strength indicators.

REPEATED SURVEYS LINES

If it is necessary to repeat a set of measurements on a survey line, you should take certain precautions to ensure data handling is done in the most effective manner. The ENVI recalls or outputs repeated data sequentially by time at the same locations, resulting in unsightly (or unintelligible) recall displays. You will also have to substantially edit your data files to properly use them with the ENVI MAP software

Tip: It is recommended that you assign a minor increment to the survey line number prior to re-surveying to avoid problems. For example, if you are about to re-survey line 40N, enter the line number as 40.1N instead.

MAGNETOMETER OPERATION

WALKMAG — TOTAL-FIELD/GRADIOMETER (AUTOMATIC MODE)

The following sets of instructions will lead you step by step through the first three survey lines of an imaginary total-field survey looking for buried drums. This should give you a better understanding of what you will be required to do when doing your ENVI MAG survey.

- It is assumed that the lines are marked and pegged intervals of 10 units.
- The most suitable configuration for such a survey is with the sensor mounted (and properly oriented) onto the back plate or optional backpack.
- Ensure that the sensor orientation is such that when you are walking along the survey line, the **N** mark on the sensor is facing magnetic North (or South).

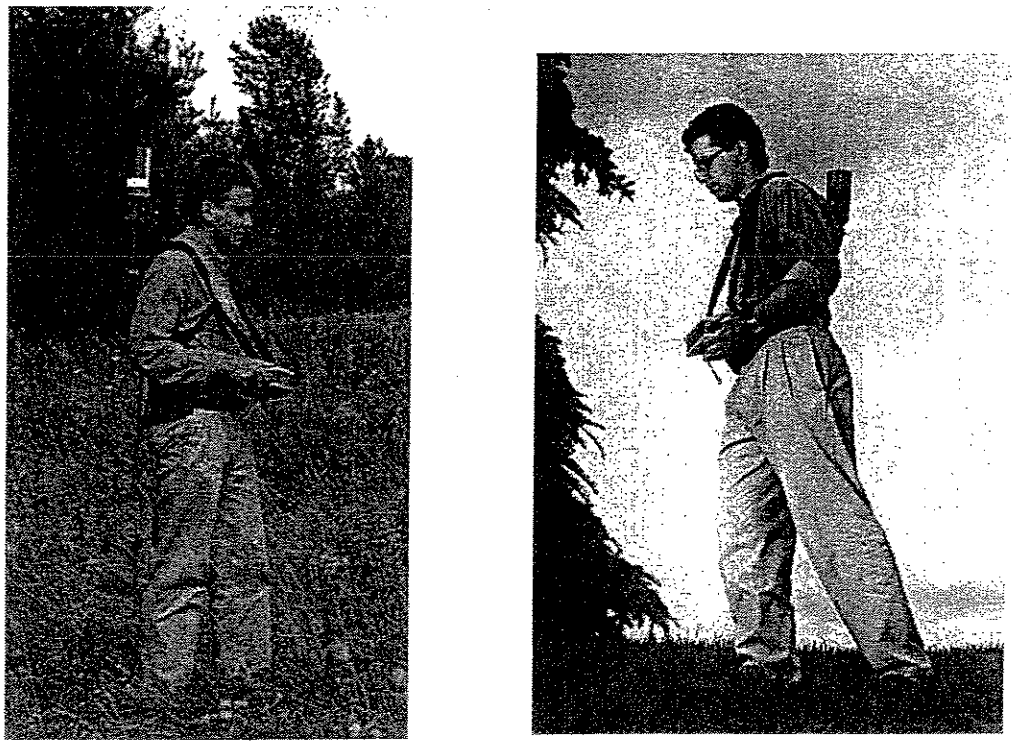


Figure 68 Typical WALKMAG configurations.

Press the "SETUP" and "ON" keys simultaneously and select configuration 2 - `Drum Locations`. This is described fully in "Basic mode configuration displays" on page 4–3.

Check your setup

1. Set up Line and Station Number and Separations as shown in the example under "Line and Station setup" on page 5–9.

2. Do the setup shown under "Sample total-field setup (WALKMAG or WALKGRAD)" on page 5–17.

Start survey

3. Proceed to your first location.

4. **Press** the "START" key.

5. Proceed immediately with your desired pace toward the West.

6. **Press** the "NEXT" key when the *sensor* passes the first station peg. If you trigger the station marker at the time that you yourself pass the station, rather than the sensor, you will likely introduce a herring-bone pattern into the survey data. Observe how the Station Number decrements.

7. Repeat the previous step at each peg.

8. At Station 50 W, **Press** "STOP" right after you have pressed "NEXT".

9. If you wish to inspect your data graphically (before you press "ESCAPE"), you will need to press the "NUM/GRAPH" key. This will show you up to the last 178 readings on the line.

10. **Press** the "ESCAPE" key.

11. Move the cursor to `ST: SEP:`

12. **Enter** 10.

13. Move the cursor to LN:

14. **Press** the "+" (plus) key. The Line number increments to 18.

15. Proceed to Line 18 N, Station 50 W.

16. **Press** the "START" key.

17. Press the "NUM/GRAPH" key to enter the graphics display mode.

18. Proceed *immediately* walking to the East.

19. At each peg, **Press** the "NEXT" key.

20. At Station 50 E, **Press** "STOP" right after you have pressed "NEXT."

21. **Press** the "ESCAPE" key.

22. Change the ST: SEP: to -10.

23. Move the cursor to LN:

24. **Press** the "+" (plus) key. The Line number increments to 20.

25. Proceed to Line 20 N, Station 50 E.

26. **Press** "START", and proceed walking to the West again etc. The beep indicates the start of the first reading which belongs to Station 50 E.

Tip: Walk gently without swinging your shoulders unnecessarily to prevent excessive rotation of the sensor or agitation of the sensor fluid, otherwise this will lead to noisy data.

WALKGRAD gradiometer survey

A walking type of gradiometer survey is done in the same manner as the WALKMAG, with the following exceptions:

- At the MODE : select GRAD.
- The standard back plate is *not* suitable to carry this large sensor configuration (you will encounter a high degree of motion noise in your readings). The specially designed optional backpack is best suited for this purpose.

MANUAL MODE— TOTAL-FIELD/GRADIOMETER (SEMI-AUTOMATIC)

These instructions lead you through the steps for the first three survey lines of an imaginary gradiometer survey. A fully manual procedure (using the advanced mode) is explained first, followed by some suggestions on how to make it semi-automatic.

It is assumed that:

- the lines are marked and pegged at 10 units of interval,
- the sensor is carried on the staff. This gives the highest precision by eliminating the possibility of a small magnetic signature caused by the ENVI MAG console. *The sensor has to be oriented for each reading and should be held as steady as possible.*

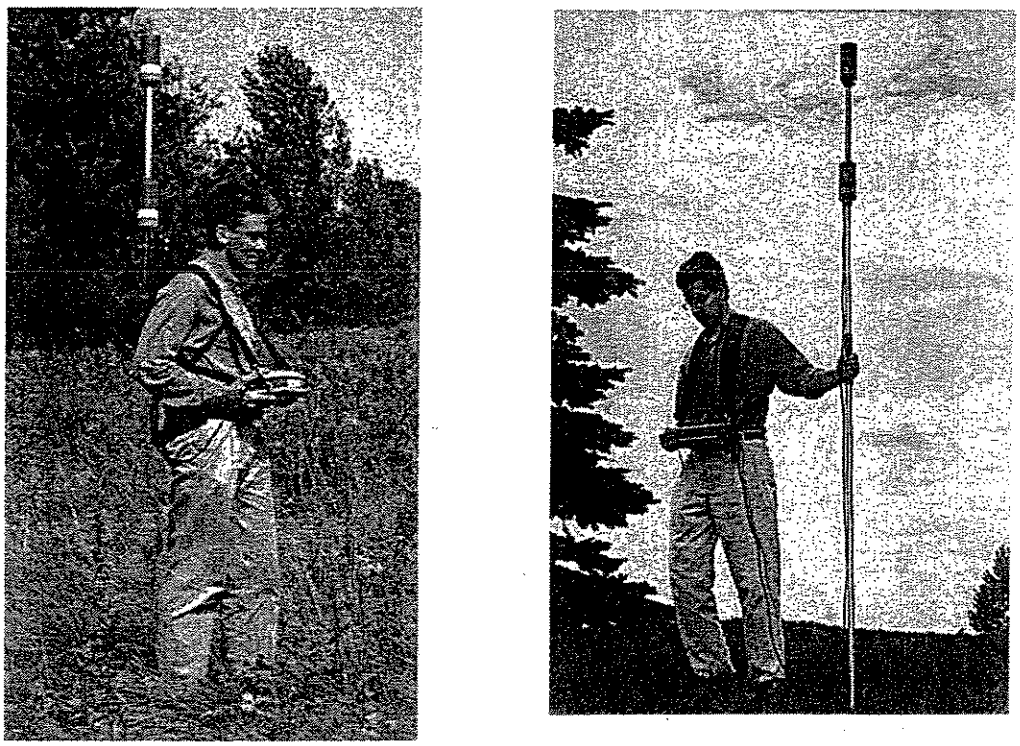


Figure 69 Typical gradiometer configurations.

Press the "SETUP" and "ON" keys simultaneously to get the configuration menu. Select `1-MAG only` and then select configuration `6-Mineral Exploration`. This is described fully in "Advanced mode configuration displays" on page 4–13.

Check your setup

1. Set up Line and Station Number and Separations as shown in the sample setup on page 5–9.

2. Do the setup as shown under "Instrument setup" on page 5–15, except set the:

   ▲ `CYCLE REPEAT: as no`

3. Do the setup as shown under "Sample total-field setup (WALKMAG or WALKGRAD)" on page 5–17.

Tip: To operate as a total-field magnetometer in the Stop-and-Go mode, make the following change in the `mag setup:` screen, `MODE: T-FLD`

4. Enter a Note as shown under "Note entry" on page 5–37.

Start survey

5. Proceed to your first location.

6. Hold the sensor steady and **Press** the "START" key to take a reading.

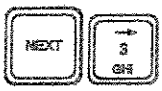
7. Inspect the data.

8. Re-adjust the `LOCAL FIELD` in the `mag setup` if necessary to the current total-field value.

9. **Press** the "RECORD" key to save the data.

10. **Press** "ESCAPE", optionally followed by "OFF".

11. Proceed to the next station to the West.



12. Move the cursor to ST:

13. **Press** the "+" key. Verify that the Station has decremented to 40 W.

14. Take a reading and record the data.

15. Continue along the line and take a reading at each station.

16. At 10 W, before you press the "START" key, **Press** the "NOTE" key and then the "1" key to enter the note "fence 1". You may also enter your Macro or any unique note after the measurement, but before you **Press** the "RECORD" key.

17. After completing 50 W, proceed to 50 W on Line 18 N.

18. At the MAIN OPERATING display move to cursor to ST: SEP:

19. **Enter!** 10.

20. Move the cursor to LN:

21. **Press** the "+" key to increment the line number to 18 N.

22. Take a reading and proceed along line 18 N toward the East.

23. At 10 W again, before you press the "RECORD" key, **Press** the "NOTE" key, and then the "1" key.

24. After you have finished the line, move to Line 20N and proceed to 50E.

25. At the MAIN OPERATING display move the cursor to ST: SEP:

26. **Enter!** –10.

27. Move the cursor to LN:

28. **Press** the "+" key to increment the line number to 20 N.

29. Proceed with Line 20 N.

Automating your measurements

There are two items which can be automated after each measurement:

- data recording,
- altering of the Station Number can take place automatically.

Caution: Please note that *repeat measurements* will alter the Station Number and possibly disrupt the correlation between location and data.

To enable both features do the following:

1. In the Instrument setup, move the cursor to `AUTO ST.INC.:`
   Select! `YES`

2. In the `mag setup`, move the cursor to `AUTO RECORD:`
   Select! `YES`

BASE-STATION OPERATION

Base-station operation is a simple matter of setting up the equipment and getting it operational. A single base-station can be used with a multiple of mobile (portable, airborne) instruments. The base-station sensor(s) should have the same location for multi-day projects.

A chart recorder may be used for a continuous analog output, though the on-line graphics capability may make this unnecessary. See "Data Interface Connector" on page 3–3. for more information on this.

The magnetic base-station operation uses the standard base-station sensor with the 50m cable. However, the total-field sensor can also be used for convenience. You will be asked whether you are using a long (50m base-station) or short (total-field) cable.

After all the equipment has been set up and connected, proceed as described in steps **1** – **3** to set up the instrument (or at least to verify proper settings as shown in the "Sample base-station setup" on page 5–22). You may have to press "SETUP" + "ON" to get your ENVI system configured for magnetometer operation and select one of the advanced configurations.

Warning: It is of **utmost importance** that **date** and **time** coincide on all instruments to successfully correct the mobile data.

Proper correction also requires a *base field* value, which has to be entered into **all** magnetometers before the base-station correction takes place. This usually is one of the first readings of the base-station taken on the first day of an extended survey. This value **must not** be changed while in the same area.

Check your setup

1. Set up Line and Station Number to the actual location of the base-station. This is recommended to avoid later confusion.

2. Do the setup as shown under "Instrument setup" on page 5–15, except set:

   ▲ CYCLE REPEAT: as no

3. Do the setup as shown under "Sample base-station setup" on page 5–22.

Start operation

4. **Press** the "START" key, read the console message and act accordingly.

5. After two or three readings, **Press** the "STOP" key.

6. **Press** the "ESCAPE" key.

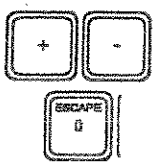
7. Bring up the MAG SETUP display by pressing the "SETUP" key, then moving the cursor to `mag setup` and pressing the "ENTER" key.

8. **Enter!** the measured total-field value as `TUNE FIELD:` and also as the `BASE FIELD:`

9. **Enter!** the same Base Field value into all mobile units.

10. **Press** the "ESCAPE" key and resume the measurement.

11. **Press** the "NUM/GRAPH" key to show the graph.



12. **Press** the "+" or "–" key to change the sensitivity of the graph. The new full-scale value is shown briefly on the message line at the bottom of the display. You can also press the "0" (zero) key to center the graph vertically.

Note: Data scrolled off the screen may be inspected using the RECALL feature. This, however, requires interruption of data acquisition cycle. A change in the graph sensitivity does not affect the recorder sensitivity.

MAGNETIC SEARCH MODE

The magnetic *search* mode is useful for small areas where simple targets can be located immediately, without data plotting and interpretation. Examples are paved-over utility covers or valves etc. Due to the possibly small physical size of the target it is necessary to use the highest sampling rate and slow sweep rate. The total-field sensor or the base-station sensor can be used. You will need to specify which one you are using.

Basic

Press the "SETUP" and "ON" keys simultaneously to get the configuration menu. Select configuration `4-Search Magnetometer`: This is described under "Search mode configuration display" on page 4–9. You then can follow the setup as described under "Search mode for magnetometer" on page 5–14. You only need to enter *two* values before you start:

- the duration of the reading (typically 0.5 sec)
- the tuning field value

Advanced

This procedure gives you the same results as using the basic mode described above. Press the "SETUP" and "ON" keys simultaneously to get the configuration menu. Select one of the advanced configurations (5-7). This is described under "Advanced mode configuration displays" on page 4–13.

