

# OPERATING MANUAL

# VIA Echo

Vector Impedance Analyzer / Network Analyzer



*VIA Echo 1000 – 4MHz to 1.0GHz*

*VIA Echo 2500 – 4MHz to 2.5GHz*

*VIA Echo MRI – 4MHz to 1.0GHz (Pictured on inside cover)*

 **Technology, Inc.**



*VIA Echo MRI - 4MHz to 1.0GHz or 0.1 to 20 Tesla*



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US Patent Number 7,030,627 B1

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# 1. Introduction

## VIA Echo Highlights

The VIA Echo is the most complete Network Analyzer ever designed into two highly portable form factors: The rugged, rechargeable battery powered, 2 pound (1Kg) hand-held models or the ultra-low magnetic Echo MRI which is also rechargeable battery powered and only 9.5 pounds (4.3Kg) in its rugged carrying case. Our hand-held models are:

VIA Echo 1000 (4MHz to 1.0GHz)

VIA Echo 1000SF (4MHz to 1.0GHz) with Spectrum Analyzer, Power Meter and FDR

VIA Echo 2500 (4MHz to 2.5GHz) with Spectrum Analyzer, Power Meter and FDR

Our ultra-low magnetic version is:

VIA Echo MRI ((4MHz to 1.0GHz) for MRI or NMR Imaging Coils

Which ever model you have chosen to purchase you now own the most powerful and economical Network Analyzer for its size on the world market today.

The Echo PC Vision™ software will provide amazingly detailed plots and Smith Charts in full color on the PC screen. Uploading plots, storing plots and creating certification databases was never made easier. The software is MS Windows® based and permits easy archiving, printing or exporting in JPG, TIFF, GIF or text format so any PC or MAC® user can read your files.

## Vector Impedance Analyzer vs Scalar

This brief note explains the advantage of measuring vector impedance vs. measuring SWR (network analyzer vs. SWR meter). Return loss and SWR express the same property (mismatch) using two different scales. All advantages and disadvantages of an SWR reading also apply to return loss readings.

The Standing Wave Ratio (SWR) of an antenna and its feedline has long been used to measure an antenna's transmit efficiency. SWR is a simple concept, you send a unit of RF energy into the feedline, and measure the amount of energy that reflects back. We assume the portion of energy not reflected back transmits out the antenna. The limitations of this measurement usually cause the transmit efficiency to be lower than what SWR predicts. Using a network analyzer to measure vector impedance during antenna alignment improves transmitted efficiency compared to a simple SWR alignment.

SWR meters have been around a long time, and many people are reluctant to change because SWR is an easy concept to understand. In the past, SWR meters were less expensive than vector impedance analyzers (aka network analyzers) which has been a determining factor in the SWR popularity. However, as costs in components continue to drop, the vector analyzers have become less expensive than they used to be. This makes it possible for more people to properly tune their antenna systems without renting complex \$30K Network Analyzers that weighs 50 pounds.

The list below shows the advantage of using a Vector Impedance Analyzer over just a Scalar

VIA Echo's Measurements

SWR Meter's Measurements

SWR  
Return Loss (dB)  
Impedance (Zo)  
Phase Angle  
Reactance  
Resistance  
Gamma Magnitude  
Gamma Angle  
Linear Gain  
Log Gain  
Phase Gain  
Spectrum Analysis  
Power Meter  
Frequency Domain Reflectometer

SWR  
Return Loss (dB)

Refer to AEA Technology Application Note AN100 "What a Scalar Does Not Show" for more detailed information concern the benefits of Vector Impedance Analyzers over Scalars. Application Note AN100 and a long list of other application notes are available on our web page at [www.aeatechnology.com](http://www.aeatechnology.com).

## Unpacking Your New VIA Echo

When first unpacking your new VIA Echo unit all of the items listed in figure 1 should be in the box along with each of the models as ordered.

VIA Echo 1000	6025-5100	(4MHz to 1.0GHz)
VIA Echo 1000SF	6025-5150	(4MHz to 1.0GHz) Spectrum Analyzer Power Meter and FDR
VIA Echo 2500	6025-5250	(4MHz to 2.5GHz) Spectrum Analyzer Power Meter and FDR
VIA Echo MRI	6025-5350	(4MHz to 1.0GHz)

<b>Part Number</b>	<b>Accessory</b>	<b>Qty included with 1000 &amp; 1000SF models</b>	<b>Qty included with 2500 model</b>	<b>Qty included with MRI models</b>
0010-0218	8 pack of NiMH AA Batteries (installed)	1	1	0
0010-0012	Sealed lead acid battery, 12volt	0	0	1
5001-0202	Battery Charger/AC Wall adapter 100-240VAC/50-60 Hz	1	1	1
0070-1200	Charger/Adapter Extension	0	0	1
6025-1220	CD-ROM with Echo PC Vision software, Operators Manual, Application Notes	1	1	1
0070-1206	USB Cable – 6 foot (2 meters)	1	1	0
0070-1207	USB Cable – 15 ft (4.6 m)	0	0	1
0070-1210	USB Cable Extender 10ft (3m)	0	0	1
5001-1002	Belt Case with hook & shoulder strap	1	1	0
6025-1005	Magnetic Materials Pouch, Orange	0	0	1
6025-3010	Quick Start Guide	1	1	1
6025-0270	N Terminator Set, 1-Open, 1-Short, & 1-50 Ohm load.	0	1	0
6015-1301	Calibration Load Set, 1- Short & 1-50 Ohm load, “N” type terminations	1	0	1
0070-1190	Adapters N-to-BNC	0	0	2
6015-1303	BNC Calibration Load Set, 1-Short & 1-50 Ohm Load	0	0	1
6015-1002	Soft Equipment Case	1	1	0

Figure 1-1

If any of the listed items are missing or appear to be inoperative, please contact AEA Technology. See our contact information on the back cover.

In addition to our standard accessories AEA Technology carries a complete line of optional accessories including hard shell kit carrying cases and SMA adapter kits. See appendix A for a list of available optional accessories.

## VIA Echo Models with Accessories



Figure 1-2

VIA Echo 1000, 1000SE, & 2500 Models with Accessories

# Physical Description

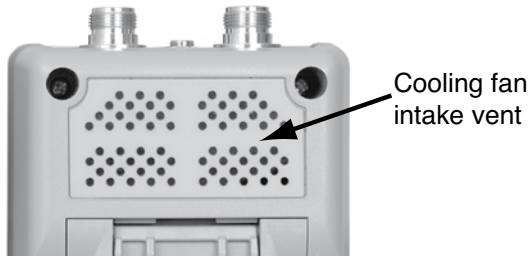
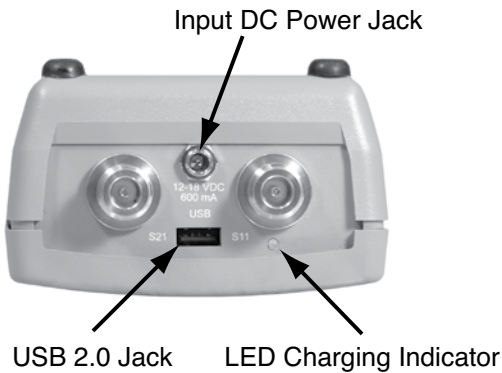
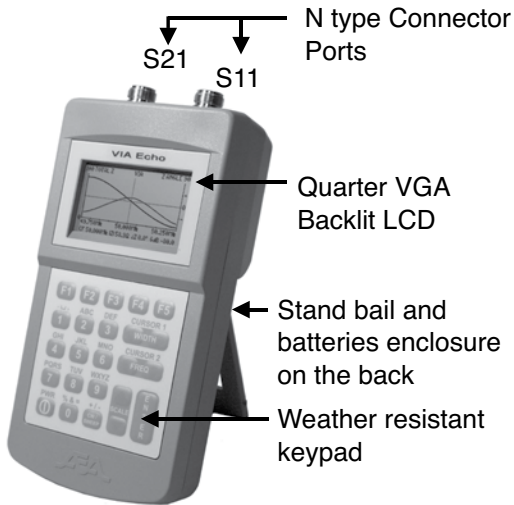


Figure 1-3



**Figure 1-4**  
VIA Echo MRI Model with Accessories

### MAGNETIC PRECAUTIONS

The VIA Echo MRI instrument was designed to be ultra-low magnetic and to function in the proximity of high Tesla MRI and NMR Systems. However, there are accessories contained in a bright orange pouch that **MUST** be removed from the case prior to entering magnetic fields. These include:

AC Wall Charger & Extender Cable

USB Cable & USB Extender Cable

Some Terminators and Adapters

These items and any other non-AEA supplied magnetic accessories should only be stored in the orange pouch to help prevent them entering magnetic field zones.

### VIA Echo MRI's Differences

The VIA Echo MRI's form factor is obviously different than the other VIA Echo models. However, it operates nearly identical to the VIA Echo 1000 described in this Manual. The manual will address any menu or operational difference in the applicable section. A quick summary of the difference are:

Added Q measurement

Sealed lead acid battery and its charging indications

Operating temperature range variations

## Physical Description



Figure 1-5

## Using This Manual

This manual was written to cover the use of all VIA Echo models. Most of the functions and feature operate the same for all three models. Statements that refer to just the VIA Echo indicate that universal application. However, where there are operational differences the manual will have separate instructions for that model. The basic differences between the models are:

<b>Model</b>	<b>Frequency Range</b>
VIA Echo 1000	4MHz to 1.0GHz
VIA Echo 1000SF	4MHz to 1.0GHz with Spectrum Analyzer, Power Meter, and FDR
VIA Echo 2500	4MHz to 2.5GHz with Spectrum Analyzer, Power Meter, and FDR
VIA Echo MRI	4MHz to 1.0GHz Ultra-Low-Magnetic

Throughout this manual, references are made to WIDTH, FREQ, SCALE, CURSOR 1 and CURSOR 2. These references are always capitalized to emphasize the reference to a key action. Note that WIDTH and CURSOR 1 share the same key and FREQ and CURSOR 2 share the same key. When referring to some menu actions a left indicator, ◀, or right indicator, ▶, only will appear in the text to direct navigation. It does not matter which left

or right arrow key, WIDTH (CURSOR 1) or FREQ (CURSOR 2) is used to execute these actions so we do not specify the key in the text. The selection of VIA Echo menu items will appear in the capitalized text and similar font as used in the instrument's firmware.

Echo PC Vision software key actions are capitalized and italicized (*ENTER*) to separate them from instrument key actions. The software menu items are placed in quotation marks ("Print") to emphasize their action in the text.

We have made every attempt to thoroughly cover the operation of the VIA Echo units and PC Vision software on the following pages. However, we consider our customers' input invaluable and are open to suggestions that would improve the Operators Manual or the Quick Reference Guide. If you have a suggestion or comments about the printed material supplied with your VIA Echo or any other AEA Technology instrument please feel free to contact us. Our toll free line, other telephone numbers and web address are shown on the back cover. We review all suggestions seriously and make updates between printings. If we make a serious omission an errata is inserted in all existing manuals until the next printing. All our latest updated instrument Operator Manuals, PC Vision software, and Quick Reference Guides can be found on our web site.

## VIA Echo Quick Start Guide

A laminated Quick Start Guide is included with every VIA Echo folded and stored in the padded belt case. The Quick Start Guide can also be downloaded from our web site at [www.aeatechnology.com](http://www.aeatechnology.com).

## Key Terminology

**Frequency Domain Reflectometer (FDR)** – This instrument or function injects a frequency on a cable and displays the reflections from events similar to a Time Domain Reflectometer. The FDR displays the distance to an event, but with less detail than a TDR. The FDR outperforms a TDR when measuring events on the far side of a frequency band selective component (i.e. microwave diplexer) or when high levels of interference are on the cable. The FDR displays events that represent cable mismatches and losses. Reflections are expressed in relative dB, along with the distance to the event as calculated using the cable's velocity factor.

**Gamma Magnitude** – S11 port reflected amplitude measured in dB.

**Gamma Angle** – S11 port reflected signal angle measured in degrees.

**Group Delay** – S11 to S21 ports path delay expressed in units of time.

**Impedance ( $Z_0$ )** – Measured in Ohms. The impedance of the antenna or device under test should match the design of the system at the center or resonant frequency. Impedance is the combined effect of resistance and reactance.

**Impedance (Phase) Angle** – Measured in degrees. This test determines whether the antenna or device measured is reactive at the measured frequency. A positive angle means the circuit is inductive, and a negative angle identifies the circuit as capacitive.



**Linear Gain** – S11 to S21 ports path gain (loss) expressed in volts per volt.

**Log Gain** – S11 to S21 ports path gain (loss) expressed in dB.

**Phase Gain** – S11 to S21 port path phase delay in degrees.

**Power Meter** – Operates as a sub-function of the Spectrum Analyzer mode. The power displays in both Watts and dB across the frequency band selected in the Spectrum Analyzer. User can choose either digital or analog power readings.

**Reactance** – Measured in Ohms. Reactance is the property of resisting or impeding the flow of AC current that is not accounted for by Resistance in an antenna or device under test. There are two types of reactance, inductive and capacitive. Inductive is denoted by a positive reactance, and capacitive is denoted by a negative reactance.

**Resistance** – Measured in Ohms. This test measures the series or parallel resistive component of the antenna and/or feed line. Resistance is the property of resisting or impeding the flow of AC and DC signal current.

**Return Loss** – Measured in decibels (db). There is a direct relationship between Return Loss and SWR. Return Loss is the amount of signal reflected back towards the transmitter expressed in decibels (db).

**Spectrum Analysis** – Viewing a set frequency or frequency band to evaluate which frequencies are present across the band and measuring their amplitude. Spectrum Analyzer uses inputs via S21 port.

**SWR (Standing Wave Ratio)** – Usually, SWR is defined as the ratio of the maximum radio-frequency (RF) voltage to the minimum RF voltage along the line. The SWR has to be at an acceptable level across the frequency band. 1:1 is the ideal reading but is not usually attainable.

**Velocity Factor (VF)** – This is speed at which a frequency will travel on a coaxial or twisted pair cable. It is expressed as a fraction of the speed of light in a vacuum (i.e VF = .66c is 66% the speed of light in vacuum). It is also known by the terms: Velocity of Propagation (VP or VoP) or Nominal Velocity of Propagation (NVP).