Proceed as shown in the following steps to change the four setup parameters, and to verify other setups as shown in the "Instrument setup" on page 5–15.

1. Line and Station number, as well as, separation are not needed or used.

2. Do the "Instrument setup" on page 5–15 as shown, except set:

   - `CYCLE REPEAT:` to `no`
   - `CYCLE DELAY:` to `0`

3. Do the "Sample base-station setup" on page 5–22 as shown, except set DURATION: to 0.5 sec

4. Move cursor to AUTO TUNE:

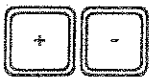
5. **Select!** no.

6. **Press** the "ESCAPE" key.

7. **Press** the "START" key. You will see prompts asking for the cable length you are using.

8. **Press** either the "2" key for the (LONG) standard 50m base-station cable or the "3" key for the (SHORT) total-field sensor cable.

9. **Press** the "NUM/GRAPH" key to display the graph.



10. **Press** the "+" or "–" key to change the sensitivity of the graph. You can also press the "0" (zero) key to center the graph vertically.

VLF OPERATION

VLF ONLY

These instructions will lead you step-by-step through the first three grid lines of an imaginary VLF survey. A fully manual procedure is explained. See "Automating your measurements" on page 6–34 for suggestions on how to make it semi-automatic.

It is assumed that the lines are marked and pegged at 10 units of interval.

Figure 70 Typical VLF survey configuration.

Press the "SETUP" and "ON" keys simultaneously and select configuration:
2-VLF only.

Check your setup

1. Set up Line and Station Number and Separations as shown in the sample setup on page 5–9.

2. Do the setup as shown under "Instrument setup" on page 5–15, except set the:

▲ CYCLE REPEAT: to no
▲ CYCLE DELAY: to 0

3. Do the setup as shown under "Sample VLF setup — Manual frequency input" on page 5–31.

4. **Enter!** Note 1 (fence 1) as shown under "Note entry" on page 5–37.

Note: The VLF operates in the stop-and-go mode only.

Start survey

5. Proceed to your first location (Station 50 North on Line 16 East).

6. Face in the direction you will be walking along the survey line, hold the sensor as steady and as near vertical, as possible, and press the "START" key. This will initialize the unit: for about 30 seconds Initializing... will appear on the status line, while the sensor is searching for VLF stations.

7. When the initialization is complete, the latest reading appears beneath each heading.

8. Inspect the data in both the numeric and graphic forms. (See "Numeric data display" on page 4–41 and "Graphic data display (profiles)" on page 4–45. The in-phase (In-Ph.) profile line will show you the location of cross-overs (anomalies).

9. Press the "RECORD" key to save the initialization data.

10. If you press the "ENTER" key without having recorded the data, the status line reports `Data NOT Recorded!`. You can then press the "RECORD" key to record the data, or press the "ESCAPE" key. If you want to take a new reading at the same Station press the "START" key to take a new reading.

11. Press the "ESCAPE" key, optionally followed by "OFF".

12. Proceed to the next Station to the South.

13. Move the cursor to `ST:`

14. Press the "+" key. Verify that the Station has decremented to `40 N`.

15. Press the "START" key to take a reading. The status line will show `Reading...` for about 10 seconds and then the latest reading appears beneath each heading.

16. Press the "RECORD" key to record the data.

17. Continue along the line and take a reading at each station.

18. At Station 10 N, before you press the "START" key, press the "NOTE" key and then the "1" key to enter the note `fence 1`. You may also enter a Macro or any unique note after the measurement, but before you press the "RECORD" key.

19. After completing Station 50 S, proceed to Station 50 S on Line 18 E.

20. At the MAIN OPERATING display move the cursor to `ST: SEP:`

21. **Enter!** `10`

22. Move the cursor to `LN:`

23. Press the "+" key to increment the line number to `18 E`.

24. Take a reading and proceed along line 18 E towards the North.

25. At Station 10 N again, before you press the "RECORD" key, press the "NOTE" key, and then the "1" key.

26. After you have finished the line, move to Line 20 E and proceed to Station 50 N.

27. At the MAIN OPERATING display move the cursor to `ST: SEP:`

28. **Enter!** - `10`

29. Move the cursor to `LN:`

30. Press the "+" key to increment the line number to `20 E`.

31. Proceed with Line 20 E.

VLF Resistivity Option operation

These instruction will lead you step-by-step through the first three grid lines of an imaginary VLF apparent resistivity survey. A fully manual procedure is explained, using the two-probe and three-probe configurations. See page 6–34 for some suggestions on how to make it semi-automatic.

It is assumed that:

- the lines are marked and pegged at 10 units of interval,
- the VLF sensor module is carried on the back using the harness or, preferably, the optional backpack

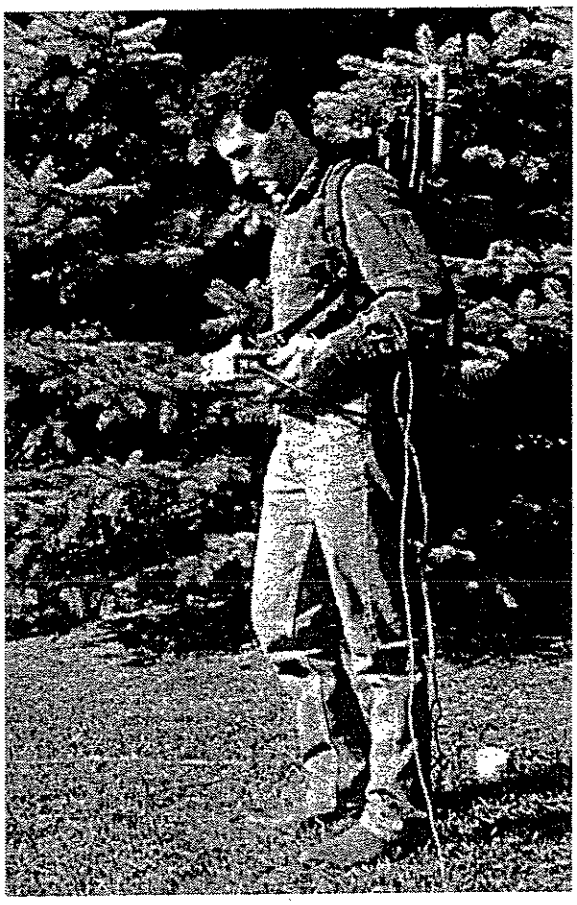


Figure 71 Typical VLF Resistivity Option configuration.

Check your setup

1. Press the "SETUP" and "ON" keys simultaneously and select configuration 2-VLF only
2. Set up Line and Station Number and Separations as shown in the sample setup page 5–9.
3. Do the setup as shown under "Instrument setup display" on page 4–53.
4. Do the VLF setup as shown under "VLF Resistivity Option operation" on page 6–26. For the TWO-PROBE parameter **Select!** yes, if you are using two probes, or **Select!** no if you are using three probes.
5. **Enter!** Note 1 (fence 1) as shown under "Note entry" on page 5–37

Initialize system

1. Attach the VLF module to the console (J101 connection).
2. Use either the capacitive or resistive probes and connect the paired cable to the lower connector on the left side of the VLF electronics module for the two-probe configuration. Attach the third probe to the upper connector,if required, for a 3-probe, non-orienting survey. This is shown in the following figure:

3. Orient the probes as described below under "Three-probe configuration" or "Two-probe configuration".

4. Press the "ON" and "SETUP keys at the same time.

5. **Select!** `2- VLF only`

6. In the MAIN OPERATING display, press the "START" key to begin initialization.

7. Wait about 30 seconds until the initialization is complete.

8. Note the resistivity initialization parameter values. These values should be as follows:

`Resis.`	`50 to 200`	Resistivity
`Phase`	`-10 to 100`	Phase angle
`Dir.`	`0`	Primary field direction

9. Press the "ESCAPE" key twice to return to the MAIN OPERATING display.

Three-probe configuration

In the three-probe configuration, no special orientation of the probes or the operator is required. However, the single probe (R3) cable must be oriented perpendicular to the line between the probe at the station (R2) and the other distant probe (R1); R1 and R3 must be the same distance from the station. Please see Figure 72 on page 6–29.

For the three-probe system, up to three frequencies may be read at one time, without concern regarding the primary field direction.

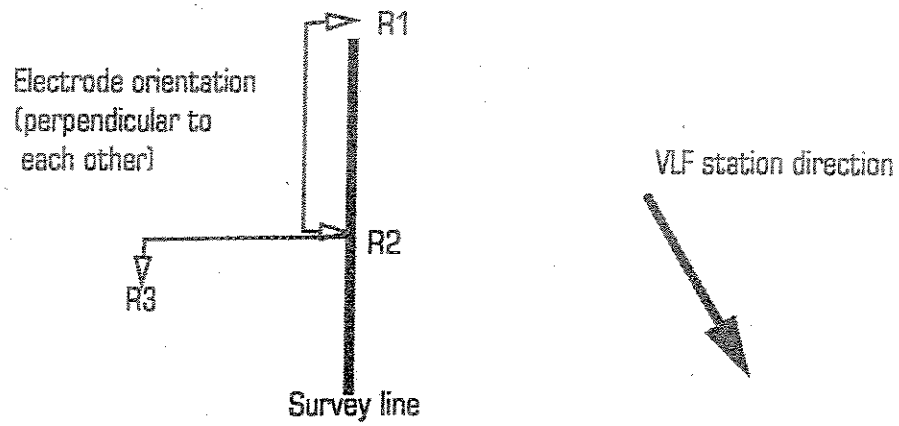


Figure 72 Orientation of three-probe configuration in VLF Resistivity Option.

Two-probe configuration

Note: ENVI VLF systems with a serial number of the form 96xxxx must be returned to SCINTREX for an upgrade in order to use the two-probe resistivity mode.

The two-probe configuration can be used to simplify and speed up a VLF resistivity survey in situations where the VLF electric field direction lies within ±70° to the survey line direction, i.e. `Dir` is equal to or greater than `20`.

Note: The VLF electrical field direction is perpendicular to the magnetic field direction. The magnetic field is the parameter measured and displayed under `Dir` on the MAIN OPERATING display. Therefore, the electric field direction can be expressed as:

$$Dir_{El} = (90 - Dir).$$

The resistivity probes R1 and R2 are set the same way as indicated for the three-probe configuration (see Figure 72). The operator must face in the direction of the survey, which also is the same as the line joining the probes.

The R3 probe is replaced by a special plug (p/n 788 041, cable-less connector) instead of the R3 probe assembly (p/n 793 045). This plug sets the electric field for R3 to zero. By removing the R2–R3 electric field, the total VLF electrical field is usually reduced in amplitude

(except for the special case of Dir = 90, where it remains unaffected). In order to correct for this, the VLF electrical field measured by the R1–R2 probes is multiplied by a correction factor:

$$\frac{1}{\cos(90 - \mathrm{Dir})}$$

For the correction to be automatically applied, the VLF parameter TWO PROBES must set to yes.

Note: Due to errors in measuring Dir, the apparent resistivity measured in the two-probe configuration may differ slightly from the value determined for the three-probe configuration. The error in Dir increases as Dir approaches 0 (zero). Consequently, the apparent resistivity is set to 999999 when Dir less than 10.

Tip: It is recommended that the direction to the VLF transmitter station used for apparent resistivity measurements be 20° or larger, i.e. Dir >20

Checking two-probe orientation

1. In the MAIN OPERATING display, press the "START" key to make a trial reading.
2. Wait about 30 seconds until the initialization is complete, and then note the direction of the magnetic primary field lines (the number immediately under Dir.) for each of the frequencies being received. The electric field is perpendicular to this direction.

3. Press the "ESCAPE" key twice to return to the MAIN OPERATING display. (You do not need to record this information.)

4. Press the "START" key to take another reading.
5. Wait about 10 seconds until the word Reading... disappears from the status line, and again note the direction of the magnetic primary field lines for each frequency used.

6. Press the "ESCAPE" key twice to return to the MAIN OPERATING display.

7. Repeat steps 4 to 6 two more times. This should provide you with enough information to determine which of the VLF frequencies can be used.

8. Once this is determined, place the probe with the longer cable into the ground outwards from the station along the line direction to the full length of the cable (either 5 metres or 10 metres).

9. Place the probe with the shorter cable in the ground at the survey station. You are now ready to begin surveying

Sample survey

1. Proceed to your first location (Station 50 North on Line 16 East).

2. Insert (or place) the probes properly oriented. For the two-probe configuration, make sure that the line joining the two probes is along the survey line and that you face in the direction of the survey line.

3. Press the "ON" and "SETUP" keys simultaneously.

4. **Select!** `2- VLF only`

5. From the MAIN OPERATING display, press the "START" key to take a reading.

6. Inspect the data.

7. Press the "RECORD" key to save the data.

8. Press "ESCAPE", optionally followed by "OFF".

9. Proceed to the next Station to the South.

10. Insert (or place) the probes as in step 2 above.

11. Press the "ON" key.

12. Move the cursor to `ST:`

13. Press the "+" key. Verify that the Station has decremented to 40 N.

14. Take a reading and record the data (steps 6 to 9 above).

15. Continue along the line and take a reading at each station.

16. At Station 10 N, before you press the "START" key, press the "NOTE" key and then the "1" key to enter the note f e n c e 1. You may also enter a Macro or any unique note after the measurement, but before you press the "RECORD" key.

17. After completing Station 50 S, proceed to Station 50 S on Line 18 E.

18. At the MAIN OPERATING display move the cursor to S T : S E P :

19. **Enter!** 1 0

20. Move the cursor to L N :

21. Press the "+" key to increment the line number to 1 8 E.

22. Take a reading and proceed along Line 18 E towards the North.

23. At Station 10 N again, before you press the "RECORD" key, press the "NOTE" key, and then the "1" key.

24. After you have finished the line, move to Line 20 E and proceed to Station 50 N.

25. At the MAIN OPERATING display move the cursor to S T : S E P :

26. **Enter!** - 1 0

27. Move the cursor to L N :

28. Press the "+" key to increment the line number to 2 0 E.

29. Proceed with Line 20 E.

MAGNETOMETER AND VLF OPERATION

Press the "SETUP" and "ON" keys simultaneously and select configuration

3- MAG & VLF

For checking the setup and starting the survey, follow the instructions for the modes of your choice appearing earlier in this chapter. The magnetometer data is presented first, followed by the VLF data.

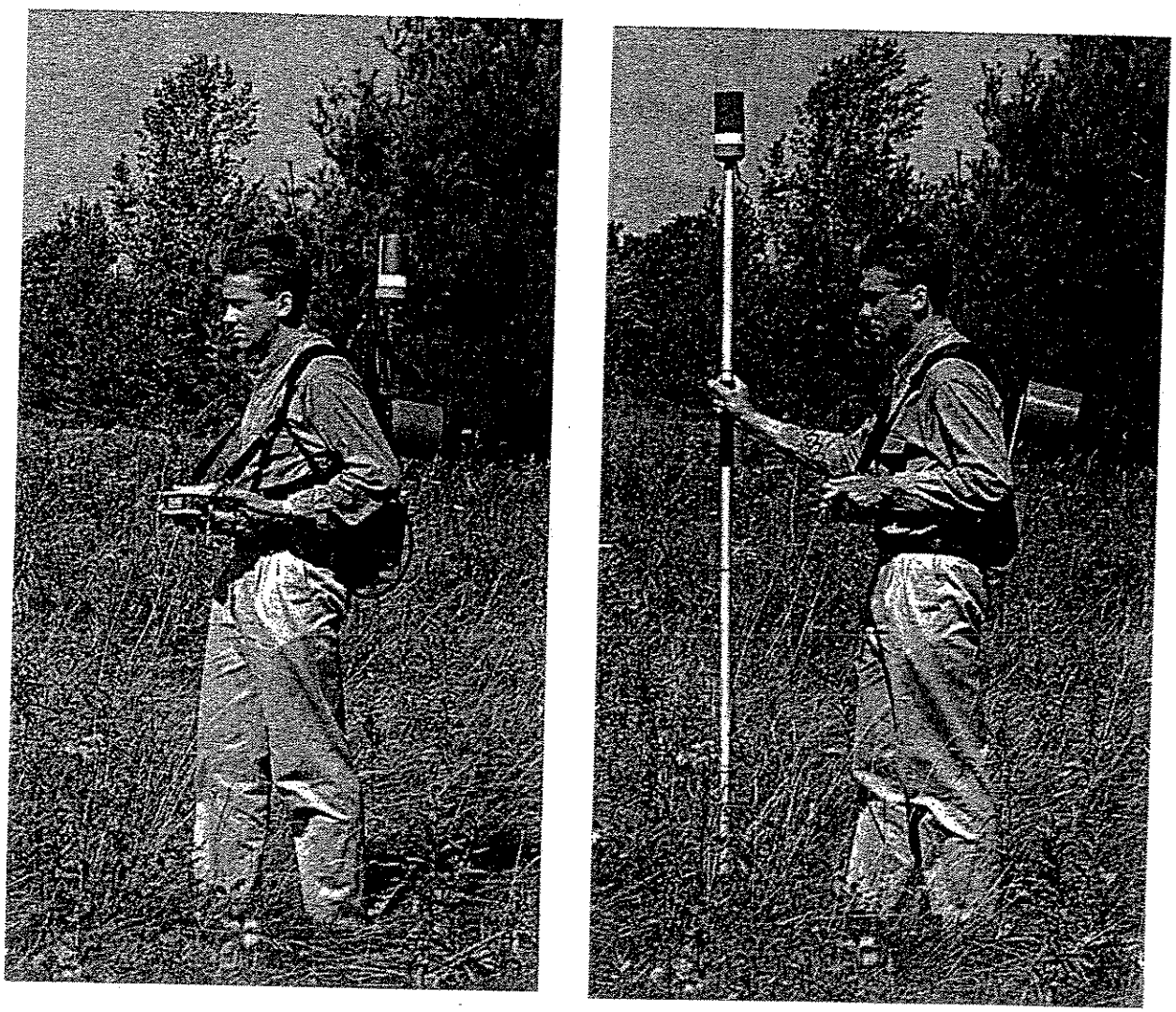


Figure 73 Typical MAG & VLF configurations.

AUTOMATING YOUR MEASUREMENTS

There are two items which can be automated after each measurement, in either the VLF mode or the Advanced mode of the magnetometer:

- ▲ data recording,
- ▲ changing the Station Number.

Caution: Please note that repeat measurements will alter the Station Number and possibly disrupt the correlation between location and data.

To enable both features do the following:

1. In the INSTRUMENT SETUP, move the cursor to `AUTO ST. INC.:`
2. **Select!** `yes`

3. In the MAG SETUP and/or the VLF SETUP, move the cursor to `AUTO RECORD:`
4. **Select!** `yes`

Note: You must operate the magnetometer in the Stop-and-go mode to be compatible with the VLF operation.

- ▲ To operate as a total-field magnetometer, in the MAG SETUP screen, **Select!** `MODE: t-fld.`
- ▲ To change this to a gradiometer survey, **Select!** `grad.`

Tip: If you need to have continuous magnetic coverage along your survey line, it is recommended that you first survey the line in one direction in the WALKMAG mode. Then turn around and re-survey the line with the VLF in the Stop-and-Go mode or vice versa.

SURVEY DATA CORRECTION PROCEDURES

The purpose of data corrections is to remove diurnal and micro-pulsation effects of the Earth's magnetic field from the magnetic data and atmospheric effects and transmitter power variations form the VLF total-field data. This gives you the cleanest data possible for interpretation. However, these procedures may not be necessary, if your goal is only target identification (anomaly hunting). Please refer to the *Magnetic Applications Guide* for a more thorough discussion on this topic.

USING BASE-STATION DATA (MAG ONLY)

You can only use base-station data when you have selected one of the advanced (5–7) survey configurations. This procedure describes the correction when using an ENVI system only. The correction with different instruments must be done independently on a computer.

Caution: The base-station correction physically modifies the data of the mobile units, but does not alter the base-station's data. The correction must only be done once. If the raw mobile unit's data are required, then it must be dumped prior to correction. Please make certain that the `BASE FIELD` value in the field unit is correct before proceeding.

To correct your data, proceed as follows:

1. Connect the units as shown.

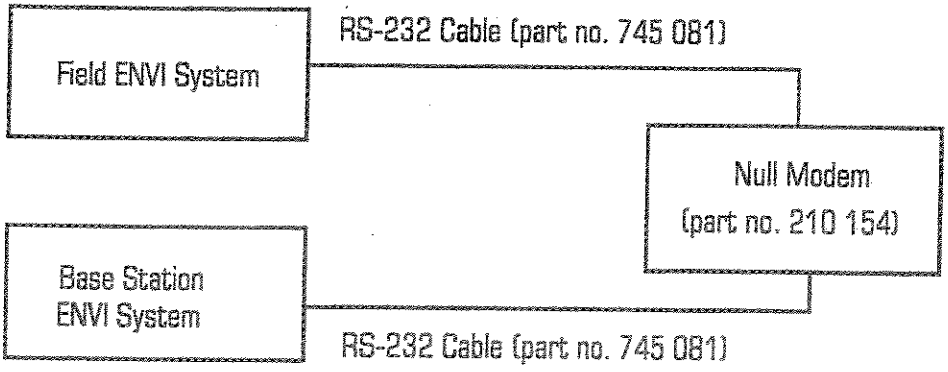
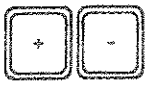


Figure 74 Connections for the Base-station correction.

2. Proceed, on both units, to the `mag setup:` display.

3. Scroll, on both, to `BASE CORRECT:`



4. **Select!** `yes`.

5. You will now see a warning message on the right side of the display of the field unit indicating that the raw data in the field ENVI MAG will not be preserved.

6. **Press** the "START" key on both. Either one can be started first.

7. You will be asked to confirm the start of the data correction by pressing either the "Y" or "N" key.

8. When finished, **Press** the "ESCAPE" key

TIE-POINT (TIE-PT) MODE

This type of correction procedure uses data from repeated stations during the course of the survey to correct for the variations in the earth's magnetic field or VLF field strength. For additional information please consult the *Magnetic Applications Guide* "Tie-point Line and Loop mode corrections" on page 31.

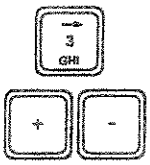
It should be noted however that this correction method is not as accurate or precise as the Base-station Correction method. A technical paper on the subject "Magnetic Correction Techniques", is available from SCINTREX.

Note: Both Looping and Line-type methods can be applied to either a WALKMAG or a Stop-and-Go type of survey. However, for the Line type, the tie-line itself must be done in the Stop-and-Go mode.

Important: This is the only method currently available to correct the VLF total-field strength data.

Loop type—collecting data

This is the default mode available when you select any of the basic configurations (1–3) from the configuration menu. To select the LOOP mode, call up the mag setup: display and:



1. Move the cursor to TIE-MODE:
2. **Select!** LOOP
3. Pick a location in your survey area that you can conveniently come back to during the course of your survey.

4. At your designated tie-point location, press the "TIE-PT" key instead of the "START" key.

5. Proceed with your normal survey, but return to your designated tie-point on a regular basis. Always take readings using the "TIE-PT" key instead of the start key at this location. This is illustrated in the following diagram.

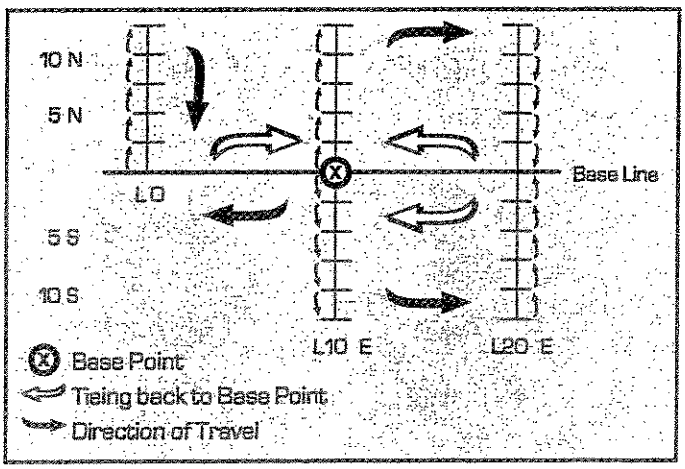


Figure 75 Looping method for collecting correction data

Line type—collecting data

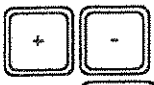
This mode is only available when using the advanced configurations (5–7). See "Advanced mode configuration displays" on page 4–13.

During a traverse along the tie-line, the Station numbers are kept constant, but the Line numbers are changed.

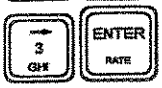
It is assumed that the instrument has been fully setup in advance for other functions. A few setup items have to be changed:

1. Call up the `instrument setup` display.

2. Move the cursor to `AUTO STN.INC.:`



3. **Select!** `NO`.



4. Call up the `mas setup:` display.

5. Move the cursor to `TIE-MODE:`

6. **Select!** `LINE`.

7. Return to the MAIN OPERATING display.

8. Move the cursor to `STN:` in the Locations block on the right side.

9. **Enter!** the Station number at the Tie-Line.

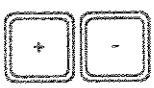
10. Move the cursor to `LN:`

11. **Enter!** the Line number at the start of the Tie-Line.

12. **Press** the "TIE-PT" key to take a measurement and record it.

13. Proceed to the next line.

14. Move the cursor to `LN:`



15. **Press** the "+" or "–" key, as needed, to change the Line number.

16. Repeat steps 12–15 to complete collecting the tie-line data.

17. Proceed with your normal survey as illustrated in the following diagram.

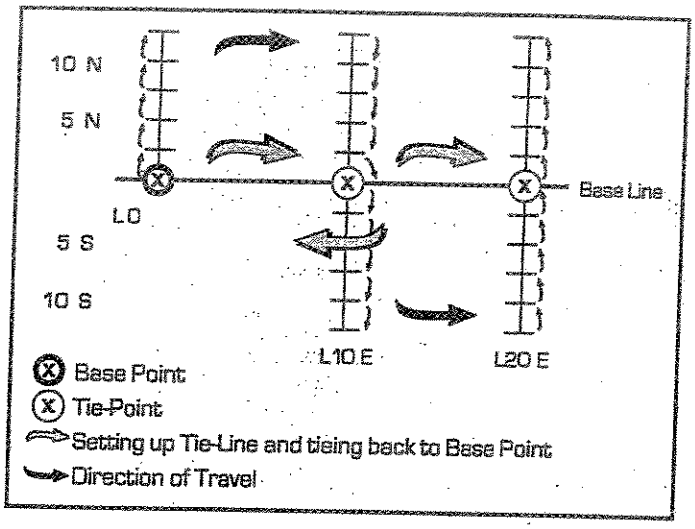


Figure 76 Tie-line method for collecting correction data

Note: If you need more than one day to complete your survey in the Line-type mode, please make sure that you collect *all* your Tie-points as the first data that you store in memory, i.e. before you survey any lines. This ensures that they will not be erased when clearing memory to make room for the next day's data.

TIE-POINT CORRECTION PROCEDURE

The Tie-point correction is performed as follows:

Basic modes (Loop only)

1. Move the cursor to `TIE:`.

2. **Press** the "ENTER" key.

3. You will now see a warning message on the right side of the display indicating that the data will be altered.

4. **Press** the key containing "Y" for yes or "N" to abort.

5. When finished, **Press** the "ESCAPE" key.

Advanced modes

1. Move the cursor to `TIE:`.

2. **Press** the "ENTER" key.

3. You will now see a warning message on the right side of the display indicating that the data will be altered.

4. **Press** the key containing "Y" for yes or "N" to abort.

5. When finished, **Press** the "ESCAPE" key.

REMOTE OPERATION

Remote Operation allows you to control the start of a magnetic measurement from a remote computer. It also controls the output of the data output stream, on the data output connector, while measuring in other modes.

Note: Remote operation is only available for the `MAG only` instrument configuration.

To enable the remote control of your ENVI MAG:

1. **Connect** the ENVI console to the serial port of the controlling computer using the RS-232 cable P/N 745 081.

2. Bring up the `mag setup:` display and initialize all appropriate parameters as explained in earlier paragraphs.

3. Move the cursor to `REMOTE:`

4. **Select!** `yes`.

5. **Press** the "ESCAPE" key to return to the MAIN OPERATING display.

6. Set up the `BAUD` rate as outlined under "Output setup" on page 7–12.

7. Send a 'S' (hex 53, dec 83) to initiate one reading. The spacing between subsequent 'S' must be greater than the chosen duration.

Tip: A 'CR' character (hex 0D, dec 13) should be sent at least every 50 seconds if the reading interval is longer than 1 minute to prevent the automatic power down sequence.

8. Receive the data after the end of each reading in the following sequence:

- Time in decimal form,
- space,
- Total-field,
- space,
- Noise,
- space,
- Gradient, if it has been enabled,
- Carriage return.

Note: A 'N' (hex 4e, dec 78) sent to the envi console simulates a "NEXT" key press to increment the station value by the station separation.

The unit still recognizes the "START" key while in REMOTE, which may be useful during installation.

Remote operation also controls the data output of a free standing magnetometer. The above data stream is output at the end of each reading, if REMOTE is enabled. The BAUD rate should be set to 1200 baud or higher, so the cycling operation is not slowed down. If remote control is not required, REMOTE should be *disabled* to conserve power.

DATA OUTPUT

There are many different types of computers and printers on the market. Consequently, only general instructions on how to dump the data will be given. The ENVI MAP software supplied with this instrument has a communications feature, and its operation is discussed in the *ENVI MAP Software User's Guide*. A specialized high-speed downloading program (BINDUMP) is supplied by SCINTREX as part of the ENVI MAP SOFTWARE UTILITIES package (SCINTREX P/N 788 042). Other communications programs are also suitable to retrieve the data from the ENVI console.