**VSWR (Voltage Standing Wave Ratio)** – Same as SWR.

## 2. VIA Echo Setup and Operation

### Powering the VIA Echo

All the VIA Echo models are capable of operating with NiMH or NiCd rechargeable batteries, using AA alkaline batteries or operating from external power with or without batteries installed. The internal charger is designed for NiMH batteries, but can recharge NiCd batteries. The VIA Echo MRI model uses a single lead acid battery rather than NiCd or NiMH AA cells which have magnetic properties. Read the VIA Echo MRI battery section below carefully as the lead acid battery requires different care than the AA dry cells.

**NOTE: Whichever type power source you choose, it is very important to press the F4 key, scroll to the BATTERY MENU and enter the battery type installed or NONE for AC power only operation. Additionally, you can optimize the rechargeable batteries' life and recharge cycles by selecting CAPACITY and entering the MilliAmp Hour (mAh) rating for the battery type installed.**



VIA Echo 1000/2500 units should be charged in a non-operational state for 6-10 hours prior to use. This will ensure a good initial charge on the NiMH batteries. Per the nature of NiMH batteries it will require three to four uses and full recharging cycles before the NiMH batteries reach their maximum operational capacity.

Typical recharging time non-operational	4-6 hours
Typical recharging time operational	30 hours
Echo 1000, 1000SF & 2500 continuous operation on battery	2½-3½ hours with or without backlight
MRI Echo continuous operation on battery	About 2 hours, reduced by 10% with backlight and significantly when in magnetic fields

The backlight timer should always be used when operating on battery power to obtain the maximum operational hours. See the F2 functions for setting the backlight timer.

1. The VIA Echo will give a 15 minute warning prior to a low power auto shutdown. This is the time to save plots and switch to AC or DC adapter power or find a fresh set of AA cells. The 15 min. is only an approximate and the VIA Echo may shutdown in 5 or 10 minutes depending battery condition.

2. Use only AEA Technology supplied power packs; AC-to-DC Universal Adapter P/N 5001-0202 or DC-to-DC Vehicle Adapter P/N 6025-0250. If a substitute is used ensure the DC plug is the correct size and polarity – Center positive. Minimum requirements 13.3VDC and 600mA. (15VDC @ 600mA for MRI model)
3. When recharging via the Vehicle Adapter, the vehicle's engine MUST be running to ensure minimum charging voltage is available. A non-operating vehicle's battery voltage is too low to charge the NiMH or NiCd cells.
4. Whenever possible start the recharging process before the batteries reach the low voltage warning state. This will reduce the recharge time and prevent potential unit or cell damage. "Cell memory" is not an issue with NiMH or newer NiCd cells.

## Pre-Amplifier Power

If the optional Pre-Amplifier (P/N 0070-0290) is used, it can be powered from the VIA Echo's batteries or from the AC wall adapter. To power from the Echo's batteries plug the Pre-Amplifier's DC power plug into the DC charging jack on the Echo. See Figure 2-0A. To power the Pre-Amplifier and the VIA Echo simultaneously from the AC wall adapter, add the AC wall adapters DC plug into the Pre-Amplifier's DC jack. See Figure 2-0B

When the Pre-Amplifier is using battery power from the VIA Echo, turning off the Echo will turn off power to the Pre-Amplifier. When the VIA Echo is receiving power via the Pre-Amplifier and the Echo is turned off, the Echo will re-charge the batteries.



Figure 2-0A



Figure 2-0B

## Battery Charger Status LED

A battery charger status LED installed on the top panel of the VIA Echo 1000/2500 and front panel of the VIA Echo MRI uses two colors and flashing/steady modes to indicate the charger status. The F4: BATTERY MENU statuses are still available in the instrument. The LED provides a more readily available status even while the VIA Echo is turned off.

The following is a guide to the LED indications which are slightly different for the MRI model:

Charger LED Indication	Echo 1000/2500 models	Echo MRI model
<b>OFF (dark)</b>	The Echo recharger is off. Possible reasons are: 1. The unit is off and has no external power applied. The AC wall charger or DC vehicle charger may be missing. Check for power at the AC or DC outlet being used or for a bad/loose connection. 2. The unit is on and using battery power. 3. The battery is too warm or too cold to recharge.	The Echo recharger is off. Possible reasons are: 1. The unit is off and has no external power applied. The AC wall charger may be missing. Check for power at the AC outlet being used or for a bad/loose connection. 2. The unit is on and using battery power. 3. The battery is almost fully charged, but became too warm to continue charging so the charger was turned off by the Echo's monitoring circuits.
<b>FLASHING RED</b>	The charger is checking the batteries	The charger is checking the battery
<b>SOLID RED</b>	The charger is recharging the batteries	The charger is recharging the battery
<b>FLASHING GREEN</b>	Trickle Charge (batteries are 95%+ charged)	Float charge at low amperes (charge is 95%+)
<b>SOLID GREEN</b>	Batteries are fully charged	Battery is fully charged

### CAUTION

Perform all instrument operations and battery charging with the belt case or soft carrying case for the Echo 1000/2500 open, and the hard case lid for the Echo MRI fully open to ensure proper ventilation and cooling.

### VIA Echo MRI Sealed Lead/Acid Battery Care (IMPORTANT INFORMATION)

The VIA Echo MRI uses a sealed lead/acid battery. This type battery is the best type of battery for this non-magnetic application. The 1700 mAh battery can be expected to support the VIA Echo in continuous operation for about 2 hours. This operational time will diminish by about 10% with backlight use and can be reduced significantly when operating in high magnetic fields.

The life expectancy of lead/acid batteries is comparable to vehicle batteries as it is dependent on charging protocol:

1. It is recommended to keep the battery charged frequently.
2. A fully depleted battery requires a full recharge cycle. Leaving the battery in a low charge state for several weeks will degrade the battery's life expectancy.

3. During periods of non-use or short use the VIA Echo MRI should be top-off charged at least every two months, preferably every month. This is due to the self-discharge property of lead/acid batteries. Long periods without a recharge WILL degrade the battery's life expectancy.
4. The battery may fail to hold a charge if goes longer than 10 months without being recharged.
5. The life expectancy of the battery is about 150 full discharge/recharge cycles, or the equivalent amount in partial discharge/recharge cycles.
6. The battery's capacity will gradually degrade to approximately 1200mAhrs over a period of five years if charging recommendations are followed and the battery is kept well charged. The battery's capacity will degrade much faster if the battery is allowed to self-discharge for too long, if fully depleted too often or generally is not kept fully charged.
7. You can not over-charge the battery. The battery charger circuit in the Echo MRI monitors the entire charging process and goes to a "Float Charge" state to maintain the charge when the battery is at 95% or greater charge. There is no harm in leaving the charger plugged in for long periods of non-use.

For more information concerning rechargeable battery operation, see the F4 Menu's BATTERY MENU in this section and/or Section 8 Maintenance, Service and Warranty.

For in-depth information refer to AEA Technology's Application Note 150 "Using Batteries in AEA Instruments" available on the enclosed CD and our web site at [www.aeatechnology.com](http://www.aeatechnology.com).

## Powering ON

When the power ON key is pressed the splash screen in Figure 2-1 will display for about 5 seconds. The calibration count may cycle 2-3 times during self calibration. After which the measurement screen will appear as shown in Figure 2-2. If the splash screen remains on constantly with word "Calibrating" in the center window, refer to the Troubleshooting Guide in Section 8.

**Note: For best accuracy allow the VIA Echo to warm up for about 5 minutes prior to taking a measurement**



Figure 2-1

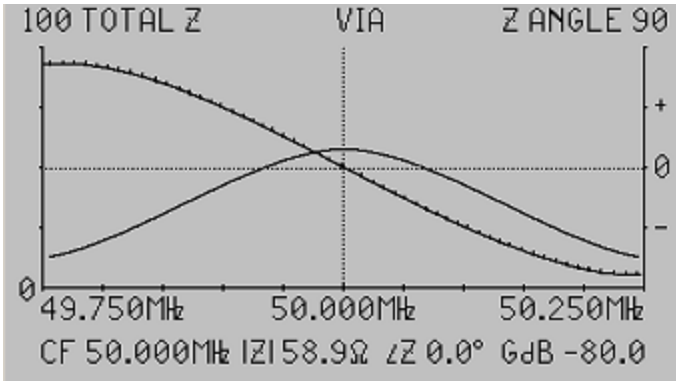


Figure 2-2

## Powering ON with Soft Reset

In the rare event that the VIA Echo powers on, but the display screen does not appear correct (i.e. information located incorrectly) or the unit's keys do not respond in the manner described, the VIA Echo's firmware may require a soft reset.

This would also be required if the cursor arrows in the Function Menus do not appear or do not respond to the  $\blacktriangledown$  $\blacktriangle$  keys. To accomplish a soft reset, first power the unit off using the **OFF** key. If the unit does not respond to pressing the **OFF** key then press and hold the **OFF** key for 10 to 15 seconds. The unit will shut off when the **OFF** key is released. Now press the power **ON** key and simultaneously press the **ENTER** key in rapid succession three to four times and wait for a normal Measurement Screen to appear. This action will return the unit to the factory default setting as opposed to the last saved settings.

## Cold Weather Operation

Operating the VIA Echo at colder temperatures will bring some noticeable changes. The LCD screen changes will slow down and the contrast will require higher than normal range settings to make the screen visible. The batteries may have difficulty maintaining power output until they warm up. NiMH batteries are better in cold weather than Alkaline or NiCd cells. Most of this can be improved or overcome by using the battery power to warm the unit.

When operating at temperatures below 0°C (32°F) with the VIA Echo starting at room temperature, use the following setups to keep the LCD and batteries warm:

1. Use the soft case for insulating the instrument
2. Power the unit up before going into the cold environment
3. Set the Battery Saver to OFF
4. If the LCD contrast fades, raise the contrast setting to a higher number
5. Protect the instrument from wind chill as much as practical. If usage is intermittent, close the soft case cover as much possible while leaving the unit powered on.

If the VIA Echo was stored at temperatures below 0°C (32°F), move it to a heated location, power the unit on. It may take 5 – 10 minutes before the LCD is readable. Follow the 5 steps above for about 15 minutes to recover the LCD and full battery power. Continue to follow the cold weather operation steps for use if required.

## Function Keys and Menus

The factory default settings in the VIA Echo are generic in nature. Because the VIA Echo serves a broad market of customers, these settings may not be the best options for your specific application. AEA recommends taking a few minutes before going on the first job site and customize the options you need the most. This will make the VIA Echo easier to use and improve efficiency for obtaining the measurements required.

Navigating through the four menus are options that control the operation of the VIA Echo and make it operate most efficiently for specific applications. Most menus operate in a similar manner. The **F1** key is different as it provides an on-screen menu for the **F2** through **F5** keys and is the **ESCAPE** key to exit the **F2** through **F5** menus back to the Measurement Screen. The top level menu is entered by pressing one of the keys **F2** through **F5**. The cursor on the left is scrolled to the desired choice by using the **SCALE** **▼▲** keys. With the menu cursor aligned to the desired choice, press either **▶** key to scroll through the choices or press **ENTER** to select the present choice. If there is a sub menu, repeat this process. Some sub menus require different keys to operate, and this will be noted on the display. If a sub-menu is a **YES/NO** selection, that choice will toggle using either the **◀** or **▶** arrow keys. If the sub-menu has three or more choices, use the **▶** to advance and the **◀** to go back through the list. Some functions require numeric or character entries instead of cursor movement. Press **◀** or **▶** then enter the required number, letter or character using the alpha-numeric key pad.

When navigating in any menu, the VIA Echo will list available choices for keypad entries to help make choices and return to the Measurement Screen. A table of menu selections is shown in Figure 2-3: Since the VIA Echo can operate as a Vector Impedance Analyzer (VIA), Spectrum Analyzer or Frequency Domain Reflectometer (FDR) the menus for any F-key will change if required when the instrument is shifted to that functional mode.

### F1 – Help Menus

The Help Menus for VIA, SA and FDR Modes are shown in Figure 2-3. This information is a help guide to the contents of the other function keys, **F2** through **F5**. When the VIA Echo's mode is changed using the **F3** menu, the help menus in **F1** will automatically change to support the function keys for the selected mode.

**F1** User Notes can be entered by pressing **F1** a second time. Then follow the on-screen instructions for entering a note or helpful reminder using the Alpha-numeric keys. Arrow keys are used for navigation and erasing. There are three User Notes pages, one for each mode. Up to 8 lines of notes can be entered on each page.

### F1 menu Help Screen – VIA Mode

F1 MEMO TEXT RECALL/EDIT  
F2 AUDIO/VIDEO: BACKLIGHT, CONTRAST  
GRIDS, VIDEO INVERT, PERSISTENCE  
VOLUME, BEEPS  
F3 MODE VIA/SA/FDR, H-V SCALES, SPAN  
CENTER FREQ, Z/GAIN FMT  
F4 UTILITIES: FILTERS, SEARCH  
3RD CSR VALUE, SERIES/PARR, O/S/LOAD  
BATTERY, SELF TEST  
F5 MEMORY SAVE AND RECALL

### F1 User Notes (Same for all Modes)

EDIT/READ MEMO NOTES  
UP/DOWN⇅ MOVES CURSOR, F1=ESCAPE  
LEFT/RIGHT⇄ TO CHANGE  
ENTER RESUMES NORMAL OPERATION

->

### F1 menu Help Screen – SA Mode

F1 MEMO TEXT RECALL/EDIT  
F2 AUDIO/VIDEO: BACKLIGHT, CONTRAST  
GRIDS, VIDEO INVERT, PERSISTENCE  
VOLUME, BEEPS  
F3 MODE VIA/SA/FDR, H-V SCALES, SPAN  
CENTER FREQ, RES BW, REF LEVEL  
F4 UTILITIES: FILTERS, SEARCH  
DEMULATOR  
BATTERY, SELF TEST  
F5 MEMORY SAVE AND RECALL

### F1 menu Help Screen – FDR Mode

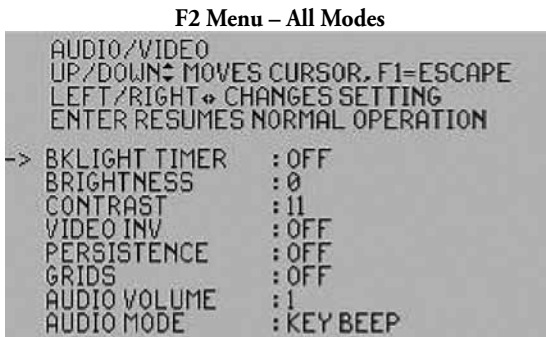
F1 MEMO TEXT RECALL/EDIT  
F2 AUDIO/VIDEO: BACKLIGHT, CONTRAST  
GRIDS, VIDEO INVERT, PERSISTENCE  
VOLUME, BEEPS  
F3 MODE VIA/SA/FDR, H-V SCALES, SPAN  
CENTER FREQ, Z0, VELOCITY FACTOR  
F4 UTILITIES: FILTERS, SEARCH  
BATTERY, SELF TEST  
F5 MEMORY SAVE AND RECALL

Figure 2-3



## F2 – Audio/Video

Menus for the all three modes are shown in Figure 2-4. Use the **SCALE** Key's ▼▲ arrows to move the cursor the desired menu items and either ► key to activate that item's options or turn the menu item ON.