The RS-232 cable, SCINTREX P/N 745 081, is the link between the ENVI system data output connector and the serial port of the computer or printer.

Warning: The null modem (SCINTREX P/N 210 154), as used for the base-station correction, **must not be used** here.

OUTPUT FORMATS

For both the advanced magnetometer mode (configurations 5 to 7) and the VLF, the data can be dumped in several different formats. These formats, for each mode, are discussed in the following sections with stylized sample data shown for each. The actual data are fully left justified. The maximum line length is 80 characters.

The data can also be dumped using the special binary BINDUMP program run on the PC. The binary data are then post-processed using the XFENVI program (also part of the ENVI MAP SOFTWARE UTILITIES) to provide formatted files for use by other applications.

MAGNETIC DATA

XYZ

The XYZ format is the *recommended format* to be used in conjunction with the ENVI MAP processing program.

The XYZ format does *not* have a header section *nor* does it contain NOTES.

A short sample of the format follows:

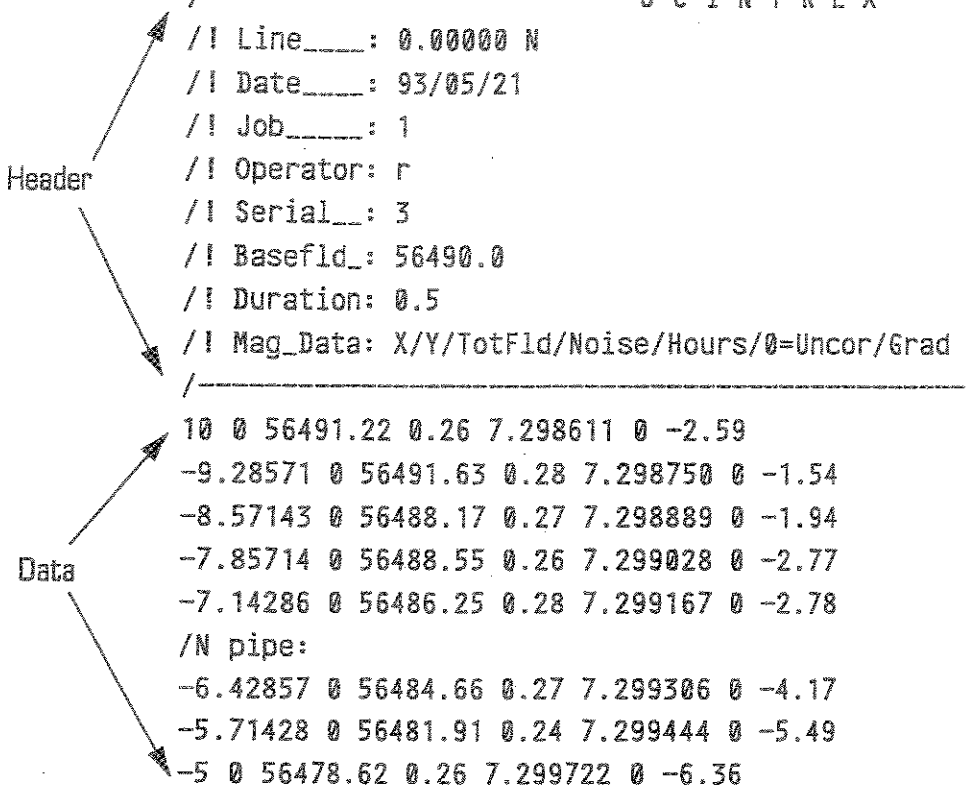
```
-10 0 56491.22 0.26 7.298611 0 -2.59
-9.28571 0 56491.63 0.28 7.298750 0 -1.54
-8.57143 0 56488.17 0.27 7.298889 0 -1.94
-7.85714 0 56488.55 0.26 7.299028 0 -2.77
-7.14286 0 56486.25 0.28 7.299167 0 -2.78
-6.42857 0 56484.66 0.27 7.299306 0 -4.17
-5.71428 0 56481.91 0.24 7.299444 0 -5.49
-5 0 56478.62 0.26 7.299722 0 -6.36
```

The data fields from left to right are:

- X
- Y
- Total Field
- Noise
- Hours
- Correction flag: 0=uncorrected
- Gradient

XYZ+

The XYZ+ format has a header section and contains user entered NOTES, but it is otherwise identical to XYZ.

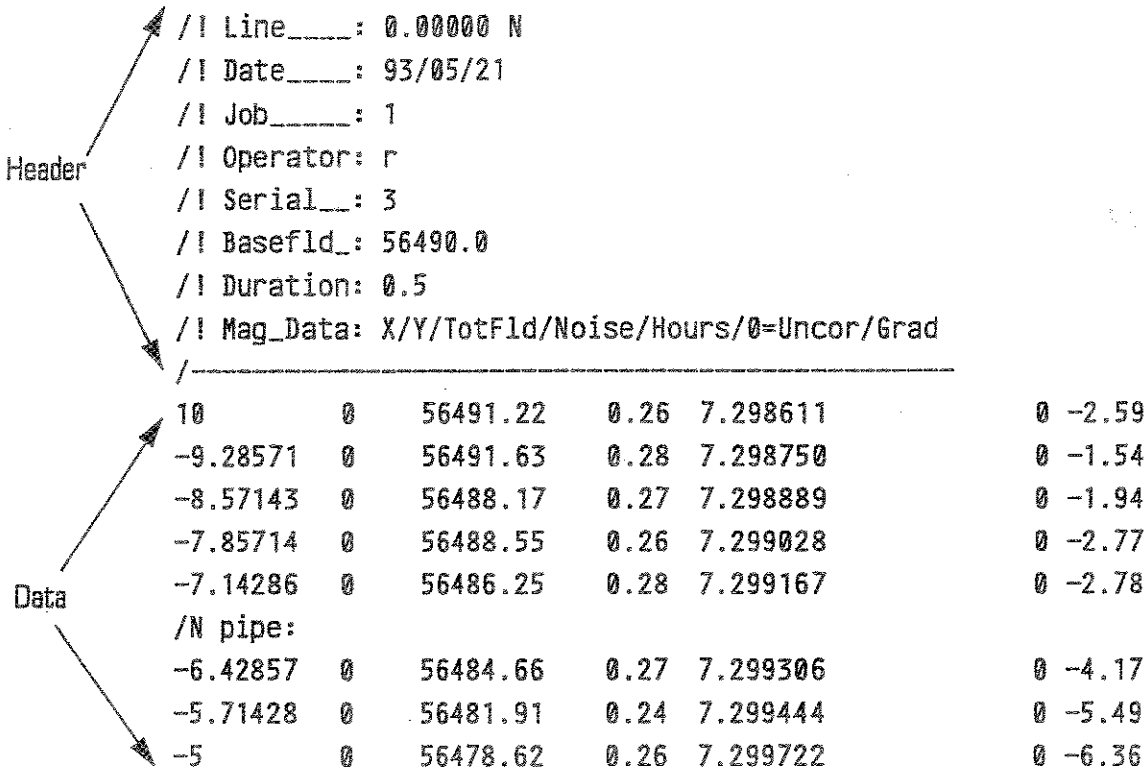



```
/------------------------------ S C I N T R E X ------------
/! Line____: 0.00000 N
/! Date____: 93/05/21
/! Job_____: 1
/! Operator: r
/! Serial__: 3
/! Basefld_: 56490.0
/! Duration: 0.5
/! Mag_Data: X/Y/TotFld/Noise/Hours/0=Uncor/Grad
/-------------------------------------------------------------
10 0 56491.22 0.26 7.298611 0 -2.59
-9.28571 0 56491.63 0.28 7.298750 0 -1.54
-8.57143 0 56488.17 0.27 7.298889 0 -1.94
-7.85714 0 56488.55 0.26 7.299028 0 -2.77
-7.14286 0 56486.25 0.28 7.299167 0 -2.78
/N pipe:
-6.42857 0 56484.66 0.27 7.299306 0 -4.17
-5.71428 0 56481.91 0.24 7.299444 0 -5.49
-5 0 56478.62 0.26 7.299722 0 -6.36
```

XYZ++

Note: This is the default format for the basic mode (configurations 1–3), however, you will not have any NOTES entries in this mode.

The XYZ++ format also has a header section and user entered NOTES. The distinguishing feature is that the data is placed into columns.




```
/------------------------------ S C I N T R E X ----------
/! Line____: 0.00000 N
/! Date____: 93/05/21
/! Job_____: 1
/! Operator: r
/! Serial__: 3
/! Basefld_: 56490.0
/! Duration: 0.5
/! Mag_Data: X/Y/TotFld/Noise/Hours/0=Uncor/Grad
/-------------------------------------------------------------
10          0     56491.22     0.26  7.298611              0 -2.59
-9.28571    0     56491.63     0.28  7.298750              0 -1.54
-8.57143    0     56488.17     0.27  7.298889              0 -1.94
-7.85714    0     56488.55     0.26  7.299028              0 -2.77
-7.14286    0     56486.25     0.28  7.299167              0 -2.78
/N pipe:
-6.42857    0     56484.66     0.27  7.299306              0 -4.17
-5.71428    0     56481.91     0.24  7.299444              0 -5.49
-5          0     56478.62     0.26  7.299722              0 -6.36
```

PRN

The PRN format is compatible with software written for the SCINTREX MP-3/4 magnetometer.


```
/------------------------------ S C I N T R E X ----------/
/! Line____: 0.00000 N
/! Date____: 93/05/21
/! Job_____: 1
/! Operator: r
/! Serial__: 3
/! Basefld_: 56490.0
/! Duration: 0.5
/! Mag_Data: Station/Dir/TotFld/Noise/Grad/Time/*=Uncor/Notes
/-----------------------------------------------------------
10          W     56491.22    0.26      -2.59       07:17:55 *
9.28571     W     56491.63    0.28      -1.54       07:17:55 *
8.57143     W     56488.17    0.27      -1.94       07:17:56 *
7.85714     W     56488.55    0.26      -2.77       07:17:56 *
7.14286     W     56486.25    0.28      -2.78       07:17:57 * pipe
6.42857     W     56484.66    0.27      -4.17       07:17:57 *
5.71428     W     56481.91    0.24      -5.49       07:17:58 *
5           W     56478.62    0.26      -6.36       07:17:59 *
```

VLF DATA

Please also refer to the corresponding magnetic output format for additional information.

XYZ

The XYZ format is the *recommended format* to be used in conjunction with the ENVI MAP processing program.

Note: Only the VLF total field and resistivity data are suitable for processing by the current version of the ENVI MAP SOFTWARE (as this software was primarily designed for magnetic data processing).

The XYZ format does *not* have a header section *nor* does it contain NOTES.

A short sample of the format follows:

```
0 0 71.9 0.1 360.06 0 10.0 3.215000 99 0.0 158.4 62.4
-9.5 0 -69.5 22.0 5.44 0 -35.7 3.224722 50 -72.9 81.1 136.0
-8.5 0 -66.1 16.1 5.25 0 -33.9 3.228889 50 -71.8 44.3 128.9
-7.5 0 -56.9 23.7 5.45 0 -30.6 3.232500 20 -76.8 73.3 138.5
```

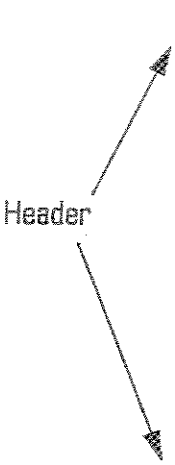
The data fields from left to right are:

- X
- Y
- In-phase
- Quadrature
- Total Field
- Correction flag: 0=uncorrected
- Tilt
- Time
- Quality & Signal/Noise
- Field Direction
- Resistivity*
- Phase Angle*

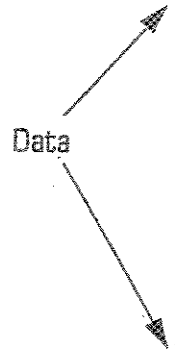
* These fields are only present when the Resistivity option is used.

XYZ+

The XYZ+ format has a header section and contains user entered NOTES, but it is otherwise identical to XYZ.



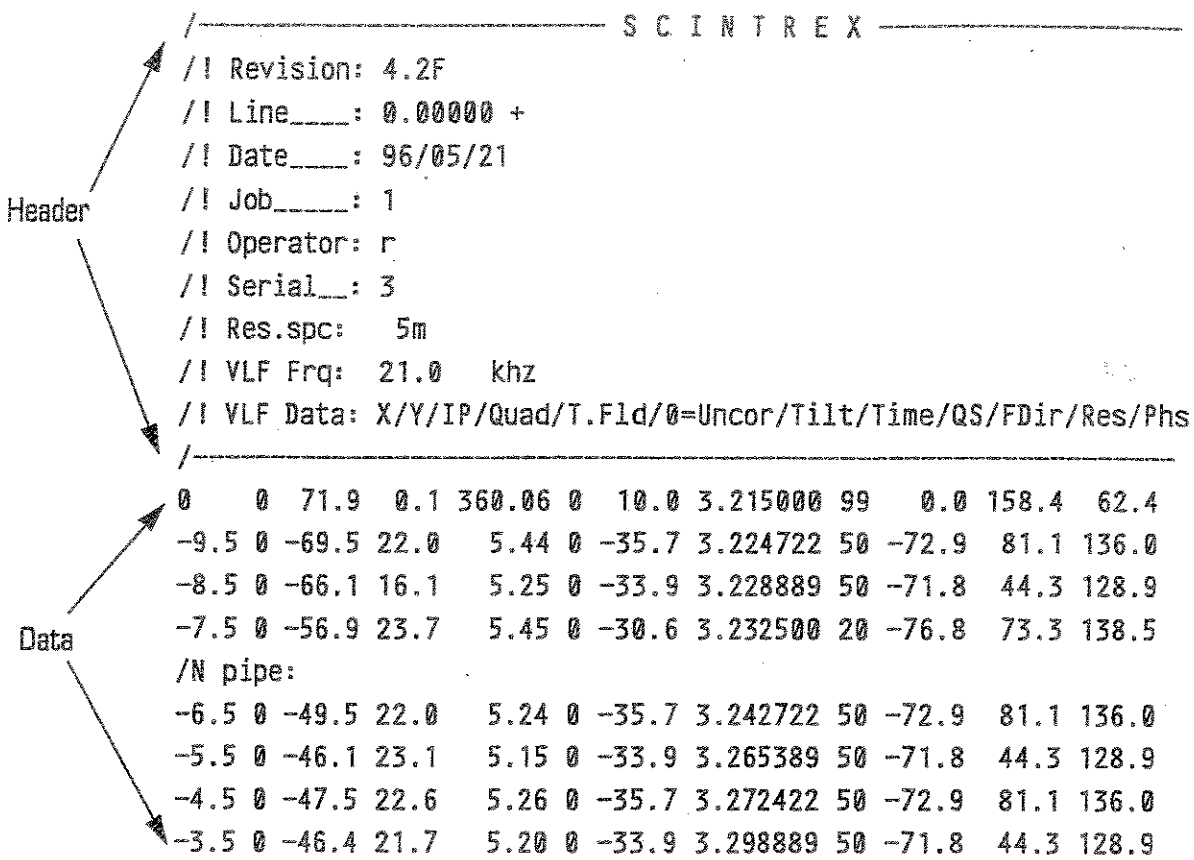

```
/------------------------------ S C I N T R E X ------------------------------
/! Revision: 4.2F
/! Line____: 0.00000 +
/! Date____: 96/05/21
/! Job_____: 1
/! Operator: r
/! Serial__: 3
/! Res.spc:   5m
/! VLF Frq:  21.0   khz
/! VLF Data: X/Y/IP/Quad/T.Fld/0=Uncor/Tilt/Time/QS/FDir/Res/Phs
/-------------------------------------------------------------------------------
```




```
0 0 71.9 0.1 360.06 0 10.0 3.215000 99 0.0 158.4 62.4
-9.5 0 -69.5 22.0 5.44 0 -35.7 3.224722 50 -72.9 81.1 136.0
-8.5 0 -66.1 16.1 5.25 0 -33.9 3.228889 50 -71.8 44.3 128.9
-7.5 0 -56.9 23.7 5.45 0 -30.6 3.232500 20 -76.8 73.3 138.5
/N pipe:
-6.5 0 -49.5 22.0 5.24 0 -35.7 3.242722 50 -72.9 81.1 136.0
-5.5 0 -46.1 23.1 5.15 0 -33.9 3.265389 50 -71.8 44.3 128.9
-4.5 0 -47.5 22.6 5.26 0 -35.7 3.272422 50 -72.9 81.1 136.0
-3.5 0 -46.4 21.7 5.20 0 -33.9 3.298889 50 -71.8 44.3 128.9
```