**Figure 2-4**

**BKLIGHT TIMER** – The default is OFF, but this timer may be activated when operating on battery power alone to gain a minor power savings. There are several timer settings and a CONTINUOUS setting to turn the backlight on constantly. Use either ◀▶ to navigate the different settings, then press **ENTER** to activate that setting and return to the Measurement Mode.

**BRIGHTNESS** – Controls the intensity of the back light. Again, the least amount of intensity that provides a readable LCD is desired to conserve battery power when the back light is on. Use either ◀▶ to navigate the intensity levels, then press **ENTER** to activate and return to the Measurement Mode.

**CONTRAST** – Controls the LCD's characters intensity. Use lower number settings in warm conditions and higher number settings in cooler conditions to make the LCD more readable. Use either ◀▶ to navigate the contrast levels, then press **ENTER** to activate and return to the Measurement Mode.

**VIDEO INV** – Video Inversion reverses the LCD's pixel color presentation so all blank areas now appear black and all black characters and lines appear light. This “photo negative” appearance is often better for photographing the LCD or night use. Use either ► arrow key to toggle Video Inversion ON or either ◀ arrow key to toggle OFF. Press **ENTER** to exit back to the Measurement Mode.

**PERSISTENCE** – Normally, waveform traces are erased and repainted with new sweeps. When Persistence is toggled ON there is no erase and each successive trace paints over the un-erased trace permitting better viewing of small or intermittent changes. Use either ► arrow key to toggle Video Inversion ON or either ◀ arrow key to toggle OFF. Press **ENTER** to exit back to the Measurement Mode.

**GRIDS** – Grid lines can be added to the plots to enhance the horizontal reference points. Use either ► arrow key to toggle Grid Lines ON or either ◀ arrow key to toggle OFF. Press **ENTER** to exit back to the Measurement Mode.

**AUDIO VOLUME** – The volume has levels 0 through 3 with 3 being the loudest and 0 turning the audio off. Use either ◀► to navigate the Audio Volume levels, then press **ENTER** to activate and return to the Measurement Mode.

**AUDIO MODE** – The audio can be set to Silent, Key Beep or Continuous. Silent and Key Beep are self explanatory. In the continuous mode the tone's frequency will vary with the trace at Center Frequency for the LEFT measurement scale. This applies to VIA, SA and FDR modes. Use either ◀► to navigate the audio modes, then press **ENTER** to activate and return to the Measurement Mode.

## F3 – Plot Settings

Menus for the all three modes are shown in Figure 2-5. Use the **SCALE** Key's ▼▲ arrows to move the cursor the desired menu items and either ► key to activate that item's options or turn the menu item ON.

### F3 Menu – VIA Mode

```
PLOT SETTINGS
UP/DOWN◄ MOVES CURSOR, F1=ESCAPE
LEFT/RIGHT◄ TO CHANGE
ENTER RESUMES NORMAL OPERATION

-> INSTRUMENT MODE : VIA
CENTER FREQ       : 5.000 MHz
SWEEP SPAN        : 10.000 MHz
LEFT PLOT TYPE    : TOTAL Z
RT. PLOT TYPE     : Z ANGLE
LEFT SCALE        : 500
RIGHT SCALE       : 90
SYSTEM Z0        : 50
```

### F3 Menu – SA Mode

```
PLOT SETTINGS
UP/DOWN◄ MOVES CURSOR, F1=ESCAPE
LEFT/RIGHT◄ TO CHANGE
ENTER RESUMES NORMAL OPERATION

→ INSTRUMENT MODE : SPECTRUM
CENTER FREQ       : 500.000MHz
SWEEP SPAN        : 5.000MHz
REF LEVEL         : 10
RESOLUTION BW    : 500kHz
VERTICAL SCALE    : 100
EXT. MODULES     : NO ATTN NO PREAMP
DISPLAY FORMAT    : SPECTRUM PLOT
```

### F3 Menu – FDR Mode

```
PLOT SETTINGS
UP/DOWN◄ MOVES CURSOR, F1=ESCAPE
LEFT/RIGHT◄ TO CHANGE
ENTER RESUMES NORMAL OPERATION

INSTRMENT MODE   : FDR
CENTER FREQ      : 500.000 MHz
PLOT LENGTH      : 250
LENGTH UNITS     : FEET
VERTICAL MODE    : RTN LOSS dB
-> VERTICAL SCALE : 2
CABLE Z0        : 50
VELOCITY FACT.  : 66.0
```

Figure 2-5

## F3 Menu – VIA Mode

**INSTRUMENT MODE** – This menu item permits selecting the Vector Impedance Analyzer (VIA), Spectrum Analysis (SA) or Frequency Domain Reflectometer (FDR) Mode of operation. Changing the mode will change some F Key menu items and the display plot automatically. Use either ◀▶ to navigate the Instrument Modes, then press **ENTER** to activate and return to the Measurement Mode.

**CENTER FREQ** – Permits setting the Center Frequency (CF) by using the alpha-numeric keypad. Range: 0.1 to 2500.000. If a digit is entered incorrectly, use the **F1** key to back up and erase the number. After entering the frequency press **ENTER** to set the Center Frequency and return to the Measurement Mode.

**SWEEP SPAN** – The Sweep Span lists specific sweep widths or standard spans. The frequency span listed is the total span from the lowest to the highest frequency that will be swept. If the CF is set to 1.0MHz and a 250kHz span is selected, the sweep will be from 875kHz to 1.125MHz. The standard spans in the menu are: 0 (Continuous Wave), 250KHz, 4MHz, 1MHz, 2MHz, 5MHz, 10MHz, 20MHz, 50MHz, 100MHz, 200MHz, 500MHz, 1GHz, 2GHz and 2.5GHz. Use either ◀▶ to navigate the span widths, then press **ENTER** to activate and return to the Measurement Mode. Non-standard spans may be entered numerically from the active Plot Screen using the alpha-numeric keys. Nonstandard span entries may be modified by the Echo due to synthesizer step size limitations.

**LEFT PLOT TYPE** – Use this to select the measurement parameter for the LEFT Plot in the VIA mode. Available plots are: Impedance, Impedance Angle, Resistance, Reactance, SWR, Return Loss, Reflection Coefficient Magnitude, Reflection Coefficient Angle, Linear Gain, Gain Phase, Log Gain and Group Delay. Use either ◀▶ to navigate the plot types, then press **ENTER** to activate and return to the Measurement Mode.

**RT. PLOT TYPE** – This operates the same as the LEFT Plot Type in the VIA mode and is not applicable in the Spectrum Analyzer and FDR modes.

**LEFT SCALE** – This item permits setting the LEFT Plot Scale to one of the values listed. The scale values list here will vary depending on the measurement parameter selected for the LEFT Plot. Use either ◀▶ to navigate the Scale values, then press **ENTER** to activate and return to the Measurement Mode.

**RIGHT SCALE** – This operates the same as the LEFT Scale in the VIA mode and is not applicable in the Spectrum Analyzer and FDR modes.

**SYSTEM Z<sub>0</sub>** – Use this to set the system under test's impedance ( $Z_0$ ). The usable range is 10 to 100 Ohms. Settings can be made outside that range, but will not yield valid readings on all the measurements. To set the System  $Z_0$  press the ▶ key and a System  $Z_0$  entry menu will appear. Use the numeric entry key pad to enter the impedance, then press **ENTER** to accept. If an entry error is made, press the F1 key to delete the last character.

## F3 Menu - SA Mode Differences

**REF LEVEL** - The Reference Level is the point of reference for the Vertical Scale on the Spectrum Analyzer plot and is at the top. Reference Level selection is detailed in Figure 4-1A.

**RESOLUTION BW** - The Resolution Bandwidth provides a horizontal menu of selectable bandwidths – 10, 20, 50, 100, 200 & 4MHz, 1, 2, 5, & 10MHz. Use the ◀▶ keys to select an available Resolution BW. The bandwidths displayed and selectable will be determined by the frequency step size per the following formula:  $fstep \leq RBW \leq 25 \times fstep$ . If you attempt to select a Resolution Bandwidth outside the displayed limit the warning “RESOLUTION BW MODIFIED” will appear. This indicates you are limited to those bandwidths displayed.

**VERTICAL SCALE** – The Vertical Scale (total vertical range) may be selected from 2, 5, 10, 20, 50 or 100 dB.

**EXT. MODULES** – This menu item is used to control the Spectrum Analyzer or Power Meter reading based on the use of either an external attenuator or Pre-Amplifier (P/N 0070-0290).  
Steps:

1. Move the cursor down to EXT. MODULES and press any ▶ key to open the selection sub-menu.

→ EXT ATTEN : REMOVED  
EXT PREAMP : REMOVED

2. At EXT ATTEN Press any ▶ key to open a numeric entry screen and use the keypad to enter the attenuator's value to be used. Use the F1 key to backspace (erase) digits. Press ENTER to set the value. This value will be automatically calculated into the displayed measurement values.

3. Move the cursor to EXT. MODULES and press any ▶ key to open the selection sub-menu.  
EXT ATTEN : REMOVED  
→EXT PREAMP : IN

4. Move the cursor to EXT PREAMP and press any ▶ key select the Pre-Amplifier, then press ENTER. This will adjust all Spectrum Analyzer readings per the Pre-Amplifiers power boost.

5. Move the cursor to both the REF LEVEL and VERTICAL SCALE desired.

NOTE: With the Pre-Amplifier selected the Reference Level range is -50dB to 105dB. See Figure 4-1A for settings.

6. Press ENTER to return to the measurement screen.

You must physically add or remove the external attenuator or Pre-Amplifier to match the setting displayed on the menu in order for the plot scales to match the actual signal levels.

Also, failure to add the attenuator when the input power exceeds +20dBm can cause damage to the Echo. It is important to set the Echo correctly as the power meter calculates only the power of the signal(s) displayed by the spectrum analyzer.

**DISPLAY FORMAT** – This menu item permits selecting the SPECTRUM ANALYZER, or Power Meter's GSM-PCM-NOISE PWR (digital), or AM-FM-CW PWR (analog) to match the signal type being measured. The former setting corrects the power reading for the effects of (pseudo) noise signals with the log detector. The displayed power includes the effect of the external attenuator so no user math is required to correct for the attenuator. Example:

Ranges: 20dBm to approx. -30dBm (without 30dB attenuator)

(100mWatts) (1μWatts)

50dBm to approx. 0dBm (with 30dB attenuator)

(100 Watts) (1mW)

## F3 Menu – FDR Mode Differences

**CENTER FREQ** – Press any ► key to go to a Center Frequency numeric entry screen. Use the numeric key pad to enter the desired Center Frequency, then press enter to accept and return to the F3 Menu. If you make an error during the numeric selection, press the F1 key to erase the last digit entered. If the frequency is NOT in the valid zone for the range selected you will see and an error message momentarily. See the Center Frequency vs Plot Length Chart, Figure 2-6. Adjust either the Center Frequency, VF or the Plot Length to match the valid zone in the chart.

**PLOT LENGTH** – This sets the span length displayed on screen. It is important that the Plot Length be longer than the cable being measured, but not excessively longer. Press any ► key to go to a Plot Length numeric entry screen. Use the numeric key pad to enter the desired Plot Length, then press ENTER to accept and return to the F3 Menu. If you make an error during the numeric selection, press the F1 key to erase the last digit entered. If the length is NOT in the valid zone for the Center Frequency selected you will see and an error message momentarily. See the Center Frequency vs Plot Length Chart, Figure 2-6. Adjust either the Center Frequency or the Plot Length to match the valid zone in the chart.

**LENGTH UNITS** – This toggles between Feet and Meters. Use either ► arrow key to toggle to Meters or either ◀ arrow key to toggle to feet. Press ENTER to exit back to the Measurement Mode.

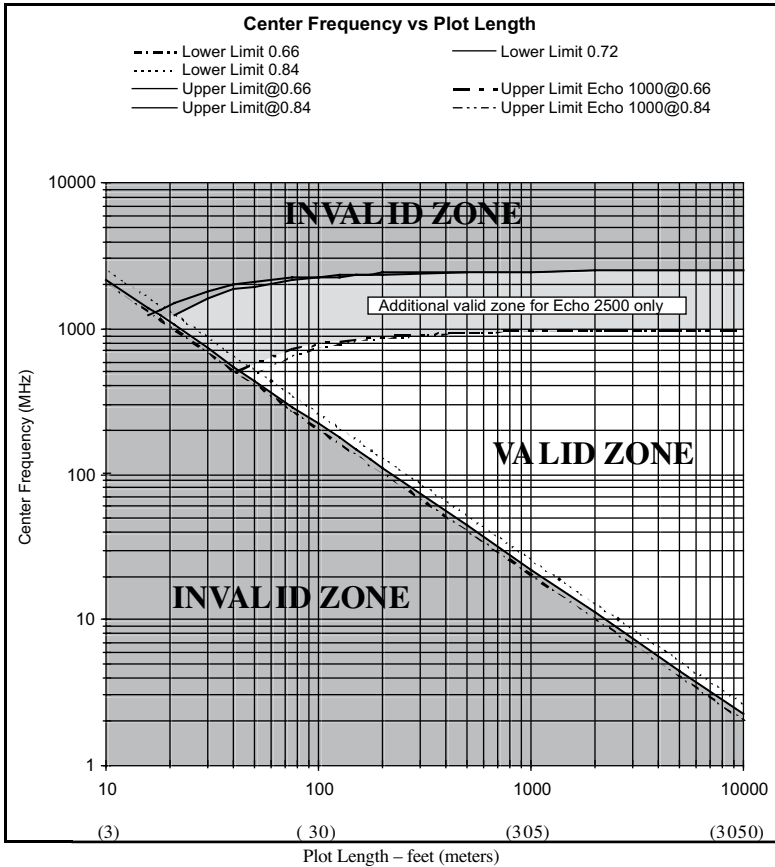
**NOTE:** When measurement is set to meters the time clock will shift to 24HR mode.