XYZ++

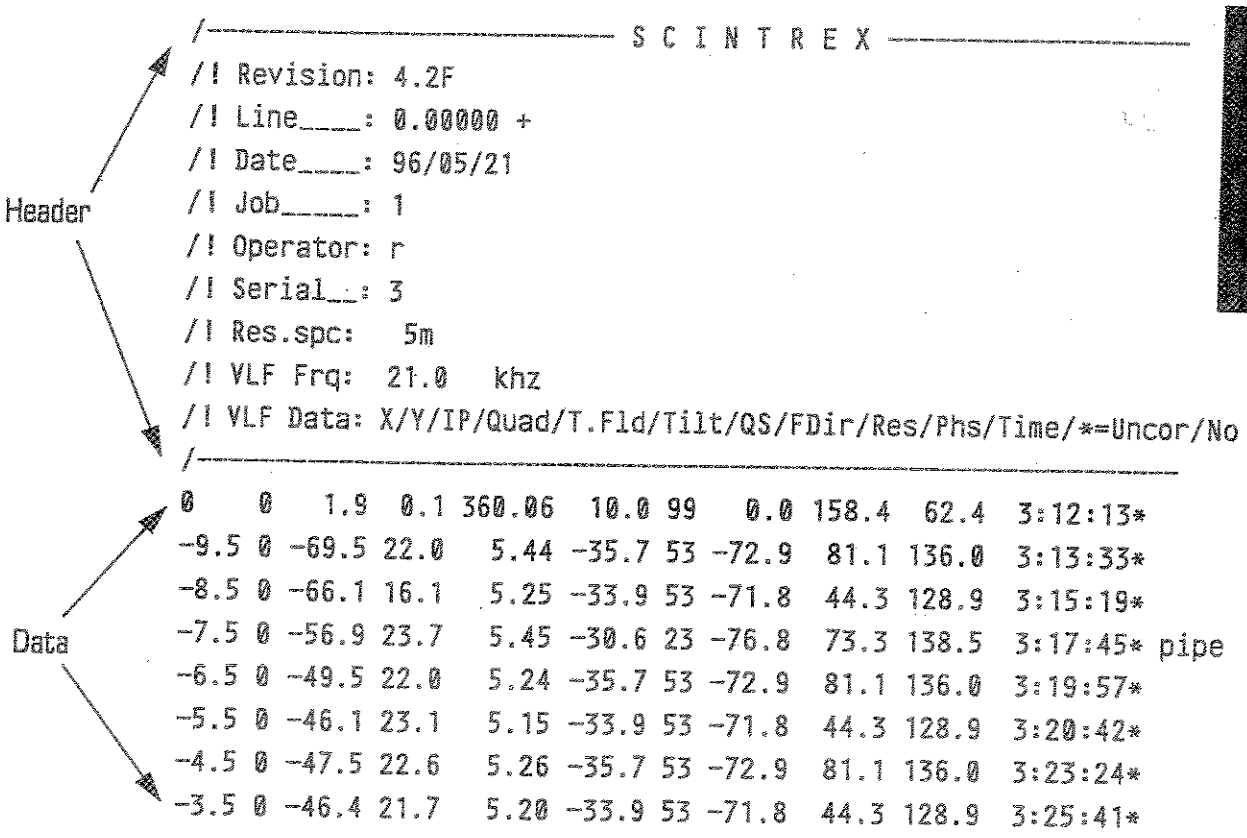
The XYZ++ format also has a header section and user entered NOTES. The distinguishing feature is that the data is placed into columns.




```
/------------------------------ S C I N T R E X ------------------------------
/! Revision: 4.2F
/! Line____: 0.00000 +
/! Date____: 96/05/21
/! Job_____: 1
/! Operator: r
/! Serial__: 3
/! Res.spc:   5m
/! VLF Frq:  21.0   khz
/! VLF Data: X/Y/IP/Quad/T.Fld/0=Uncor/Tilt/Time/QS/FDir/Res/Phs
/-------------------------------------------------------------------------------
0    0  71.9  0.1 360.06 0  10.0 3.215000 99   0.0 158.4  62.4
-9.5 0 -69.5 22.0   5.44 0 -35.7 3.224722 50 -72.9  81.1 136.0
-8.5 0 -66.1 16.1   5.25 0 -33.9 3.228889 50 -71.8  44.3 128.9
-7.5 0 -56.9 23.7   5.45 0 -30.6 3.232500 20 -76.8  73.3 138.5
/N pipe:
-6.5 0 -49.5 22.0   5.24 0 -35.7 3.242722 50 -72.9  81.1 136.0
-5.5 0 -46.1 23.1   5.15 0 -33.9 3.265389 50 -71.8  44.3 128.9
-4.5 0 -47.5 22.6   5.26 0 -35.7 3.272422 50 -72.9  81.1 136.0
-3.5 0 -46.4 21.7   5.20 0 -33.9 3.298889 50 -71.8  44.3 128.9
```

PRN

The PRN format is designed for direct hardcopy printing of the data.



NOTES

The NOTES output format just retrieves your manually entered NOTES and macros. In the output, it shows them with their respective line and station values.

For example, from the data in the PRN file on the previous page you would see the following:

```
/ Y: Line 0.00000 N / X: Stn 7.14286 W/ pipe
```

OUTPUT PROCEDURES

MAGNETOMETER BASIC MODE

When using configurations 1-3, the output procedure is quite simple, as the serial communications parameters are fixed at 9600 baud, 8 bits, 1 stop bit and no parity, while the data format is set as XYZ++ (see page 7-4 for details).

1. Connect the ENVI system to the serial port of your computer, using the RS-232 cable (SCINTREX P/N 745 081).
2. Start your ENVI MAP or other communications program, in order to receive data.

From the MAIN OPERATING display of the ENVI system:

3. **Move** the cursor to the OUTPUT: field.

4. **Press** the "ENTER" key and you will see the following status window:.

```
MODE:t-fld DUR:0.5s
TUNE FIELD:    60000
AUTO TUNE:       yes
TM/DT:     OUTPUT:->
BASE:      TIE:
ERASE MEM.:

Chg?:ENT.
```

locations

```
9600 8,1,n

START WHEN READY
```

```
help:INFO  BATT:134
```

5. **Press** the "START" key to upload your data to the computer. You will see a confirmation message that the operation is taking place.

```
MODE:t-fld DUR:0.5s
TUNE FIELD:    60000
AUTO TUNE:       yes
TM/DT:     OUTPUT:->
BASE:      TIE:
ERASE MEM.:

Chg?:ENT.
```

locations

```
OUTPUTTING DATA..
```

```
help:INFO  BATT:134
```

MAGNETOMETER ADVANCED MODE

The data output and its setup functions are all accessible from the START output of: display. Please refer to "Data output display" on page 4–28 for detailed explanations of all the parameters.

1. Connect the ENVI system to the serial port of your computer, using the RS-232 cable (SCINTREX P/N 745 081).
2. To receive data, start your ENVI MAP or other communications program.

Output setup

From the MAIN OPERATING display of the ENVI system:

3. **Press** the "AUX/LCD" key,

```
          auxiliary functions

          (+- ESC) LCD Intensity
          (1) Data Output
          (2) Factory Test *
          (3) Lock                    OFF
          (4) Reprogram System
Select function
```

4. **Press** the "1" key to get the START output of: display.

```
   START output of:                  locations
                                     BY LN:        yn
      : all data recorded            LN: 1111.1 d
MAG:  t-fld  grad. base
                                     BAUD: bbbbb
                                     DL:tttBIT:b
                                     FMT:xxxxx
Output: START                        BATT: bbb
```

At the START output of: display proceed as shown:

5. **Press** the "NEXT" key until the cursor rests within the lower *right* sub-page, i.e. the communications block.

6. Move the cursor to BAUD:

7. **Select!** your desired baud rate.

Note: The baud rate on the ENVI system *must match* the baud rate on the output device for successful communication.

8. Leave `DL:` at 0 and `BIT:` 8

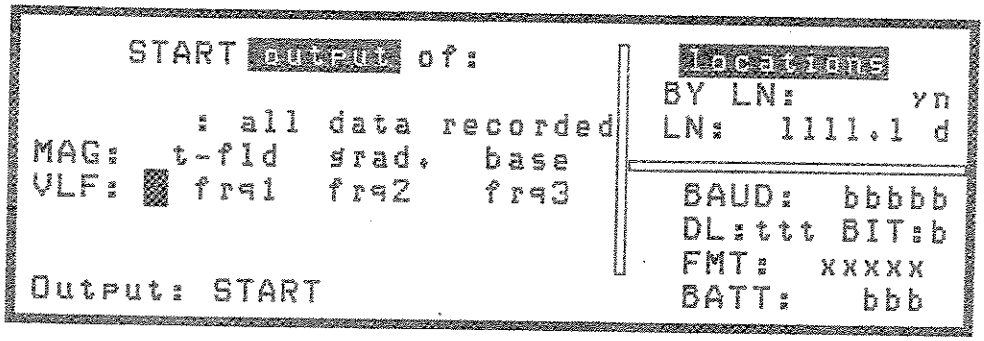
9. Move the cursor to `FMT:`

10. **Select!** the desired output data format (see "Output formats" on page 7–1).

Caution: If some characters are lost during the dump, (an occurrence in particular to some printers), it may be necessary to set the delay `DL:` to a value between 0 and 999. The actual value has to be established experimentally. `BIT:` may need to be changed to 7 to get the proper character font.

VLF & MAG/VLF MODES

Dumping the data in the VLF and MAG/VLF modes is done exactly the same way as for the advanced magnetometer mode (page 7–12). The only difference is the appearance of the `VLF:` line in the `START output of:` display.



Simply move the cursor to the desired data type to be dumped and press the "START" key *after* you have set the other parameters.

DUMPING DATA

BINARY

A binary dump transfers your data to a PC in a compact and efficient binary format. This binary data file may then be converted to any of the previous formats by means of the XFENVI.EXE program.

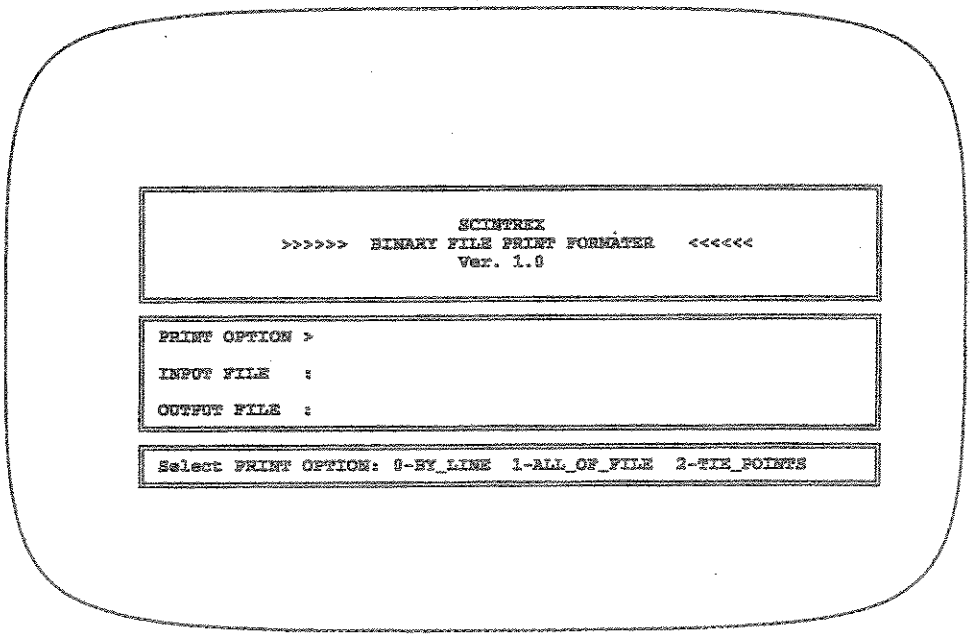
You must use the BINDUMP program on the PC and connect with a baud rate of 19200.

Converting binary data with XFENVI

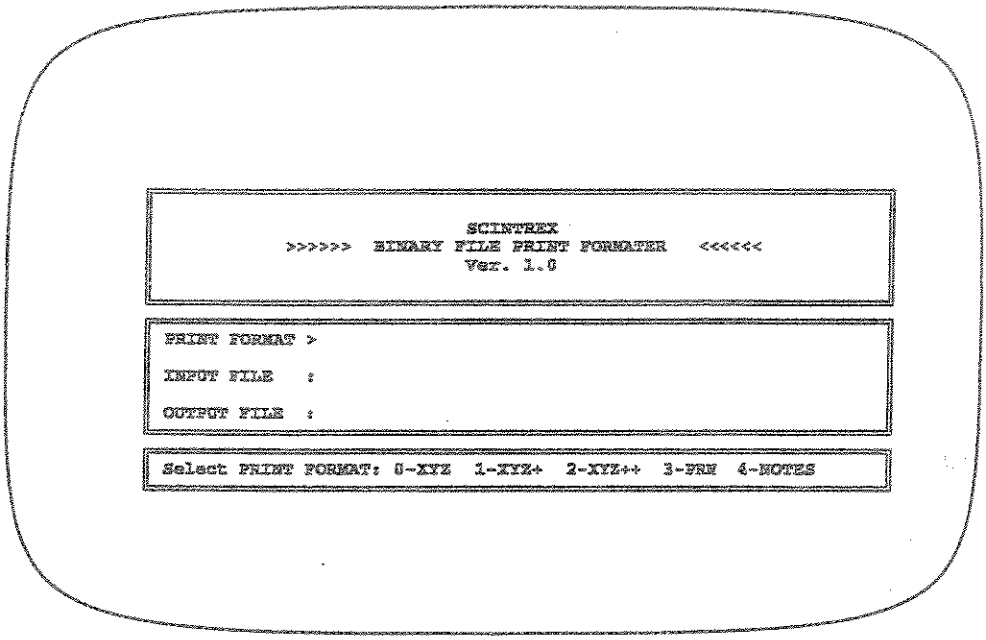
The XFENVI program is a DOS-based PC program that converts the binary output file to any of the XYZ, XYZ+, XYZ++ or PRN formats.