**VERTICAL SCALE** – This sets the Vertical Scale in either SWR or Return Amplitude dB. Set the Vertical Mode first then set the Vertical Scale. Values for the SWR vertical scale are: .5, 1, 2, 5, 10 & 20. Values for Return Amplitude are: 2, 5, 10, 20, 40 & 80 dB. Press the ◀► keys to select a value. Then press ENTER to return to the measurement screen.

**CABLE Z<sub>0</sub>** – This permits setting the cable's impedance ( $Z_0$ ). Press any ► key to go to an impedance numeric entry screen. Use the numeric key pad to enter the desired impedance, then press ENTER to accept and return to the F3 Menu. If you make an error during the numeric selection, press the F1 key to erase the last digit entered. Valid range for  $Z_0$  is 10 to 100 Ohms.

**VELOCITY FACT.** – This permits setting the Velocity Factor (VF), aka Velocity of Propagation (VP or VoP) or Nominal Velocity of Propagation (NVP), all are references to the cable's speed expressed as a fraction of the speed of light. Press any ► key to go to the impedance numeric entry screen. Use the numeric key pad to enter the desired Velocity Factor, then press ENTER to accept and return to the F3 Menu. If you make an error during the numeric selection, press the F1 key to erase the last digit entered. All entries require three digits – format = XX.X.

**VERTICAL MODE** – The Vertical Scale can be viewed as SWR or Return Amplitude in dB. Press the ◀► keys to select the desired method to read the FDR's reflections. After selecting the Vertical Mode, set the Vertical Scale per the mode.



e.g. For a center frequency of 100 MHz, the minimum allowable plot length would be approximately 250 ft.

**Figure 2-6**

**NOTE:** Performing an FDR test on shorter cables requires applying a wider differential frequency to obtain valid test results. See explanation in Application Note “AN205 FDR Comparison to TDR” on the enclosed CD or AEA Technology’s web site. The minimum distances shown in the chart above are based differential frequencies programmed in the VIA Echo. However, a shorter cable than the plot length can be clearly measured on the FDR plot display, particularly with plots uploaded to Echo PC Vision. For example: Because it is a log graph, the graph’s minimum distance is 10 feet (3 meters). To view a cable less than this length requires a longer plot range. This cable can still be seen clearly on plot ranges of 30 feet (10 meters) with a center frequency as low as 700MHz. At that center frequency the VIA Echo needs to apply a frequency differential of 1.213Ghz, which will actually test the cable across the frequency range of 93.75MHz to 1.306GHz.

## F4 Menu – Special Functions

Menus for the all three modes are shown in Figure 2-7. Use the **SCALE** Key's ▼▲ arrows to move the cursor the desired menu items and either ► key to activate that item's options or turn the menu item ON.



Figure 2-7

### F4 Menu – VIA Mode

**VIDEO FILTER** – This menu item sets the Video Filter level from 0 (OFF) to the settings in the following table shown below. Use either ◀▶ key to navigate the levels, then press **ENTER** to activate and to the Measurement Screen.

0 = OFF	3 = 200Hz
1 = 1000Hz	4 = 100Hz
2 = 500Hz	

**AVERAGING FLTR** – This menu item sets the level of the Averaging Filter in dB. The range is from 0 (OFF) to the settings in the following table shown below. Use either ◀▶ key to navigate the levels, then press **ENTER** to activate and to the Measurement Screen.

0 = OFF	3 = 9dB	6 = 18dB
1 = 3dB	4 = 12dB	7 = 21dB
2 = 6dB	5 = 15dB	



**SEARCH MODE** – This menu item turns on – Peak, + Peak or Zero Crossing, or turns it off. The unit will change to cursor 1 active and cursor 1 will track the peak or crossing. Manually pressing either cursor key will cancel the search mode.

**3RD CURSOR VALUE** – This Selects a plot type, displays the cursor’s value, but does NOT draw a third plot on the display screen.

**Echo MRI only Q MEASUREMENT OPTION** – The VIA Echo MRI model has a Q Measurement that can be displayed in the 3rd Cursor Value position on the Measurement Screen, the lower right side of the cursor data line. To select the Q Measurement use any ◀▶ arrow key to move the horizontal menu until Q MSRMT is selected. Press the ENTER key to return to the Measurement Screen and the Q of the circuit will be displayed. The Q Measurement is only available in the swept frequency mode, not the CW mode. It can also be saved and uploaded to a PC using Echo PC Vision software.

**SERIES/PARLLEL** – This menu item toggles between the Series or Parallel measurement mode. Use either ▶ arrow key to toggle to Parallel or either ◀ arrow key to toggle back to Series. Press ENTER to exit back to the Measurement Mode. NOTE: This setting does not alter the impedance of the measurement. Only the resistance and reactance plots will be altered by this setting.

**CABLE NULL** - Cable Null is a toggle for OFF or ON. When ON, the stored Cable Null data will be used to re-compute the measurements removing the cable’s affects from the algorithms. Use either ▶ arrow key to toggle Cable Null ON or either ◀ arrow key to toggle OFF. Press ENTER to exit back to the Measurement Mode. When the user toggles the Cable Null to ON, the OPEN, SHORT, LOAD, THRU sequence will occur prior to plotting. if you wish to cancel the sequence, press and hold the F4 key then toggle Cable Null to OFF.

**BATTERY MENU** – Use either ▶ arrow key to open a sub-menu of items in the Battery Menu. The Battery Menu item at this menu level will display the estimated time remaining as > X.X Hrs remaining. This is also shown in the Battery Menu, figure 2-8.

```
BATTERY PARAMETERS
UP/DOWN⇅ MOVES CURSOR, F1=ESCAPE
LEFT/RIGHT⇄ TO CHANGE
ENTER RESUMES NORMAL OPERATION

-> BATTERY SAVER      : OFF
   BATTERY TYPE     : NICK NIMH
   BATT. CAPACITY   : 2000 MAHR
   EST. RUN TIME    : >2.7 HRS
   BATTERY STATUS   : 10.2V - 170MA
   BATTERY TEMP.    : TEMPERATURE OK
   CHARGER STATUS   : IDLE
```

**Figure 2-8**

To view the Battery Menu screen above Press the F4 key, then ▼ to select BATTERY MENU and press any ▶ key.

**Battery Saver:** Has two settings, ON or OFF. Use any ◀▶ key to switch between the settings. On will power down the VIA Echo if no key is pressed in approximately 5 minutes.

**Battery Type:** Permits selecting between NONE, ALKALINE or NIMH NICD cells. “Alkaline” MUST be selected if carbon or alkaline cells are place in the unit or damage to the VIA Echo and/or cells may result.

**Batt. Capacity:** This setting is required when new rechargeable batteries are installed to ensure the optimum recharge and operational times. This will also make the estimated run time more accurate. The mAh rating for NiMH or NiCd cells is specified on the manufacturer’s packaging and should be set to exactly what the manufacturer states. Setting the capacity higher or lower than the manufacturer’s specifications will degrade performance rather than enhance it. To set the mAh’s, press any ◀▶ until the reading matches the manufacturer’s specification. Range is 400 to 5300 mAh’s.

**Est. Run Time:** Calculated by the charger based on amount of charge in cells. New cells may require several charging/discharge cycles for charger to synchronize with the cells and make the estimate accurate.

**Battery Status:** Displays the voltage and charging (positive) or discharging current (negative). Normal voltages for the cells will range from 8.8 to 12.5. See the Battery Current Table for it’s indication.

**Battery Temp:** If the batteries are too hot or cold they can not be charged. The charger reads their temperature constantly and adjusts for temperature changes. See the Troubleshooting Table for temperature related symptoms.

**Charger Status:** IDLE = No DC input power, alkaline cells detected or cells are already at full charge - charging will not start.

BATT CHK = Charger is checking batteries’ condition

PRE CHRГ = Conditioning Charge

CHARGING = Normal Charging

TRICKLE = Batteries fully charged and being sustained

### Example Echo MRI Battery Menu

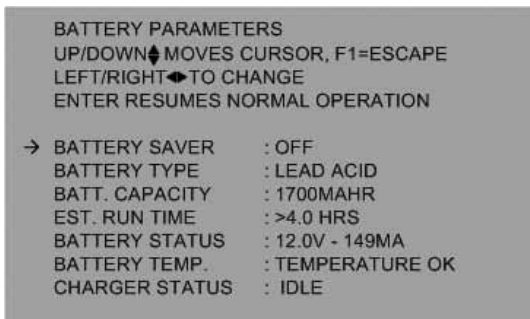


Figure 2-8A

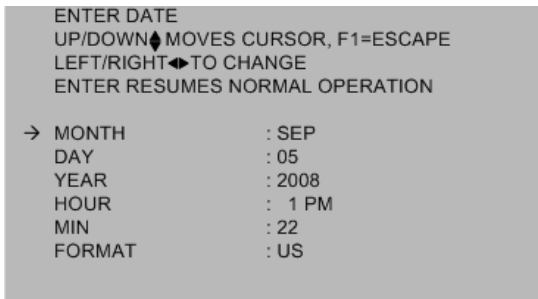
The Echo MRI F4 – BATTERY MENU shown in figure 2-8A.

Essentially the functions are the same as those in the Echo 1000/2500 models with the following exceptions:

BATTERY TYPE: LEAD ACID is the only type that will display

CHARGER STATUS: IDLE – Same as the OFF (dark) LED conditions  
 BATT CHK – Charger is checking the battery condition  
 CHARGING – Normal charging  
 FLOAT – Battery is nearly at full charge, current is reduced to 100mA to “Top Off” the battery

**DATE/TIME** – Displays the current date and time. If this display is not correct, press any ► key to enter the correct date and time.



**Figure 2-9**

In this menu use the ▼▲ arrow keys to move between the items and ◀▶ arrow keys to cycle the Month, Day, Year, Hour or Minutes until the correct setting is reached. FORMAT – refers to the time format and has two settings: US and METRRIC. Set to US, time will appear with AM or PM, set to metric, time will appear in 24 hour format. Use ◀▶ to switch between US and metric.

**NOTE:** The Date and Time will continue to function for ONLY 60 seconds during a battery change. Be sure you have the fresh batteries ready to insert and move quickly when removing the old cells. If you exceed the 60 seconds, turn the unit back on with fresh cells and return to this menu to reset the Date and Time. If the batteries become fully discharged, the date/time will be lost and need to be re-entered.

## **F4 Menu – SA Mode Differences**

**SEARCH MARKER** – This menu item turns ON or OFF a marker for locating the highest positive peak (or lowest negative peak) in the selected frequency span. Use either ► to toggle -PK, +PK or either ◀ to toggle OFF.

**DEMODULATOR** – This menu item selects AM, NBFM or WBFM demodulation to listen to signals carried on either the Center Frequency or the frequency marked by Cursor 1. Use either ◀▶ key to navigate the type of demodulation, then press ENTER to activate and to the Measurement Screen. The active Cursor selects what frequency is demodulated. The plot updates are suspended while in demodulation is active.

## F4 Menu – FDR Mode Differences

Same as F4 Menu-SA Mode less DEMODULATOR. All other menu items work identical to those in SA Mode.

## F5 –Memory Operations

Menus for the all three modes are shown in Figure 2-10. Use the **SCALE** Key's ▼▲ arrows to move the cursor the desired menu items and either ► key to activate that item's options or turn the menu item ON.

## F5 Menu – All Modes

Some instruments have separate save operations for saving instrument setups or saving plots to memory. The VIA Echo saves both the plot and the instrument settings in one Data Save operation. To recall an instrument setting simply recall a saved plot with those settings, exit the "Freeze" mode; now the instrument operates with the recalled settings.

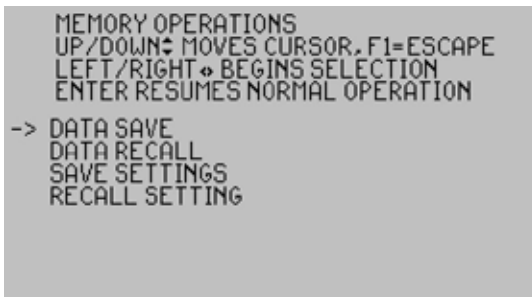


Figure 2-10

**DATA SAVE** – This menu item permits saving the current plot and the instrument settings used to obtain the plot. Press either ► arrow key to perform a Data Save function and call the Description Entry Screen shown in Figure 2-11.

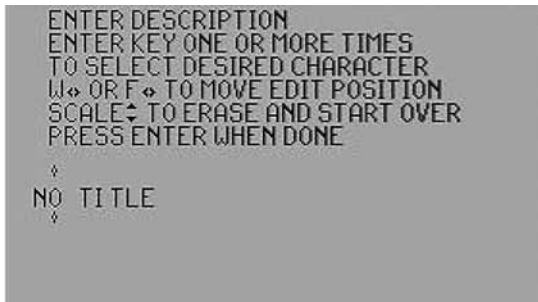


Figure 2-11

The Description can be up to 15 characters in length including: Punctuation, special characters and spaces. Use the ◀▶ arrows to change edit position and enter a new character. Use the ▼▲ arrows to erase the entire description and start over. When the description is completed, press the **ENTER** key to save the plot and instrument settings. In addition to the

Description the Echo will save the Date, Frequency and Plot Mode (VIA, SA or FDR), which can be used later to recall the plot.

**NOTE:** DATA RECALL will reset the Echo to all the testing parameters saved with the recalled plot. This will over ride any current settings. If you wish to return to the current settings use the SAVE SETTINGS now and the RECALL SETTING when you are finished with recalled plots. Refer to figure 2-10.

**SAVE SETTINGS** – Saves all current settings in the VIA Echo. Press the ▼ to move the cursor to the Save Settings feature. Press the ► to perform the save. The settings are not in an addressable memory slot and can only be recalled using the Recall Settings feature.

**RECALL SETTINGS** – Recalls the settings saved using Save Settings. Press the ▼ to move the cursor to the Recall Settings feature. Press the ► to perform the recall.

**DATA RECALL** – Data Recall provides a list of all plots saved (up to 250). To manage finding the plots you wish to recall, a sub-menu permits sorting for the desired plot(s) by Center Frequency and/or Plot Type and/or Date. This reduces the list you will see and makes it easier to locate the specific plot(s) you wish to recall.

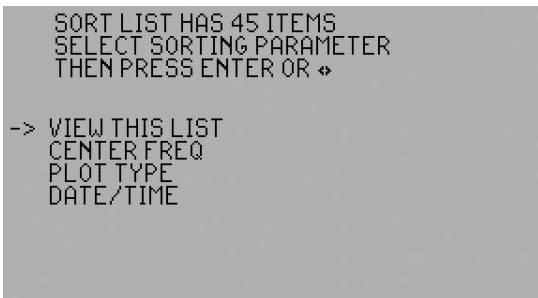
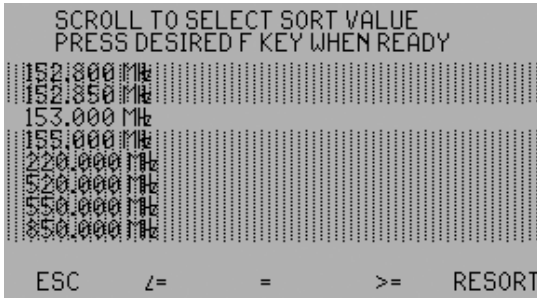


Figure 2-12

### Sorting Steps

1. Press the ▼▲ arrows to select the sorting parameter. See figure 2-12.
2. Use the ◀▶ arrows to see the list sorted by that parameter.
3. Select the targeted parameter. Use the ▼▲ arrows to move the list by one line. Use the ◀▶ arrows to see a different page (shift by 8 lines).
4. Then use the F1 through F5 keys to select one of the sorting functions presented above the key. See figure 2-13.



**Figure 2-13**

Note the F1 through F5 keys now have action items in the LCD. Refer to Figure 2-13.

- F1 – ESC – Press to Escape back to the Sorting List with no selections
- F2 – <= – Press to select frequencies less than or equal to the one highlighted (153MHz). This will reduce the number of saved tests displayed to only those frequencies.
- F3 – = – Press to select frequencies equal to the one highlighted (153MHz). This will reduce the number of saved tests displayed to only those equal to the one highlighted.
- F4 – >= – Press to select frequencies greater than or equal to the one highlighted (153MHz). This will reduce the number of saved tests displayed to only those frequencies.
- F5 – RESORT – Whether this list has been reduced or not you can return to the “Sort List” and Resort the list of tests on a different parameter. In this case by PLOT TYPE or DATE. The Resorting can be repeated as required to narrow the list of tests or define a particular test.

Sorting on the PLOT TYPE and/or DATE works similar to sorting on the CENTER FREQUENCY.

**DELETING SAVED TEST** - The Echo PC Vision software versions 2010.x and higher have a DELETE TEST feature in the Memory Catalog. After uploading the catalog, saved tests results can be selected and deleted from the VIA Echo’s memory. NOTE: This action will permanently delete the selected test results and there is no un-delete feature so be sure any test results marked for deleting have been saved on the PC before using this feature. See the Operator Manual’s section 7 for instructions.

## VIA Echo's 3 Modes

The VIA Echo can operate as a Vector Impedance Analyzer, Spectrum Analyzer or Frequency Domain Reflectometer. To change the modes, press **F3** and press **▶** at "INSTRUMENT MODE." Then press the **▶** to select the mode and press **ENTER** to return to the new measurement screen for that mode. Figure 2-14 shows the three mode screens with example waveforms for their plot.

NOTE: The Power Meter is a subfunction of the Spectrum Analyzer Mode

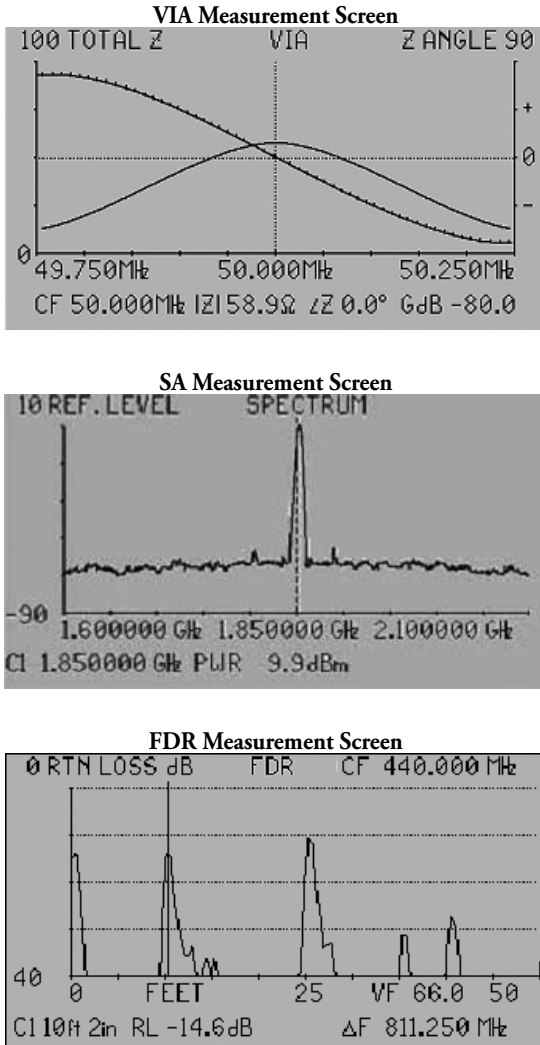


Figure 2-14

## Vector Impedance Plot

The screen shown in Figure 2-15 will appear after the splash screen if the VIA Echo is in the Vector Impedance Analyzer mode or if the Vector Impedance Analyzer mode is selected.

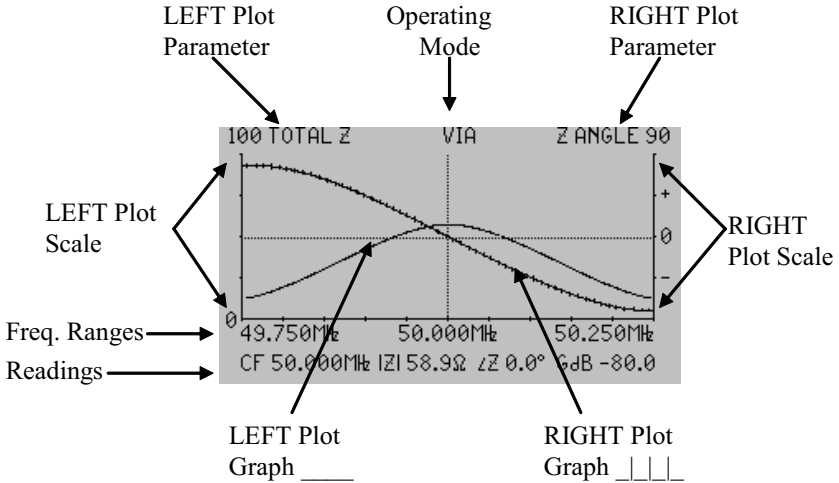


Figure 2-15

The LEFT and RIGHT Plot parameters, LEFT and RIGHT Scales, Center Frequency (CF), Sweep Range are all user selectable and will be different depending on the instrument set ups.

## Spectrum Analyzer Plot

The screen shown in Figure 2-16 will appear after the splash screen if the VIA Echo is in the Spectrum Analyzer mode or when the Spectrum Analyzer mode is selected.

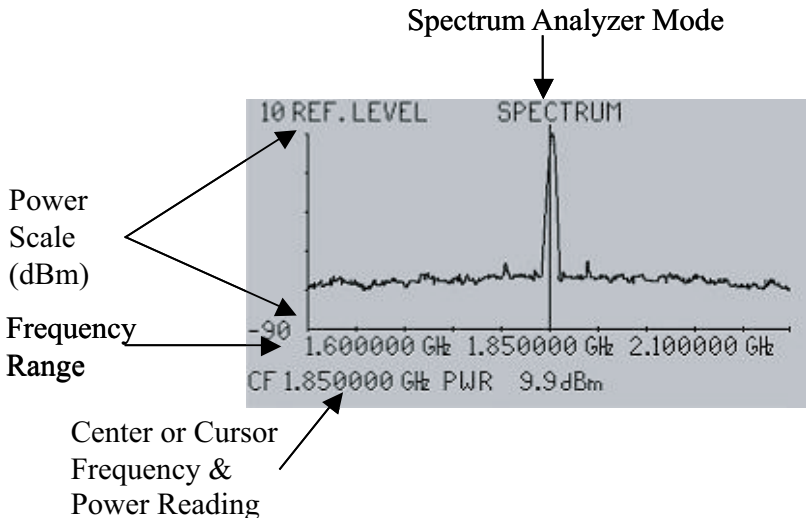


Figure 2-16



## Frequency Domain Reflectometer (FDR) Plot

The screen shown in Figure 2-17 will appear after the splash screen if the VIA Echo is in the Frequency Domain Reflectometer (FDR) mode or if the FDR mode is selected.

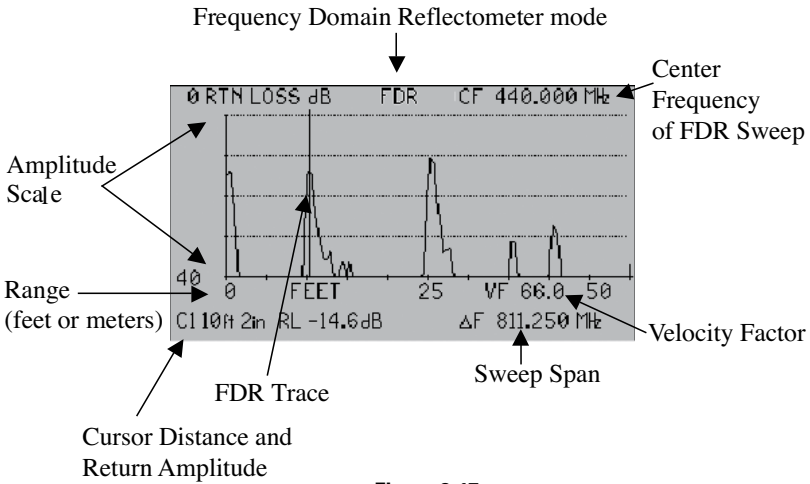


Figure 2-17

## Action Keys

Most of the VIA Echo's action keys are located on the right side of the keypad with one key in the lower right of the alpha-numeric keys as shown in figure 2-18.

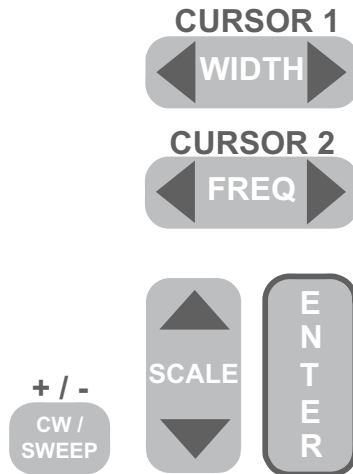


Figure 2-18

**CURSOR 1 / WIDTH** key is a shared function key. In the Cursor Display Mode, pressing the ◀ or ▶ arrow keys will move Cursor 1 left or right and the cursor readings in the display will be for Cursor 1. When in the Center Frequency Display Mode, pressing the ◀ or ▶ arrow keys will adjust the WIDTH of the horizontal scale to look at a wider or narrower

range of frequencies. In the F key or Menu Mode, either arrow lets the user cycle through lists of options or push into a new menu.

**CURSOR 2 / FREQ** key is a shared function key. In the Cursor Display Mode, pressing the ◀ or ▶ arrow keys will move Cursor 2 left or right and the cursor readings in the display will be for Cursor 2. When in the Center Frequency Display Mode, pressing the ◀ or ▶ arrow keys will adjust the Center Frequency. In the F key or Menu Mode, either arrow lets the user cycle through lists of options or push into a new menu.

**SCALE** key is a single action key. In any mode, pressing the ▲ or ▼ arrows will adjust the left vertical scale. When in the F key or Menu Mode, pressing the ▲ or ▼ arrows will move the menu cursor vertically to select a menu function.

**ENTER** key has three distinct functions: In the Function Menus **ENTER** is a single action key that accepts the changes and exits the menu level or exits back to the measurement screen depending on the action. When in the measurement screen, **ENTER** is a cyclic action key. Successive presses will cycle the VIA Echo through Center Frequency (CF) Mode, Cursor Mode and Cursor Differential Mode. It also serves as a soft reset key during the Power ON. A soft reset is used to recover the firmware processor's normal instruction execution sequence in the rare event that it should become hung up. Press the **Power ON** key and then press the **ENTER** key repeated 4-5 times as the unit powers up. A normal recovery is indicated by the splash screen followed by the calibration screen and measurement screens appearing normally. However, the instrument will now be reset to factory default settings and a saved setting may need to be recalled to restore the desired settings. Figure 2-19 represents operation of the **ENTER** key's three modes.

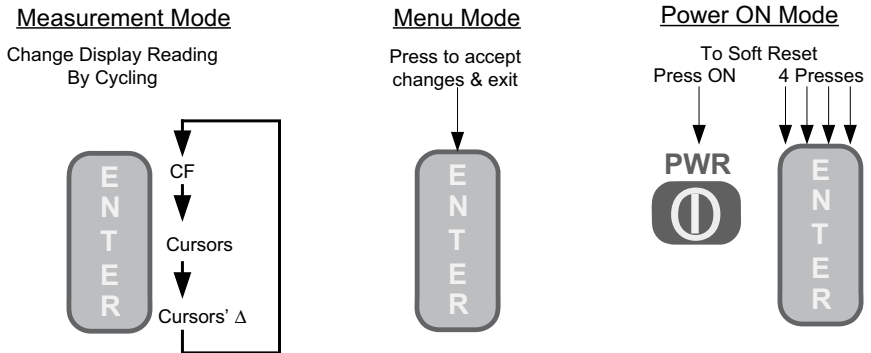


Figure 2-19

**CW / SWEEP** key, Figure 2-20 is a cyclic action key. Successive presses will cycle the VIA Echo through **Sweep**, **Freeze Plot** and **Continuous Wave (CW)** modes. If the Echo is in a numeric entry operation, this key toggles the numbers between positive and negative (+ or -) if negative entries are valid. If the Echo is editing a line of text (User Notes or Data Save) this key toggles between the three characters indicated (+ / -).

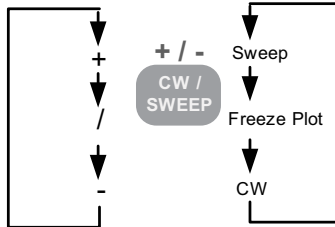


Figure 2-20

## Alpha-Numeric Keys

The alpha-numeric keys are located on the lower left side of the keypad as shown in Figure 2-21.