1. Start the program on your PC by entering:
   X F E N V I and ↵.

   You will then see the following screen

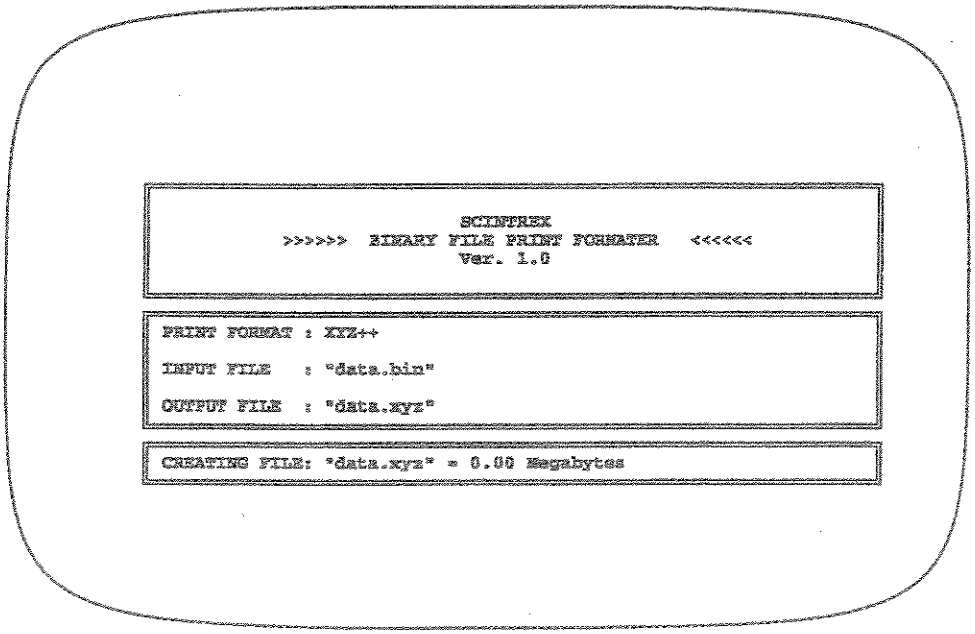


2. Select either option 0=BY_LINE or 1=ALL_OF_FILE by pressing either the 0 or 1 keys. You will then see:



3. Select either option 0=XYZ, 1=XYZ+, 2=XYZ++ or 3=PRN by pressing either the 0, 1, 2 or 3 keys.

4. You will then need to enter the name of your binary input file and the name of your output file. The program will automatically perform the conversion after you have supplied both file names. The bottom line displays the status of a successful conversion.



STANDARD

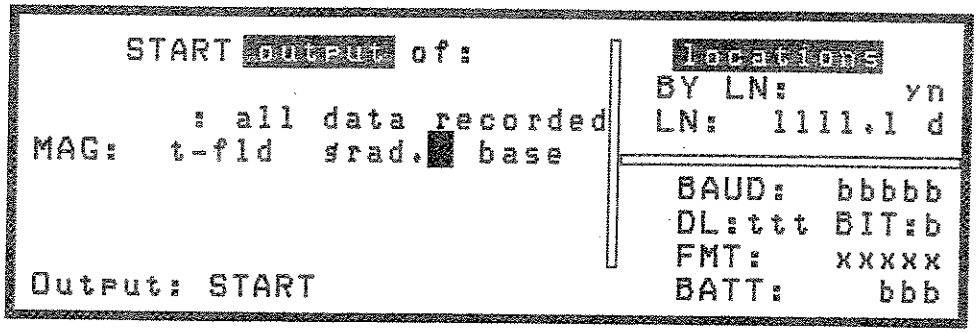
The ENVI console has three different ways in which to dump data:

- all data—regardless of method; one *big* sequential dump,
- by method or sub-method, i.e. total-field, gradient or base,
- on a line by line basis.

Note: You can only dump one mode (magnetic or VLF) at a time.

All data

At the `START output of:` display proceed as shown:



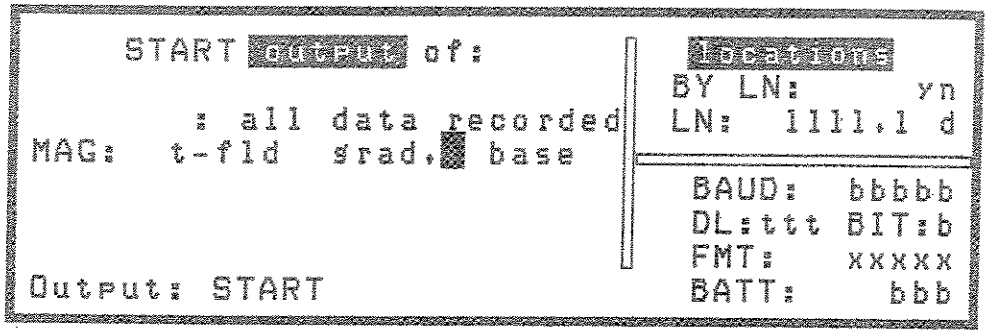
1. **Press** the "NEXT" key until the cursor rests within the *left* sub-page.

2. Move the cursor to: `all data recorded`

3. **Press** the "START" key.
   Options:
   - **Press** the "STOP" key to temporarily suspend dumping.
   - **Press** the "ESCAPE" key to *abort* the dump.

Specific data

At the START output of: display proceed as shown:



1. **Press** the "NEXT" key until the cursor rests within the *left* sub-page.

2. Move the cursor to one of the three data types at the MAG: field: t-fld grad, base

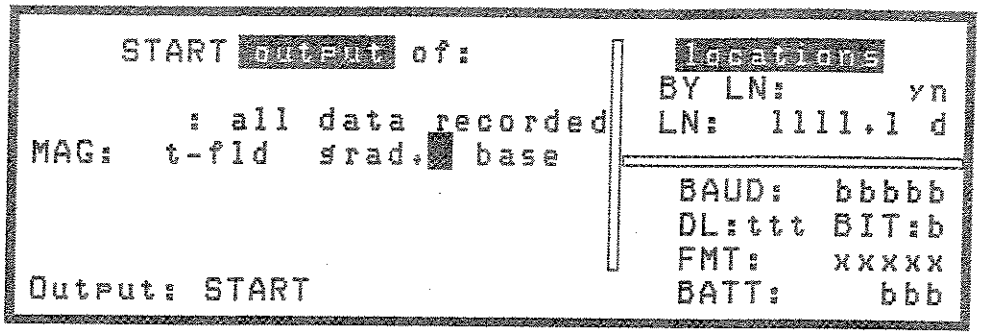
3. **Press** the "START" key.
   Options:

   - **Press** the "STOP" key to temporarily suspend dumping.

   - **Press** the "ESCAPE" key to *abort* the dump.

Line by line

At the START output of: display proceed as shown:



1. **Press** the "NEXT" key until the cursor rests within the top *right* sub-page, i.e. the locations block.

2. Move the cursor to BY LINE:

3. **Select!** yes to activate this function.

4. Move the cursor to LN:

5. **Enter!** the desired Line number and direction.

6. **Press** the "NEXT" key until the cursor rests within the *left* sub-page.

7. Move the cursor to one of: MAG: t-fld grad. base

8. **Press** the "START" key.
   Options:
   - **Press** the "STOP" key to temporarily suspend dumping.
   - **Press** the "ESCAPE" key to *abort* the dump.

9. Repeat steps **4** to **8** as required.

10. **Press** the "ESCAPE" key to return to the MAIN OPERATING display.

ERASING DATA FROM MEMORY

After you have successfully dumped your data to a computer and have verified that it is all there, you should free up the ENVI system's memory for your next survey. This is done by activating the ERASE MEMORY option. This removes only the data from memory (both the VLF and magnetic simultaneously), but preserves the rest of your configuration parameters. To clear everything, you must do a cold boot.

If you are using the TIE-PT mode of diurnal correction with the Line option, there is a special provision for not clearing the TIE-PT data. This allows multi-day surveys to be corrected to the same set of control values. However, this also requires you to collect *all* of the TIE-PT data before you start surveying the rest of the grid.

MAGNETOMETER BASIC MODE

From the MAIN OPERATING display:

1. Move the cursor to ERASE MEM.:

```
MODE: t-fld DUR: 0.5s          locations
TUNE FIELD:      60000
AUTO TUNE:         yes         ST:      10. E
TM/DT:     OUTPUT:             SEP:       25.
BASE:      TIE:                DIVBY:     0.0
ERASE MEM.:                    LN:        1. N
                               SEP:       10.
Chs?:ENT.              help:INFO  BATT:134
```

2. Press the "ENTER" key.

```
MODE:t-fld DUR:0.5s            locations
TUNE FIELD:    60000
AUTO TUNE:       yes     !! Memory erase !!
TM/DT:     OUTPUT:
BASE:      TIE:          CONFIRM:(Y/N).
ERASE MEM.:

Chs?:ENT.              help:INFO  BATT:134
```

3. You will be asked to confirm that you want to erase all the data from memory by pressing the "Y" key. The *Block memory free* parameter will increment on the prompt line as it is cleared.

MAGNETOMETER ADVANCED MODE

From the MAIN OPERATING display:

1. **Press** the "SETUP" key.

The INSTRUMENT SETUP display now appears:

```
                 Instrument setup
MAG SETUP:■->menu          AUTO ST.INC.:    yn
                           LINK REC/START:  yn
                           CYCLE REPEAT:    yn
                           CYCLE DELAY:     ddd
                           ERASE MEMORY:    yn
                           HEATER:          yn
Chg?:ENT.                                BATT:bbb
```

2. **Move** the cursor to ERASE MEMORY:.

3. **Select!** yes

4. You will now see a prompt on the bottom line:
   Mem.erase! 1:DATA 2:TIE+DATA

```
                 Instrument setup
MAG SETUP: ->menu          AUTO ST.INC.:    yn
                           LINK REC/START:  yn
                           CYCLE REPEAT:    yn
                           CYCLE DELAY:     ddd
                           ERASE MEMORY:■   yes
                           HEATER:          yn
Mem.erase! 1:DATA 2:TIE+DATA          BATT:bbb
```

Options:

- 1:DATA
  This will only clear the current days data and leave any TIE-PT data in the memory for the next day's use.
- 2:TIE+DATA
  This will clear all of the data, including the TIE-PT data.

5. You will be asked to confirm that you want to erase all the data from memory by pressing the "Y" key. The *Block memory free* parameter will increment on the prompt line as it is cleared.

VLF Mode

The procedure is exactly the same as for the magnetometer advanced mode. From the MAIN OPERATING display:

1. **Press** the "SETUP" key.

The INSTRUMENT SETUP display now appears:

```
Instrument setup
MAG SETUP: ->menu          AUTO ST.INC.:    yn
VLF SETUP: ->menu          LINK REC/START:  yn
                           CYCLE REPEAT:    yn
                           CYCLE DELAY:     ddd
                           ERASE MEMORY:    yn
Chg?:ENT.                  HEATER:          yn
                                      BATT:bbb
```

2. **Move** the cursor to ERASE MEMORY:.

3. **Select!** yes

You will now see a prompt on the bottom line:
Mem.erase! 1:DATA 2:TIE+DATA

4. **Press** either "1" or "2".

5. You will be asked to confirm that you want to erase all the data from memory by pressing the "Y" key. The *Block memory free* parameter will increment on the prompt line as it is cleared.

MAINTENANCE AND REPAIR

BATTERY CHARGING

The ENVI system uses lead-acid batteries. These are a reliable power source when properly maintained. They can provide power through a few hundred charge/discharge cycles. However, the main source of trouble with these batteries is *deep discharge*. This occurs when the battery is fully discharged and left discharged for an extended period.

To prevent deep discharge in the ENVI system, electronic circuitry monitors the battery voltage and shuts the instrument down when the battery has reached its lower operating level. It should then be recharged as soon as possible. However, the instrument draws a small current even when turned off. If the ENVI system is left in a discharged state, for even a few days, then the battery will eventually deep discharge. Once this has happened, you will need to replace the deep-discharged battery with a new one (SCINTREX P/N 400 078 or 400 080).

Warning: The small current drain just mentioned above, is the reason why the battery **MUST BE DISCONNECTED FOR SHIPMENT AND STORAGE.** Batteries also self discharge slowly, therefore, they must be recharged periodically, e.g. every 3 months, even when in storage. Finally, batteries should also be stored at room temperature, or as close to it as possible.

Up to two batteries can be charged at the same time. If high capacity batteries are charged, such as those used in the External Heavy Duty Battery Pack, it is important that the charging begin right after work and continue over night.

Optimum charging takes place at room temperature. Provision is made to compensate for variation in temperature in the 0° to 40° Celsius temperature range. The battery and console should also be at the same temperature.

To charge the batteries proceed as follows.

ONE BATTERY

1. Connect the charger to the power outlet. Adjustment for different line voltages are made automatically.
2. Connect the charger to the charger input connector.
3. Flip the switch on the charger to **On**.
4. Observe the charging light at the left hand side of the ENVI system console. It will be **On** while charging at a high rate and turn **Off** when the battery is nearly charged.