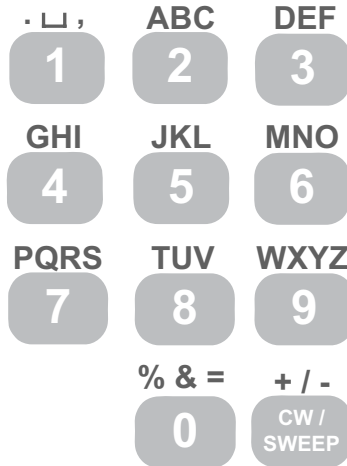


Figure 2-21

Each of the alpha-numeric keys is a cyclic key. Pressed once it will enter the number on the key. Pressed again it will enter the first character on the left above the key. Repeated presses will cycle to the second and third characters eventually returning to the number.

To enter a number:

Enter a sequence of numeric keys to display the desired number. To erase the last digit entered, press the F1. Enter zeros as required to complete the number of digit positions.

Press ENTER or one of the other action keys as required to accept the number.

To Enter Text:

Move Right – Press either ► key to go to the next character position.

Move Back – Press either ◀ key to go back a position.

Overwrite – Press any alpha-numeric key to overwrite an existing character

Erase All – Press either the ▼ or ▲ keys to erase the line of text and start over

### 3. Vector Impedance Analyzer Operations

**Vector Impedance Measurements** – Most antenna systems are 50 Ohms. This includes the output impedance of the transceiver, the impedance of the feeder cable, and the impedance of the antenna. An antenna is resonant at the frequency(s) where the Impedance (Phase) Angle is equal to zero (0). Refer to the system or radio specifications for operating requirements. The antenna impedance should be at or near the manufacturer’s specification (usually 50 Ohms) across the frequency band of interest.

For good power transfer, cable impedance should match the antenna impedance and transmitter impedance. In addition, the antenna should be close to resonant at the frequency of interest. When the reactance of an antenna is not zero, the current either leads (capacitive) or lags (inductive) the voltage waveform, which results in a lower power factor and lower transmitted power. Thus, having the reactance (series) near zero (near resonant) is desirable for good transmitter efficiency.

Using a network analyzer to measure vector impedance during antenna alignment improves transmitted efficiency compared to a simple SWR alignment. Below are a list of the measurement parameters available from the VIA Echo. The Echo’s display can provide a graphical display for any one or two of these parameters at a time. If you are new to using a vector impedance analyzer, AEA Technology recommends starting with the Reactance (Total Z) in the left plot and Impedance (phase) Angle in the right plot. A perfectly tuned antenna will show the reactance peaking at or near 50 Ohms at center frequency and the impedance angle crossing zero at center frequency as depicted in figure 3-1.

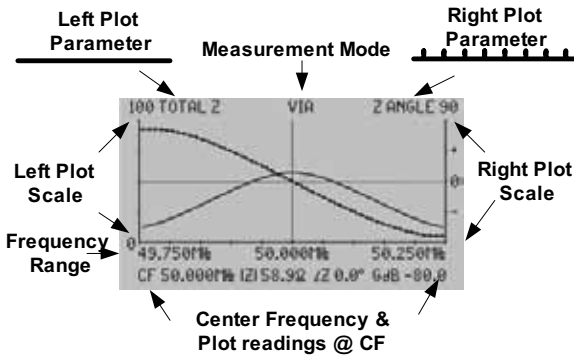


Figure 3-1

#### VIA Echo Measurements Available

**Resistance** – Measured in Ohms. This test measures the series or parallel resistive component of the antenna and/or feed line. Resistance is the property of resisting or impeding the flow of AC and DC signal current.

**Reactance** – Measured in Ohms. Reactance is the property of resisting or impeding the flow of AC current that is not accounted for by Resistance in an antenna or device under test.

There are two types of reactance, inductive and capacitive. Inductive is denoted by a positive reactance, and capacitive is denoted by a negative reactance.

**Impedance** – Measured in Ohms. The impedance of the antenna or device under test should match the design of the system at the center or resonant frequency. Impedance is the combined effect of resistance and reactance.

**Impedance (Phase) Angle** – Measured in degrees. This test determines whether the antenna or device measured is reactive at the measured frequency. A positive angle means the circuit is inductive, and a negative angle identifies the circuit is capacitive.

**SWR** – Usually, SWR is defined as the ratio of the maximum radio-frequency (RF) voltage to the minimum RF voltage along the line. The SWR has to be at an acceptable level across the frequency band. 1:1 is the ideal reading but is not usually attainable.

**Return Loss** – Measured in decibels (dB). There is a direct relationship between Return Loss and SWR. Return Loss is the amount of signal reflected back towards the transmitter expressed in decibels (dB).

## Measurement Setups


First, observing all local safety precautions, disable the transmitter(s) and disconnect the antenna to be tested from the transmission line. If you plan to measure the transmission line and the antenna together, see when to use “Cable Nulling” procedures later in this section.

**NOTE: For improved accuracy:**

**Turn on the VIA Echo to warm up for about 5 minutes before taking measurements.**

Connect the antenna directly or via a feed line to the S11 port on the VIA Echo. If your antenna connection is not an “N” Type connector you will need an adapter connection.

Turn on the VIA Echo and make the following settings:

1. Press the  key to open the plot settings menu. If not already in the VIA mode, press the ◀ key to select the VIA mode.
2. Move the menu cursor down to CENTER FREQ and press any ▶ key.
3. Use the Alpha-Numeric key pad to enter the Center Frequency, then press **ENTER** to set and exit to the menu.
4. Select **SWEEP SPAN** then continue to use the ◀▶ keys to scroll across to the desired span and press **ENTER** to set and exit.

**NOTES: A.** This is the entire frequency range to be displayed centered on the Center Frequency. Example: If you entered 500MHz as the Center Frequency

and 100MHz as the Sweep Span, you would display a plot from 450MHz to 550MHz. A 100MHz span centered on 500MHz.

- B. If you desire to set a frequency span other than the ones listed in the menu, complete the other F3 menu settings, return to the Measurement Screen and use the Alpha-Numeric keypad to enter the Sweep Span directly. See “Measurement Screen Direct Controls.”
- C. For Echo MRI’s frequency to Tesla Table see Appendix C”

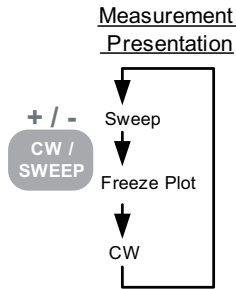
5. Select the LEFT PLOT TYPE, then use the ◀▶ keys to scroll to the desired measurement parameter. Press **ENTER** to set the measurement and exit.
6. Select the RT. PLOT TYPE , then use the ◀▶ keys to scroll to the desired measurement parameter. Press **ENTER** to set the measurement and exit.  
**NOTE:** Normally the Left and Right plots would be different measurement parameters, but they could be set the same and use different vertical scales to view both the large measurement range and a smaller more focused measurement range for the same parameter at the same time.
7. Select the LEFT SCALE, then use the ◀▶ keys to scroll to the desired Scale and press **ENTER** to set and exit.
8. Select the RIGHT SCALE, then use the ◀▶ keys to scroll to the desired Scale and press **ENTER** to set and exit.
9. Press **ENTER** again to exit to the Measurement Screen

Examine the Measurement Screen and ensure the desired information is being displayed as selected. See figure 3-1 on previous page. If changes are required, use the **F3** key to change LEFT PLOT TYPE, RT. PLOT TYPE, LEFT SCALE, or RIGHT SCALE. You can use the keypad to change Center Frequency, Sweep Span or Step Size. See Measurement Screen Direct Controls.

## Measurement Screen Direct Controls

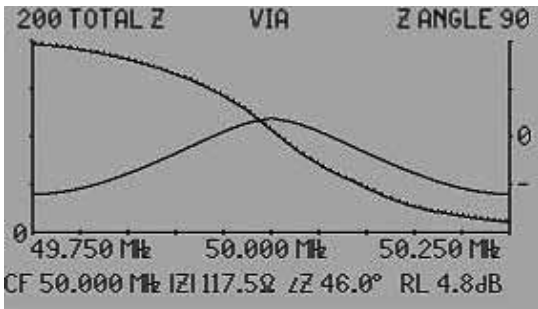
The direct controls refers to managing the Measurement Screen without having to go to the menus. The VIA Echo has been designed to place as much control as possible at the user’s finger tips while in the Measurement Screen. To accomplish this, the Action Key group all have multiple functions as described in Section 2. Some keys actions changes depending on the mode selected by other keys (example: Pressing the **ENTER** key to activate the Cursors changes the action of both the WIDTH and FREQ keys to CURSOR 1 and CURSOR 2 respectively.

**CW/SWEEP Key** – In the Measurement Screen, this key controls the Measurement Presentation by cycling the mode between Sweep, Freeze Plot and Continuous Wave (CW). See figure 3-3. The active Measurement Presentation can be identified by looking at the Measurement Screen. See figures 3-3, 3-4 and 3-5.



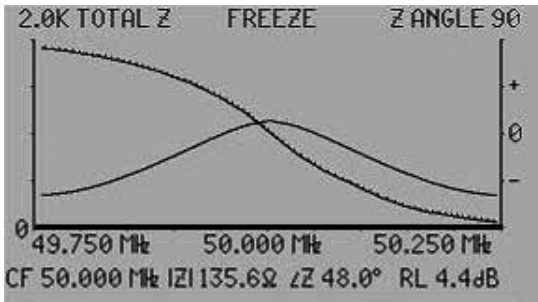
**Figure 3-2**

Sweep Mode Screen set to Center Frequency (CF) and no Cursors ON



**Figure 3-3**

Freeze Mode screen. Note the screen title at the top changes to “FREEZE” indicating this is not a live plot any more.



**Figure 3-4**



Figure 3-5



When the **ENTER** key has the Measurement Presentation set to Sweep or Freeze, the **ENTER** key can cycle the Measurement Mode between Center Frequency, Cursor1, Cursor 2 or Cursors  $\Delta$ . When operating in CW mode the **ENTER** key toggles between the Center Frequency and Cursor 1. See figure 3-6 for the cycle sequence.

Measurement Mode

Change Display Reading  
By Cycling

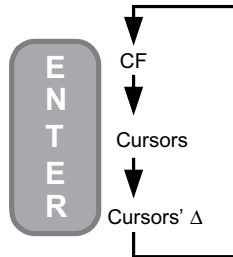


Figure 3-6

Measurement Screen in Sweep Presentation and Center Frequency Mode. The readings on the bottom line “CF” are at Center Frequency.

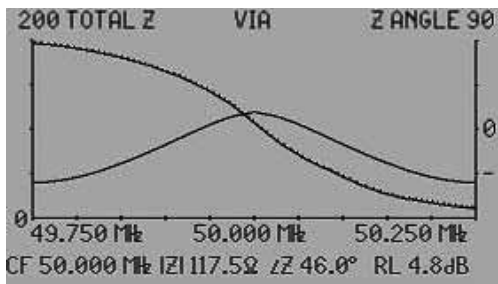


Figure 3-7



Measurement Screen in Sweep Presentation and Cursors Mode. The readings on the bottom

### CURSOR 1



line "C1" are at Cursor 1's position. The key is now in control of Cursor 1 and the data will change with its movement.

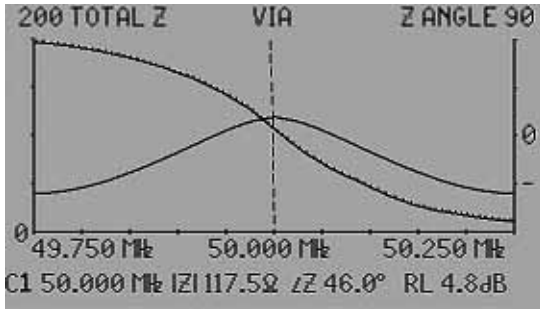


Figure 3-8

### CURSOR 2



Pressing will activate the second cursor and the information on the screen's bottom line will change to "C2" data. Reprising Cursor 1 will return the information to "C1" data.



Pressing the key again will change the Measurement Mode to Cursors' Δ. Figure 3-9 is an example of the Cursors' Δ screen.

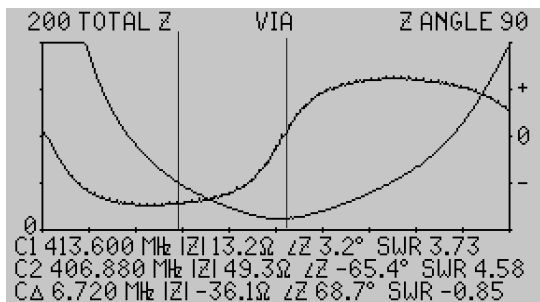


Figure 3-9

The Step is used while in the Measurement Screen, and CF Mode. Pressing the

## CURSOR 2

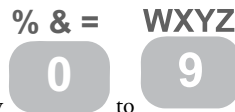


key will jump the Center Frequency higher or lower by the Step size.

The Step size can be set by the user. See “Measurement Screen Direct Controls of Frequencies” next in this section.

## Measurement Screen Direct Controls of Frequencies

Whenever the Measurement Screen is present, the VIA Echo permits changing the Center Frequency (CF), Frequency Steps, and Sweep Span Width via the Alpha-Numeric keypad and the use of the ENTER, WIDTH and FREQ keys.



To activate these Direct Controls press any key to **0** to **9** on the Alpha-Numeric keypad. The Direct Control screen shown in figure 3-10 will appear.

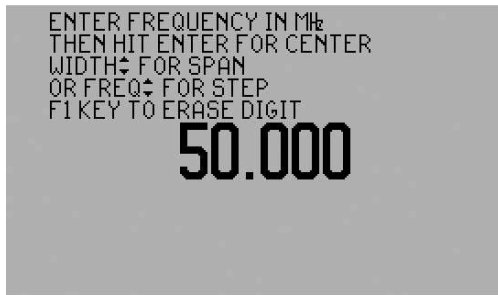


Figure 3-10

Use the Alpha-Numeric keypad to enter either a new Center Frequency (CF), a new Sweep Span Width or a new Step Size. The numeric value will be displayed in MHz (.100 = 100KHz,

1.000 = 1MHz, 1000.000 = 1GHz, etc.) Use the **F1** key to erase a mis-entered

number. Use **F5** key to escape without making a change. The range for setting these values is:

### Center Frequency

VIA Echo 2500	Range .100 to 2500.00 MHz
VIA Echo 1000SF	Range .100 to 1000.00 MHz
VIA Echo MRI	Range .100 to 1000.00 MHz

NOTE: All Echo models can accept entries down to 100KHz, but specifications may not be met below 4MHz

## Steps

Up to 1.1GHz

Range = Any multiple of 1KHz

Greater than 1.1GHz

Range = Any multiple of 10KHz

## Sweep Span Width

VIA Echo 2500

Range 0Hz to 2.5GHz

VIA Echo 1000SF

Range 0Hz to 1.0GHz

VIA Echo MRI

Range 0Hz to 1.0GHz

**NOTE:** Setting Sweep Span to zero changes the display the Continuous Wave (CW) Presentation.

Once the desired frequency value has been entered, press one of the following:



to set the new Center Frequency (CF)

### **CURSOR 1**



to set the new Sweep Span Width

### **CURSOR 2**



to set the new Step size

**NOTE:** The Center Frequency (CF) and Sweep Span can be initially set in the F3 menu, but the Step size can only be set by using the Measurement Screen Direct Controls. The Step size will remain at whatever value was last set regardless of other frequency changes.