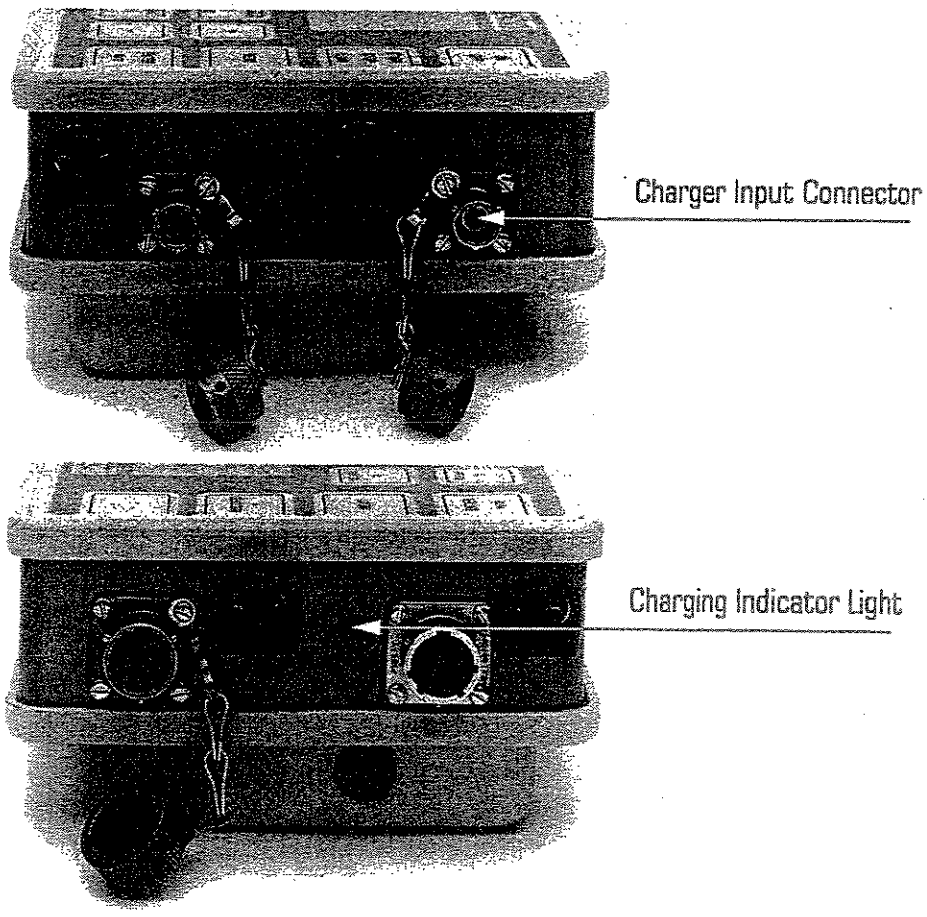


Figure 77 Charger port and charging light.

TWO BATTERIES

1. Place the console, face down, onto a flat smooth surface.
2. Unscrew the knurled screws on each side of the battery cover and lift off the cover.
3. Connect the spare battery to the AUX. CHARGER OUTPUT connector. Either side of the plug may be on top.
4. Connect the charger to the power outlet. Adjustments for different line voltages are made *automatically*.
5. Connect the charger to the charger input connector.
6. Flip the switch on the charger to **On**.
7. Observe the charging light at the left hand side of the ENVI system console. It will be **On** while charging at a high rate and turn **Off** when the battery is nearly charged.

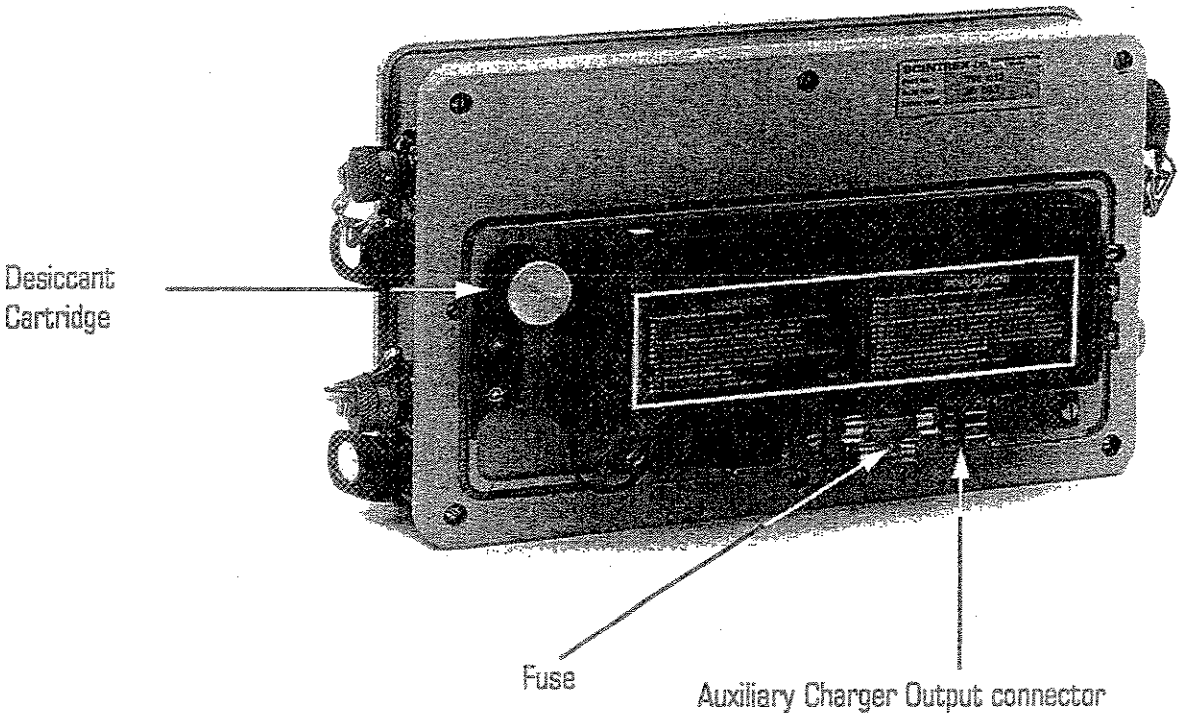


Figure 78 Location of the auxiliary charger output connector, fuse and desiccant cartridge.

PERIODIC MAINTENANCE

CLEANING THE SENSORS

There is only minimal periodic maintenance required: the cleaning of the sensors. Due to their proximity to the sensor coils, magnetic dust particles on the sensor housing may upset the magnetic field. This would result in erroneous absolute values. Therefore, it is good practice to wash the sensor(s) periodically with soap and water.

DESICCANT EXCHANGE

Small amounts of moisture may possibly enter the ENVI system console, even though it is fully sealed. A cartridge filled with a drying agent (desiccant) is located under the battery cover, refer to Figure 78 on page 8–3 for the exact location. The desiccant should be dried out periodically as required. A spare cartridge is supplied as part of the Minor Spare Parts Kit.

To dry out the cartridge:

1. Place the console, face down, onto a flat smooth surface.
2. Unscrew the screws at both sides of the battery cover.
3. Lift off the cover.
4. Pull out the cylindrical plug while gently turning.
5. Place the cartridge in front of a heat source for about one hour. A hair drier is a good source of dry heat.
6. Clean the mating surfaces on the cartridge and the access hole.
7. Replace the cartridge.
8. Replace the battery cover.

FUSE REPLACEMENT

There is one fuse located inside the battery cover and another one is under the metal cover of the External Heavy Duty Battery Pack.

Two fuses holders are provided under the battery cover of the ENVI system, as shown in Figure 78 on page 8–3. One is for a 1.5 A quick, standard North American fuse (SCINTREX P/N 512 018). The other fuse holder is for a 5 x 20mm European fuse.

Caution: ONLY *one* fuse may be in place at any given time.

The fuse in the External Battery Pack (SCINTREX P/N 512 049) is a standard 5A automotive fuse.

CONSOLE DISASSEMBLY/ASSEMBLY

Warning: Disassembly of the console is strongly discouraged due to its complexity, but should disassembly of the console be required proceed as follows:

1. Place the console, face down, onto a flat smooth surface.
2. Unscrew the screws on both sides of the battery cover.
3. Lift off the cover.
4. Remove the battery.
5. Unscrew the eight screws.
6. Lift off the rear panel carefully.
7. Watch for the wires.
8. Place the panel above the instrument on the surface.

9. Turn the console over.
10. Lift off the front panel carefully.
11. Place it to the left of the console.
12. Take care of the cable.
13. Clean all connecting surfaces before re-assembly.
14. Make sure that the wires coming from the power connector located at the bottom left hand side of the display module are placed side by side and that all other wiring is placed such as not to get pinched.
15. Repeat steps 1 to 12 in reverse order to assemble the console again.
16. Tighten up the screws with a medium-sized *slotted* screwdriver. Do *not* overtighten.

CABLE REPAIR

The cable connectors should be periodically checked to ensure that they are not filled with dirt. An electronic contact cleaner spray can be used to flush the connectors.

Cables may occasionally need repair as conductors eventually break due to flexing. Some connectors are sealed with a silicon compound to prevent the entry of water and dirt. The sealing material can be removed after the cable clamp has been unscrewed to gain access to the pins. It is a good practice to seal the connector again when repaired. The proper connections are indicated in the following table:

Cable	Wire Color	Connector Pin
Total Field (780 547 & 780 550)	Shield/Bare	K
	White	G
Gradiometer (788 028)	Shield/Bare	A
	Green	C
	Red	G
	White	H
	Black	K
Base Station (780 546)	Shield/Bare	A
	White	G
	Black	K
External Power (788 029)	Red	Outside
	Black	Center
VLF Sensor to Console (793 500)	Shield/Bare	F [Strap to P]
	Black	P [Strap to F]
P1 Right angle 18 pin connector	Brown	C
	Blue	D
	Green	A
	White	S
	Red	M

Cable	Wire Color	Connector Pin
P2 Straight 10 pin connector	Black	G
	Brown	H
	Blue	B
	Green	F
	White	D
	Red	C
VLF 2-probe (793 043) P1 Right angle 18 pin connector	White	A
	Red & Black	B
	Green	E
	Shield/Bare	—
	Strap	F (Strap to G)
		G (Strap to F)
P2 Straight 6 pin connector (0.5 m cable)	White	C
	Red & Black	A
	Green	B
	Shield/Bare	D
P3 Straight 6 pin connector (10 m cable)	White	C
	Red & Black	A
	Green	B
	Shield/Bare	D
VLF 3rd probe (793 044) P1 Right angle 18 pin connector	White	A
	Red & Black	E
	Green	D
	Shield/Bare	—
	Strap	B
		C
P2 Straight 6 pin connector (10 m cable)	White	C
	Red & Black	A
	Green	B
	Shield/Bare	D

TROUBLE SHOOTING

Problems	Possible Causes	Possible Solutions
On/Off key does not respond (no beep)	Battery not connected	Install battery
	Battery discharged	Charge battery
	Fuse blown	Disconnect sensor. Check and replace fuse in the battery compartment or in the External battery pack depending on which one you are using.
Instrument shuts off immediately	Low battery	Charge battery.
Fuse blows after the start of a reading	Short circuit in sensor cable	Repair sensor cable.
Display is very slow	Display is too cold	Turn on the LCD heater, using the AUX/LCD button to access option, if the ambient temperature is below minus 15° C.
Display is invisible	Incorrect LCD intensity setting	1. If no data is in the instrument, perform a cold boot. 2. Adjust LCD intensity using AUX/LCD button to access option. 3. Turn on the heater if below minus 15° C.
Reading noise is high	No sensor(s) attached	Connect the sensor(s).
	Tuning is incorrect	1. Properly set the manual tuning 2. Use Auto-tuning.

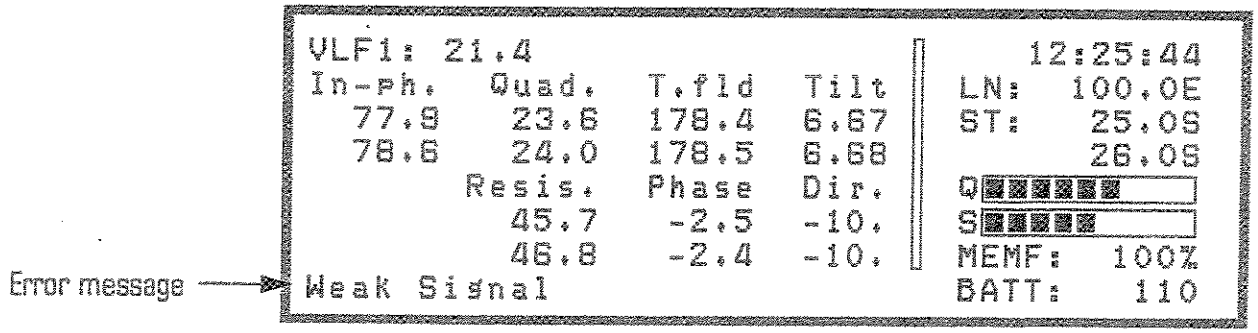
Problems	Possible Causes	Possible Solutions
Reading noise is high (continued)	Sensor cable is improperly connected	Connect properly.
	Sensor cable is broken	Repair sensor cable.
	Improper sensor orientation	Make sure that either the N or S mark on the sensor points to magnetic North.
	High gradient	1. Monitor the Numeric Page 2 display chart. 2. Readings may be impossible to make in this situation.
	External interference (e.g. power line)	Readings may be impossible.
	No fluid in the sensor (shake & listen for sloshing sound)	Contact SCINTREX Customer Service.
Data does not dump	RS-232 cable not connected	Connect cable.
	Computer not communicating	1. Run the computer communications program. 2. Check that you are using the correct serial port on your computer.
	Baud rate incompatible	Set baud rates on the computer and ENVI console to be identical.
	No such data in instrument	1. Make sure that you are asking for data that you have measured, i.e. asking for base or grad when t-fld recorded. 2. Select: dump all records.
	No matching line number	Set proper line number or disable line by line dump.

Problems	Possible Causes	Possible Solutions
Base-station correction does not work	Base unit and mobile unit not properly interconnected.	Interconnect units via Null Modem.
	No matching date or time	Correction must be made externally on a computer.
Cannot recall data	No respective line or station (or time, if base-station).	Set recall parameters to match survey parameters, i.e. LN, SEP, STN, SEP may be out a digit.

VLF ERROR MESSAGES

The ENVI VLF has a set of seven error messages to help you to potential problems during the course of a survey. Immediate and appropriate action should be taken when you see any of these messages.

The error message is displayed on the status prompt line as in the following example:



Error message	Meaning
Strong Interference	A strong local noise is present and interfering with the VLF signal (e.g. thunderstorm activity). Wait until the local source has weakened or abort the survey.
Bad Power Supply	The VLF module is experiencing a partial or total disruption of power. The VLF electronics module has its' own power supply which draws power from the battery cartridge attached to the console. Check your cables for loose connections or damage. Check the battery strength.
RAM Error	This indicates that there is a problem with the VLF Electronics module. Please contact SCINTREX Customer Service.
Tilt Transducer Error	This indicates that your tilt transducer has malfunctioned. The tilt transducer is located in the VLF module and is used to compensate the in-phase and tilt values due to the angle of vertical deviation by the operator. Abort the survey and contact SCINTREX Customer Service.
VLF Calibration Error	One of the calibration values is outside of the acceptable range. Re-initialize the system. If the problem persists, then contact SCINTREX Customer Service.
Resistivity Calib. Error	One of the calibration values is outside of the allowable range. Reinitialize the system. If the problem persists, then contact SCINTREX Customer Service.
Weak Signal	The signal strength of one of the selected VLF frequencies is below an usable level. The station may have gone off the air.

VLF Transmitter Stations

The following table lists some of the available VLF stations world-wide and known maintenance schedules to help you plan your survey times.

Note: There are many more usable VLF frequencies around the world that are not listed here. Consequently, it is important that you do a VLF spectrum at your survey area to determine the background noise levels, usable vlf stations and most importantly, the direction that the stations are in with respect to your survey grid. Please also refer to "Sample VLF setup — Frequency scan feature" on page 5–27.