## **Tuning an Antenna**

For best link efficiency, you must properly tune the antenna to resonance. Additionally, if the antenna has two or more adjustments available, you should also tune the antenna for the optimum match.

Resonance occurs when the reactive portion of the antenna impedance is zero. This causes the voltage to be in phase with the current, and allows the antenna to radiate its maximum power. SWR or return loss readings do not provide enough information to determine resonance. You must use a vector impedance reading to see resonance.

The transmission lines used to feed the antenna can add a layer of confusion to the measurements. If practical, tune the antenna by itself first, then add in the feedline for more measurements.

Read the manufacturer's instructions to find out about available tuning adjustments. Some common forms of adjustment include length (height) adjustment, feed


element tap, variable caps or coils, or some balun adjustment. The mounting height combined with the mast and tower affect the tuning, so try to make the measurement under conditions that represent the actual installation. Always use the simplest set of adaptors required to make a measurement. If you are operating at high frequencies or at a very narrow bandwidth, you should cable null the analyzer (and adaptors). See “Cable Nulling” next in this section.

1. Tune the antenna to resonance. Set one of the plots on the network analyzer to impedance angle (or reactance). Tune for zero reactance or impedance angle. If the combinations of adjustments are unable to do this, a tuning stub may be required. See AEA Technology’s Application Note on Stub Tuning.
2. Tune the antenna for best match, while maintaining resonance. Set the other plot of the network analyzer to Total Z. The best match occurs when the total Z approaches the characteristic impedance ( $Z_0$ ) of the system, usually 50 ohms. Multiple adjustments often interact, so a little patience goes a long way.
3. Once you have achieved both resonance and match, save the reading to memory for saving to the PC later on. Return to the Sweep Mode to save plot data. CW data is only a subset of the plot. Many people want to see reports with the scalar values, i.e. SWR or return loss. You may extract this data from the vector data (Z and Z angle or Resistance and Reactance) using the Echo PC Vision software.
4. Add the feed line to the antenna. Measure the input of the feed line; it should be close to a good match and near resonance. When the  $Z_0$  of the feed line does not match the antenna Z, the resonance information will be masked by the feedline length. This situation should be addressed with baluns or other matching networks. Ideally, you want the feed line  $Z_0 =$  Antenna Z.

The recommended sequence for setting the VIA Echo’s display for tuning is:

1. Follow the instructions at the beginning of this section to set the VIA Echo’s display with Total Z (Reactance) in the LEFT PLOT and Z Angle (Phase Angle) in the RIGHT PLOT. Set the Center Frequency (CF) and Span Width as desired for the antenna being tuned. This will provide a graphical display similar to figures 3-1 or 3-3.



2. From the Measurement Screen press the  key twice to change from the Sweep Presentation to the Continuous Wave (CW) Presentation. The VIA Echo’s display will change to the CW Numeric Presentation similar to figure 3-11. All the measurement shown are for the Center Frequency in the lower left corner.



**Figure 3-11**

Concentrate on just two of the figures, Impedance (Z) and Phase Angle (A). Tune the Phase Angle first, getting as close to zero as possible, then tune Impedance getting as close to 50 Ohms as possible. Repeat both tunings until optimum balance between both is reached.

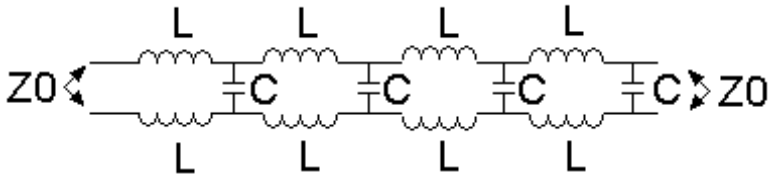


- When satisfied with this tuning press **CW / SWEEP** key once to shift back to the Sweep Presentation. Note the Phase angle crossing zero the Impedance near 50 Ohms at Center Frequency (CF). Use the Measurement Screen Direct Controls to examine the frequency spectrum as desired.

### Cable Nulling

One general property of all transmission lines is they have a uniform cross section, which results in a uniform distribution of inductance, capacitance and resistance along the length of the cable. These quantities may be measured using a network analyzer.

Lets look at an ideal transmission line model as shown in figure 3-12:



**Transmission Line Model**

**Figure 3-12**


The effect of the uniformly distributed components creates an impedance to a signal that is applied to the cable. We name this impedance the “characteristic impedance”, or  $Z_0$ . Normally the  $Z_0$  of the transmitter, cable and antenna are all matched to minimize reflections and maximize power out of the antenna. However, the best of systems will have imperfections that need compensation or tuning. Tuning the antenna has been covered. This discussion covers measuring the cable and “Cable Nulling”. Cable Nulling permits measuring the antenna and nulling the effects of the test lead on an antenna measurement.

**NOTE.** The higher the frequency of the antenna the more important cable nulling is to eliminate skewed measurements. Even short cables should be nulled from the measurements.

#### Cable Nulling Steps:

1. Set up the VIA Echo for the antenna to be measured or tuned per the instructions earlier in this section.

A grey rounded square button with the white text "F4" in the center.

2. Press  key and select CABLE NULLING and press either ► to turn ON.

3. Follow the screen prompts to OPEN the cable end, then to connect the SHORT and MATCHED terminators. (OPTION: To skip the through path calibration, press **ENTER** and proceed to step 4. To test the THRU path connect the cable's far end to the S21 port.

A grey rounded rectangular button with the white text "ENTER" in the center, arranged vertically.

4. Press  to exit back to the Measurement Screen.

5. Disconnect the far-end of the cable from the S21 port and reconnect it to the antenna. If a substitute piece of cable was used for nulling, remove that cable completely and re-connect to the antenna and feed line via the S11 port.

Executing the Cable Nulling steps will characterize the cable, store the results and make the measurement data presented accurate for the antenna.

## Measuring Isolation Between Antennas

Cosite antenna locating is a common practice and often leads to self-generated interference. The transmissions of one antenna lead to the desensitization of receive signals on other antennas/radios. Mitigators can be used to help prevent self-generated interference like noise filters, notch filters and frequency separation, but the number one prevention factor is proper antenna isolation. There are volumes written on the factors involved and formulae to use for vertical and horizontal antenna separation. Almost every reference recommends testing the isolation between cosited antennas. The VIA Echo's dual port capability is designed to perform isolation testing. It can be used to test existing sites or planned antenna locations to read the isolation for an operational frequency or frequency spectrum and prevent having to implement other expensive mitigations.

The following steps explain how to use the VIA Echo's S11 and S21 ports to perform antenna isolation testing.

**CAUTION** – ENSURE BOTH ANTENNAS ARE DISCONNECTED FROM THEIR RESPECTIVE TRANSMITTER(S) OR RECEIVER(S) PRIOR TO STARTING THIS MEASUREMENT PROCEDURE.

1. Connect one of the two antennas to the S11 port and the other antenna to the S21 port. For testing purposes, the antenna on the S11 port is the transmitter and the antenna on the S21 port will be the receiver.

**NOTE:** Since there are numerous factors involved with antenna propagation, the law of reciprocity may not apply. Once the testing is completed with the designated transmitter antenna and receiver antenna, reverse the S11 and S21 connections and retest the isolation in the opposite direction to ensure reciprocal isolation.



2. Press the **F3** key and set the INSTRUMENT MODE: VIA, CENTER FREQ and SWEEP SPAN as desired.

3. Select and set the LEFT PLOT as desired (AEA recommends setting to GAIN DB as this is the primary isolation measurement and the left plot's scale is keypad adjustable).

4. Select and set the RT PLOT as desired (AEA recommends setting to TOTAL Z, but any measurement for the S11 port will be satisfactory)

**NOTE:** To save data from both the S11 and S12 ports, one plot (left or right) MUST be set to measure an S21 port parameter and the other to measure an S11 port parameter. See the S11/S21 Port Measurement Table that follows:

**S11/S21 Port Measurements Table**

Measurement Parameter	S11	S21
Impedance (Total Z)	X	
Impedance Angle (Phase)	X	
Resistance	X	
SWR	X	
Reactance	X	
Return Loss	X	
Gamma	X	
Gamma Angle	X	
Gain dB* or Linear		X
Gain Angle		X
Group Delay		X
None	-	-

\* Gain in dB is shown as attenuation (loss) with symbol of “A” on the VIA Echo’s display

5. To obtain accurate data when measuring antenna isolation be sure to perform “Cable Nulling” in the following manner:

A. Connect the S11 (transmit) antenna’s cable to the S11 port with the far-end open.

**F4**

B. Press the **F4** key and select CABLE NULLING.

C. Perform the Open, Short and Load (matched terminator) portion of Cable Nulling on just the one cable from the S11 port to the transmit antenna's cable, less the antenna. See figure 3-13A.

D. When given the instruction to make the THRU connection, connect both the transmit and receive antenna's cables together in a loop with one end starting at S11 and the other ending at S21. See figure 3-13B

E. Complete the Cable Nulling and return to the Measurement Screen.

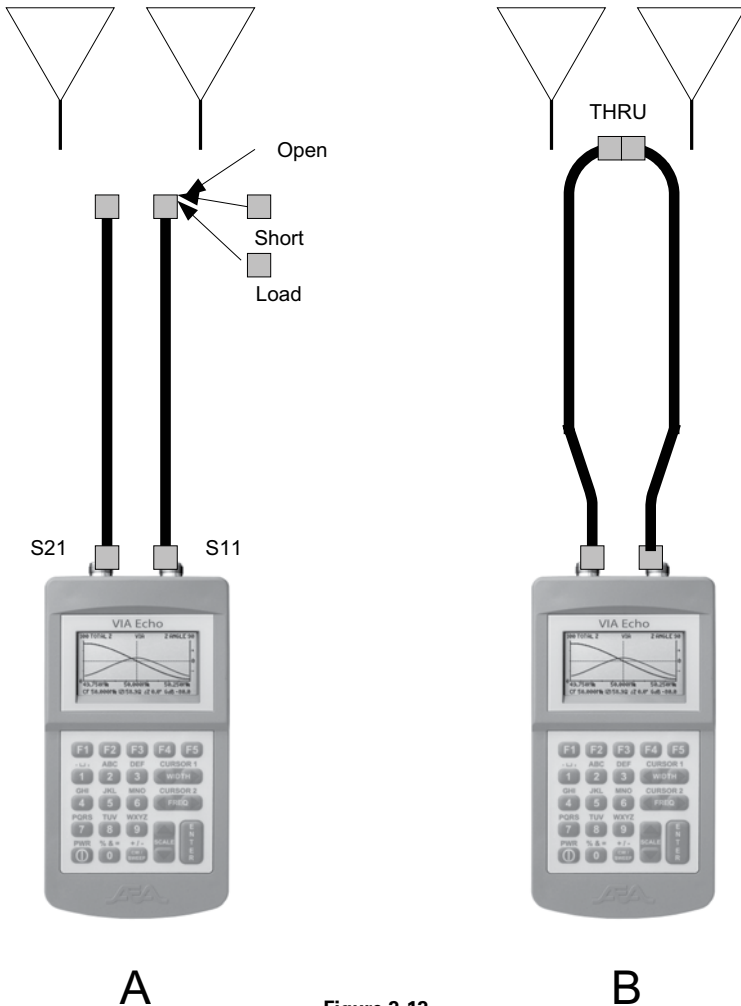


Figure 3-13



6. With the Cable Nulling completed, reconnect the two target antennas with the transmitter remaining on the S11 port and the receiver on the S21 port.
7. Conduct all the measurements desired using the instructions for Measurement Screen Direct Controls covered earlier in this section.
8. When completed, swap the two cables at the antennas and repeat Step 7.

## Cable Nulling with SMA Adapters

Whenever testing is done using SMA adapters and connector cables, the Cable Nulling procedure should be performed for the adapters and the test lead or system cables. Figures 3-14 A and B show the correct connections for the terminators supplied in AEA Technology's optional N-to-SMA Adapter Kit (Part Number 6025-0260). This kit contains two SMA-to-N adapters, two short terminators, male and female, and two 50\_ (matched) terminators, male and female. The matched terminators are marked with a black end. See Figure 3-15. Use the same Cable Nulling procedures described in paragraph 5A-E on the previous pages.

### Cable Nulling a SMA-Female connector

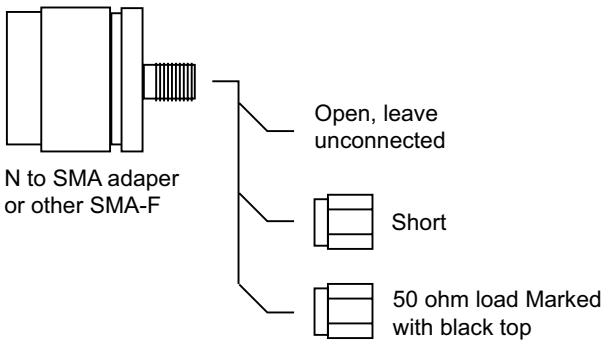


Figure 3-14A

### Cable Null at end of a cable

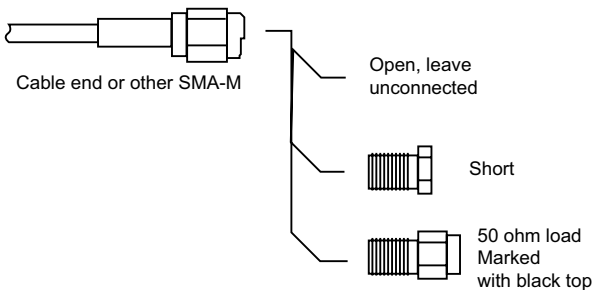


Figure 3-14B

# N-to-SMA Adapter Kit

Part Number 6025-0260



Figure 3-15

## Other Applications for Vector Impedance Analysis

NOTE: All the measurements listed have AEA Technology Application Notes discussing the formulae, reasons and detailed test methods. The App Notes are on the enclosed CD with the VIA Echo or can be found along with other helpful App Notes on our web site at [www.aeatechnology.com](http://www.aeatechnology.com).