Table 17: Known VLF Stations

Frequency (kHz)	Station	Location	Power (kW)	Maintenance Schedule (all times are UMT)
15.1	FUO	Le Blanc, France	500	
16.0	GBR	Rugby, UK	750	Tuesday 1000–1400
16.4	JXZ	Hegeland, Norway	350	
16.8		France		
17.1	UMS	Moscow, Russia	1000	
17.4	NDT	Yosami, Japan 34°58′15″N 137°01′18″E	200	2300–0900 the first Thu–Fri of the month; 2300–0700 all other Thu-Fri
19.0		Criggeon, UK		Wednesdays
19.6	GBZ	Oxford, UK		
22.3	NWC	Exmouth, Australia 21°49′01″S 114°09′50″E	1000	Mon, 0000–0800. If Mon. is a holiday, then Tues. May also be off Tues. 0000–0400
23.4		Rhauderfehn, Germany		

Table 17: Known VLF Stations (Continued)

Frequency (kHz)	Station	Location	Power (kW)	Maintenance Schedule (all times are UMT)
23.4	NPM	Lualualei, Hawaii 21°25′30″N 158°09′20″W	600	1800–0400 the last Wed–Thu of the month; 1800–0200 all other Wed–Thu
24.0	NAA	Cutler, Maine USA 44°38′50″N 67°16′54″W	1000	Mon. 1200–2000. If Mon. is a holiday, then the preceding Fri. Testing 2000–2200 Mon. Operator training 1st, 3rd & 5th Thur.
24.8	NLK	Jim Creek, Wash. USA 48°12′15″N 121°55′00″W	200	Thurs. 1600–2400 (1500–2300 during daylight savings time)
28.5	NAU	Aguada, Puerto Rico	100	Wed 1200–2000

REFERENCE INFORMATION

ENVI SYSTEM TECHNICAL SPECIFICATIONS

Magnetometer	
Total field range:	20,000 to100,000 nT
Total field absolute accuracy:	±1 nT
Sensitivity:	0.1 nT at 2 second reading time, reduced at other reading times.
Sensor spacing: (Gradiometer)	0.5 metre
Tuning:	Fully solid state. Manual or automatic; keyboard selectable.
Reading period:	0.5 sec 1 sec 2 sec
Cycle time: (Base Station)	**Internal**: The minimum is determined by the reading period, max.9999 s, in 1s intervals. **External**: Any, as long as it exceeds the reading period and is initiated by a command at the RS-232 interface.
Cycle delay:	The minimum is determined by the reading (WALKMAG) period; max. 8 s, in 1 ms intervals.

TVLF	Up to 3 simultaneous stations can be read.
Frequencies	15 to 30 kHz digital tuning, user-selectable. Auto-scan and frequency selection feature.

Components measured:	vertical in-phase	percent
	vertical quadrature	percent
	total field strength	nA/m
	vertical dip angle/tilt	degrees
	magnetic primary field direction	degrees
	apparent resistivity (opt.)	ohm-metres
	phase angle (opt.)	degrees

Console

Display:	8 lines by 40 characters, 64 x 240 dots. LCD *Super-twist* display, with heater.
Keyboard:	17 keys, membrane type. Main mode is Function Key; secondary mode is Alphanumeric.
Note Entry:	32 characters, and 5 user pre-defined MACROs of 15 characters each, for quick-entry.
Audio:	Beeper to acknowledge key-press, start of reading to act as a pacer.
Clock:	Real time clock with date and time. 1 second resolution and ±1 second stability over 12 hours.

Data memory:

Mode	Standard	Expanded
Base Station:	151,000 rdgs.	750,000 rdgs.
Portable mode	28,000 rdgs.	140,000 rdgs.
Gradiometer mode	21,000 rdgs.	109 000 rdgs.
VLF (3 frequencies)	4,500 rdgs.	24,000 rdgs.

Data presentation:	Current and three previous readings in numerical form. Up to 178 readings in graphic form. Display shifts ¾ screen when full.

Data output interface:	RS-232C interface, 600 to 57600 Baud, 7 or 8 data bits, 1 start, 1 stop bit, no parity format. Selectable carriage return delay (0-999 ms) to accommodate slow peripherals. Handshaking is done by X-On/X-Off. High speed binary dump.
Data output format:	Data dump of all acquired data in memory or on a mode by mode and line by line basis in XYZ or printer listing format. Separate dump for "Notes".
Analog Output:	0 to 999 mV full scale output voltage with keyboard selectable range of 1, 10, 100, 1000 or 10000 nT full scale.
Data Recall:	On the LCD display in graphic format. Based on time for the base station, on line and station basis for other modes. Bi-directional scan.
Power supply:	2.3 Ah Lead-acid battery (Camcorder type). 12 V at 0.65 A for magnetometer. 1.2 A for gradiometer. Approximate battery life is 40000 readings as a WALKMAG at 25° C. External 12V input for base station operation. Optional external battery pouch for cold-weather operation.
Battery charger:	110 V - 230 V 50/60 Hz
Environmental Range:	-40° to 60° C. Humidity 0 -100% Fully sealed. Easy to exchange desiccant cartridge.

Dimensions & Weight	
Console:	250 mm x 152 mm x 55 mm
	300 mm x 152 mm x 82 mm overall.
	2.45 kg
Magnetic sensors:	70 mm diameter x 140 mm
	70 mm diameter x 175 mm overall, total field.
	70 mm diameter x 675 mm overall, gradiometer.
	1.0 kg total field; 1.15 kg gradiometer.
Staff:	25 mm diameter x 2 m in 4 sections.
	0.8 kg
VLF sensor Head:	140 mm x 130 mm
	0.9 kg
VLF Electronics module:	280 mm x 190 mm x 75 mm
	1.7 kg

ENVI SYSTEM COMPONENTS LIST

Item Description	SCINTREX Part Number
ENVI MAG Total Field Magnetometer	788 001

Item	Part No.
ENVI Electronics Console	788 011
Total Field Sensor	788 020
Sensor Staff	788 022
Total Field Sensor Cable	780 550
Carrying Harness	788 023
Back Plate/Foam	788 024
RS-232 Cable	745 081
Rechargeable Battery	400 078
Battery Charger 110/220 V	400 139
Minor Spare parts Kit	788 030
ENVI MAG Information Kit	788 532
Transit Case	788 507

ENVI MAG Information Kit	788 532

Item Description	Part No.
ENVI Geophysical Manual	788 700
ENVI MAP Software Manual	759 705
ENVI MAP Software Package	788 032
ENVI MAP Software Utilities	788 042
Magnetic Applications Guide	759 700

Item Description	SCINTREX Part Number
ENVI GRAD Magnetic Gradiometer	788 002

Item	Part No.
ENVI Electronics Console	788 012
Total Field Sensor	788 020
0.5m Gradiometer Sensor	788 021
Sensor Staff	788 022
Total Field Sensor Cable	780 550
Gradiometer Sensor Cable	788 028
Carrying Harness	788 023
Back Plate/Foam	788 024
RS-232 Cable	745 081
Rechargeable Battery	400 078
Battery Charger 110/220 V	400 139
Minor Spare parts Kit	788 030
ENVI MAG Information Kit	788 532
Transit Case	788 507

ENVI MAG Information Kit	788 532

Item Description	Part No.
ENVI Geophysical Manual	788 700
ENVI MAP Software Manual	759 705
ENVI MAP Software Package	788 032
ENVI MAP Software Utilities	788 042
Magnetic Applications Guide	759 700

<table>
<tr><th>Item Description</th><th>SCINTREX Part Number</th></tr>
<tr><td>ENVI VLF EM system
<table><tr><th>Item</th><th>Part No.</th></tr><tr><td>ENVI Electronics Console</td><td>788 013</td></tr><tr><td>ENVI VLF Sensor</td><td>793 007</td></tr><tr><td>Harness Assembly</td><td>788 023</td></tr><tr><td>Harness Belt</td><td>793 533</td></tr><tr><td>VLF Sensor to Console Cable</td><td>793 500</td></tr><tr><td>RS-232 Cable</td><td>745 081</td></tr><tr><td>Rechargeable Battery</td><td>400 078</td></tr><tr><td>Battery Charger 110/220 V</td><td>400 139</td></tr><tr><td>Minor Spare parts Kit</td><td>788 030</td></tr><tr><td>ENVI VLF Information Kit</td><td>788 531</td></tr><tr><td>Transit Case</td><td>788 508</td></tr></table></td><td>788 003</td></tr>
<tr><td>ENVI VLF Information Kit
<table><tr><th>Item Description</th><th>Part No.</th></tr><tr><td>ENVI Geophysical Manual</td><td>788 700</td></tr><tr><td>ENVI MAP Software Utilities</td><td>788 042</td></tr><tr><td>VLF Interpretation Manual</td><td>788 714</td></tr></table></td><td>788 531</td></tr>
</table>

<table>
<tr><th>Item Description</th><th>SCINTREX Part Number</th></tr>
<tr><td>ENVI MAG/VLF system

<table><tr><th>Item Description</th><th>Part No.</th></tr><tr><td>ENVI Electronics Console</td><td>788 014</td></tr><tr><td>Total Field Sensor</td><td>788 020</td></tr><tr><td>Sensor Staff</td><td>788 022</td></tr><tr><td>Total Field Sensor Cable</td><td>780 550</td></tr><tr><td>Carrying Harness</td><td>788 023</td></tr><tr><td>Harness Belt</td><td>793 533</td></tr><tr><td>Back Plate/Foam</td><td>788 024</td></tr><tr><td>RS-232 Cable</td><td>745 081</td></tr><tr><td>ENVI VLF Sensor</td><td>793 007</td></tr><tr><td>VLF Sensor to Console Cable</td><td>793 500</td></tr><tr><td>Rechargeable Battery</td><td>400 078</td></tr><tr><td>Battery Charger 110/220 V</td><td>400 139</td></tr><tr><td>Minor Spare parts Kit</td><td>788 030</td></tr><tr><td>ENVI MAG/VLF Information Kit</td><td>788 533</td></tr><tr><td>Transit Case</td><td>788 508</td></tr></table></td><td>788 004</td></tr>
<tr><td>ENVI MAG/VLF Information Kit

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</table>

Item Description	SCINTREX Part Number
ENVI GRAD/VLF system	788 005

Item Description	Part No.
ENVI Electronics Console	788 015
Total Field Sensor	788 020
0.5m Gradiometer Sensor	788 021
Sensor Staff	788 022
Total Field Sensor Cable	780 550
Gradiometer Sensor Cable	788 028
Carrying Harness	788 023
Harness Belt	793 533
Back Plate/Foam	788 024
RS-232 Cable	745 081
ENVI VLF Sensor	793 007
VLF Sensor to Console Cable	793 500
Rechargeable Battery	400 078
Battery Charger 110/220 V	400 139
Minor Spare parts Kit	788 030
ENVI MAG/VLF Information Kit	788 533
Transit Case	788 508

ENVI MAG/VLF Information Kit	788 533

Item Description	Part No.
ENVI Geophysical Manual	788 700
ENVI MAP Software Manual	759 705
ENVI MAP Software Package	788 032
ENVI Software Utilities	788 042
Magnetic Applications Guide	759 700
VLF Interpretation Manual	788 714

OPTIONAL ENVI COMPONENTS

Item Description	SCINTREX Part Number
Memory Expansion for ENVI console (0.5 to 2Mb)	788 060
ENVI Backpack for WALKGRAD or combined VLF	788 040
Staff Supporting Kit for Base Station	788 025
Minor Spare Parts Kit	788 030
Major Spare Parts Kit	788 031
Gradiometer Sensor Cable	788 028
Total-Field Sensor Cable (short for WALK modes)	780 547
Total-Field Sensor Cable (long)	780 550
Base-Station Sensor Cable	780 546
Recorder Cable	788 027
RS-232 Cable	745 081
Single-probe Resistivity Cable	793 044
Dual-probe Resistivity Cable	793 045
Null Modem	210 154
Charger	400 139
External Heavy Duty Battery Kit	788 026
Battery 7.2 Ah	400 080
Battery 2.3 Ah	400 078
External Power Cable	788 029
Fuse 1.5A	512 018
Fuse 5 A	512 049
Carrying/Shipping Case (Old Style)	140 161
External Trigger Interface Kit	788 033

WARRANTY & REPAIR

WARRANTY

All SCINTREX equipment, with the exception of consumable items, is warranted against defects in materials and workmanship for a period of one year from the date of shipment from our plant. Should any defects become evident under normal use during the warranty period, SCINTREX will make the necessary repairs free of charge.

This warranty does not cover damage due to misuse or accident and may be voided if the instrument console is opened or tampered with by persons not authorized by SCINTREX.

To validate the warranty, the warranty card supplied with the instrument must be returned to SCINTREX within 30 days of shipment from our plant.

REPAIR

When to ship the unit

Please do not ship your instrument for repair until you have communicated the nature of the problem to our Customer Service Department by telephone, facsimile or correspondence. Our Customer Service Department may suggest certain simple tests or steps for you to do which may solve your problem without the time and expense incurred in shipping the instrument back to SCINTREX for repair. If the problem cannot be resolved remotely, our personnel will request that you then send the instrument to our plant for the necessary repairs.

Description of the problem

When you describe the problem, please include the following information:

- the symptoms of the problem,
- how the problem started,
- if the problem is constant, intermittent or repeatable,
- if constant, under what conditions does it occur,
- any printouts demonstrating the problem.

SHIPPING INSTRUCTIONS

No instrument will be accepted for repair unless it is shipped *prepaid*. After repair, it will be returned *collect*, unless other arrangements have been made with SCINTREX. Please mention the instrument's serial number in all communications regarding equipment leased or purchased from SCINTREX.

Warning: Please do not ship the instrument with the batteries installed.

FURTHER DAMAGE MAY RESULT!

Head Office

Instruments within Canada should be shipped to:

SCINTREX Limited
222 Snidercroft Road
Concord, ON L4K 1B5
tel: (905) 669-2280

Australia

Instruments for repair in Australia should be shipped to:

SCINTREX Limited
1031 Wellington St.
West Perth,
West Australia 6005
tel: 61(9) 321-6934

U.S.A.

Instruments for repair in the United States should be shipped to:

SCINTREX Inc.
10816 East Newton Street
Tulsa, OK 74116
tel: (918) 438-9255

Outside Australia/Canada/U.S.A.

Instruments shipped for repair from outside Australia, Canada or the U.S.A. should be addressed to SCINTREX and shipped to:

SCINTREX Limited
c/o DANZAS Custom Brokers
1600 Drew Road
Mississauga, ON L5S 1S5 CANADA
tel: (905) 405-9300

Three sets of customs documents must be included:

- one set inside of the package,
- one set attached and sealed to the outside of the package,
- one set attached to the air waybill.

SCINTREX instruments are manufactured in Canada, consequently there is no customer duty payable in Canada. It is advisable to state on the customs documents the following:

- **"Canadian Goods Returned to Canada for Repair"**
- **Name of the equipment**
- **Value**
- **Serial Number**
- **Reason for return**
- **Packaging and weight**

Index

Symbols

Numerics

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Z