**Magnetic Resonance Imaging (MRI) or Nuclear Magnetic Resonance (NMR) Coil Testing & Tuning** – The hand-held VIA Echo 1000 and the VIA Echo MRI operate very similar. However, the VIA Echo MRI is ultra-low magnetic and safe to use in MRI rooms or near NMR's. It also has a special Q measurement for MRI/NMR coils. Instructions for use are integrated into this edition of the Operating Manual.

**Discrete Component Testing** – The VIA Echo can be used to measure resistors, capacitors, inductors, etc. Refer to AEA Technology Application Notes available on our web site.

**Signal Source** – The S11 port of the VIA Echo can be used as a signal source. The source can be either a saw-tooth waveform swept frequency or a Continuous Wave (CW). There will be some modulation of the signal in the CW mode.

**Find Transmission Line's Characteristics** – Use the VIA Echo to determine a transmission line's characteristic impedance, velocity factor, capacitance, inductance, and bandwidth. The measurement techniques, described in AEA Technology's application notes, measure coaxial, twisted wire pair (TWP), twinax, triax, twin lead, CAT5, Cat6, Cat 7, power line, and virtually any cable that has at least two conductors paired together.

**Measure Amplifier Gain** – Amplifier gain may be measured using the VIA network analyzer. The amplifier input connects to the S11 port and the output to the S21 port. Quality connections to the analyzer, attenuator, and amplifier are required to get accurate readings. Connectors at the amplifier end of the cables allow a convenient way to perform cable null.

**Measure Group Delay** – Group delay measures how evenly a spectrum travels through a system or sub-circuit. If all frequencies of interest have the same transit time through the system or sub-circuit, then we say that it has a "flat" group delay or a linear phase response. Engineers strive for flat group delay to prevent phase distortion of the signal.

**Measure Gain Compression** – Gain compression measures gain linearity of a system or sub-circuit. When the input signal level increases by 1dB, a linear amplifier will increase the output by 1dB. If the gain is less than 1dB, the amplifier has compressed the gain. It is important to minimize gain compression to prevent amplitude distortion of the signal.

**Measure Differential Amplifiers** – The VIA Echo support non-differential measurements. There are two methods to use the VIA Echo for differential testing. The first method uses baluns, the second uses superposition.

**Measure AM to PM Conversion** – AM to PM conversion creates nonlinearity in a system or sub-circuit that plays a major role in phase noise performance. When the input signal level changes, a well behaved amplifier maintains the same delay time to for a signal to travel through the circuit. It is important to minimize AM to PM conversion to minimize the phase noise added to a signal.

# 4. Spectrum Analyzer and Power Meter Operations

## Preliminary -Spectrum Analyzer

The VIA Echo’s Spectrum Analyzer is designed to provide full spectrum (4MHz to 1.0GHz or 2.5GHz) or partial spectrum (any frequency range between 4MHz and 1.0 GHz or 2.5GHz) All frequency selection is similar to that in the VIA. First choose a Center Frequency (CF) then a Span to view centered on that frequency. Unlike the VIA the Spectrum Analyzer does not have a Continuous Wave (CW) mode. The minimum Span is 2.5MHz for all models. See the Reference Level and Range chart, Figure 4-1A, for setting limits applicable when an external attenuator and/or a Pre-Amplifier are or are NOT selected

**CAUTION –** The maximum acceptable input power for the VIA Echo is 20dBm. Exceeding this level can cause damage to sensitive components. This type of damage is not a “Manufacturing Defect” and is therefore NOT covered by warranty. Be sure to use an external attenuator for signals that might exceed 20dBm on the S21 port.

Figure 4-1 is an example Spectrum Analyzer Screen.

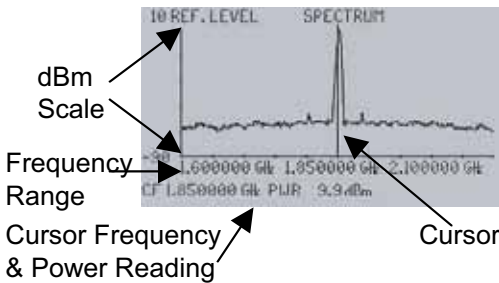


Figure 4-1

External Module Settings	Valid Reference Level Settings	Range Settings
NO ATTEN - NO PREAMP	+20 to -70dB	2, 5, 10, 20, 50 or 100dB
NO ATTEN - PREAMP IN	-50 to -105dB	2, 5, 10, 20, 50 or 100dB
ATTEN IN - NO PREAMP	Attenuator Value + (+20 to -70dB)	2, 5, 10, 20, 50 or 100dB
ATTEN IN - PREAMP IN	Attenuator Value + (-50 to -105dB)	2, 5, 10, 20, 50 or 100dB

Figure 4-1A

- NOTES:**
1. Pre-Amplifiers applicable with Version 2.2.12 and higher.
  2. Attenuators applicable with Versions 2.6 and higher.
  3. Filters applicable with any version.
  4. See Appendix A for Attenuator or Pre-Amplifier accessories

## Preliminary – Power Meter

The Echo Power Meter is a sub-function of the Spectrum Analyzer. The Echo power meter calculates and displays the total power of the signal(s) plotted on the spectrum analyzer.

Signals not displayed on the spectrum analyzer are not included in the measurement. This makes it important to set up the Center Frequency and Sweep Span correctly then select the Power Meter using the F3 menu's DISPLAY FORMAT.

The Power Meter can be set for digital power using GSM-PCM-NOISE PWR, or analog power using AM-FM-CW PWR. Readings on the Power Meter Measurement screen will show in both Watts and dBm. External attenuators are required for power exceeding 20dBm. External attenuators can be 1-60 dB and should be set in the F3 menu to process the correct power reading.

**CAUTION – The maximum acceptable input power for the VIA Echo is 20dBm. Exceeding this level can cause damage to sensitive components. This type of damage is not a “Manufacturing Defect” and is therefore NOT covered by warranty. Be sure to use an external attenuator for signals that might exceed 20dBm on the S21 port.**

Figure 4-1B is an example Power Meter Screen

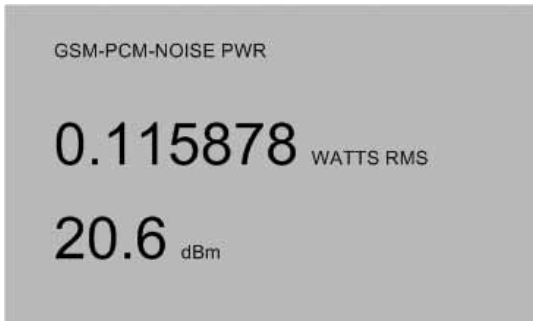


Figure 4-1B

## Measurement Setups

First, connect the antenna or antenna and feed line to the VIA Echo's S21 port. If the antenna and feed line close to the radio are used in the measurement, the dBm levels will reflect levels at or close to what the receiver will sense. Measurements taken at an antenna may be higher due to elimination of feed line losses.

Second, press the **F3** key to make the following basic selections:

**INSTRUMENT MODE:** Use ◀▶ to set SA

% & = WXYZ  
0 9

**CENTER FREQUENCY:** Use the key pad to enter CF. Then press the **ENTER** key to set and exit.

**NOTE:** User can adjust all F3 selections prior to pressing **ENTER** key.

**SWEEP SPAN:** Use ◀▶ to select a preset then press the **ENTER** key to set and exit.

**NOTES:** A. Sweep Span is the entire frequency range to be displayed centered on the Center Frequency. Example: If you entered 500MHz as the Center Frequency and 100MHz as the Sweep Span, you would display a plot from 450MHz to 550MHz. A 100MHz span centered on 500MHz.

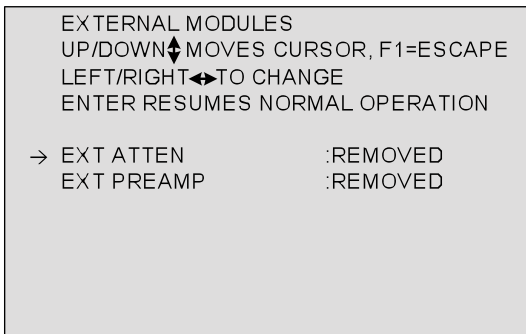
B. In the Spectrum Analyzer mode, the Span can NOT be set to zero. There is no CW mode for the Spectrum Analyzer. The minimum Span setting is 2.5MHz.

C. If you desire to set a frequency span other than the ones listed in the menu, complete the other F3 menu settings, return to the Measurement Screen and use the Alpha-Numeric keypad to enter the Sweep Span directly. See “Measurement Screen Direct Controls.”

**REFERENCE LEVEL:** Use ◀▶ to select a preset dBm level. (This will be the reading at the top line of the scale or maximum reading possible)

**VERTICAL SCALE:** Use ◀▶ to select a preset dB range. (This will determine the vertical resolution and the lowest scale reading).

**EXT MODULES** – This menu item is used to control the Reference Levels and Ranges for the Spectrum Analyzer and/or Power Meter Readings. If the Echo’s Pre-Amplifier (optional P/N 0070-0290) or an attenuator are installed on the S21 port use this menu to indicate their presence and in the case of the attenuator to enter the dB value being used. This will automatically adjust the Echo’s readings for the added accessory. Press any u key to enter the selection menu shown in figure 4-1C.



**Figure 4-1C**

Press any u at EXT ATTEN to enter the attenuator’s value (Range 1-60 dB).

Use the F1 key to erase digits. Enter 0 to remove the attenuator.

Press ENTER to confirm entry and ENTER again to return to the EXTERNAL MODULES menu.

Press any u at EXT PREAMP to add the pre-amplifier or press any t key to remove the pre-amplifier.


NOTE: See Figure 4-1A for the affect on Reference Levels and Ranges.”

You must physically add or remove the external attenuator or pre-amplifier to match the setting displayed on the menu in order for the plot scales to match the actual signal levels. Also, failure to add the attenuator when the input power exceeds +20dBm can cause damage to the Echo. It is important to set the Echo correctly as the power meter calculates only the power of the signal(s) displayed by the spectrum analyzer. The reference levels available will change in accordance with the external attenuator value.


**DISPLAY FORMAT** – This menu item permits selecting the SPECTRUM ANALYZER, or Power Meter’s GSM-PCM-NOISE PWR (digital), or AM-FM-CW PWR (analog) to match the signal type being measured. The former setting corrects the power reading for the effects of (pseudo) noise signals with the log detector. The displayed power includes the effect of the external attenuator so no user math is required to correct for the attenuator. Example:



Ranges: 20dBm to approx. -30dBm (without 30dB attenuator)  
(100mWatts) (1 $\mu$ Watts)  
50dBm to approx. 0dBm (with 30dB attenuator)  
(100 Watts) (1mW)





Finally, press  to accept and exit to Measurement Screen.



Press  key to display the Special Functions Menu.

**VIDEO FILTER** – This menu item sets the Video Filter level from 0 (OFF) to the settings in the following table shown below. Use either   key to navigate the levels, then press **ENTER** to activate and to the Measurement Screen.

1= 1000Hz  
2= 500Hz  
3= 200Hz  
4= 100Hz

**AVERAGING FLTR** – This menu item sets the level of the Averaging Filter in dB. The range is from 0 (OFF) to the settings in the following table shown below. Use either   key to navigate the levels, then press **ENTER** to activate and to the Measurement Screen.

1= 3dB  
2= 6dB  
3= 9dB  
4= 12dB  
5= 15dB  
6= 18dB  
7= 21dB

**SEARCH MARKER** – This menu item turns ON or OFF a marker for locating the highest positive peak or lowest negative in the selected frequency span. Use any ◀▶ arrow to toggle between OFF, -PK, and +PK.

**DEMODULATOR** – This menu item selects AM, NBFM or WBFM demodulation to listen to signals carried on either the Center Frequency or the frequency marked by Cursor 1. Use either ◀▶ key to navigate the type of demodulation, then press **ENTER** to activate and to the Measurement Screen.

NOTE: The Demodulation in the Echo is NOT high fidelity, it is only used to determine the type of signal (music, voice, data, etc). The Demodulation is only available on sweep widths of 50MHz or less. The Demodulation tuning resolution improves as you lower the sweep width. The Demodulation is tuned by moving the cursor to the desired frequency. The best Demodulation tuning frequency will be offset from the center of the signal by ½ the modulation BW. It is recommended that you place the cursor at the required frequency prior to turning the Demodulation on. Once the Demodulation is on, bumping the Demodulation frequency with the cursor will be a slow process. You may turn the Demodulation off by pressing the CW/SWEEP key once. To turn the Demodulation back on, return to the F4 menu.

**BATTERY MENU** – Use either ▶ arrow key to opens a sub-menu of items in the Battery Menu. The Battery Menu item at this menu level will display the estimated time remaining as > X.X Hrs remaining. This is also shown in the Battery Menu.

```
BATTERY PARAMETERS
UP/DOWN⇄ MOVES CURSOR. F1=ESCAPE
LEFT/RIGHT⇄ TO CHANGE
ENTER RESUMES NORMAL OPERATION

-> BATTERY SAVER      : OFF
   BATTERY TYPE      : NIMH NIMH
   BATT. CAPACITY    : 2000 MAHR
   EST. RUN TIME     : >2.7 HRS
   BATTERY STATUS    : 10.2V - 170MA
   BATTERY TEMP.    : TEMPERATURE OK
   CHARGER STATUS    : IDLE
```

To view the Battery Menu screen above Press the F4 key, then ▼ to select BATTERY MENU and press any ▶ key.

**Battery Saver:** Has two settings, ON or OFF. Use any ◀▶ key to switch between the settings. On will power down the VIA ECHO if no key is pressed in approximately 5 minutes.

**Battery Type:** Permits selecting between NONE, ALKALINE or NIMH NIMH cells. “Alkaline” MUST be selected if carbon or alkaline cells are place in the unit or damage to the VIA ECHO and/or cells may result.

**Batt. Capacity:** This setting is required when new rechargeable batteries are installed to ensure the optimum recharge and operational times. This will also make the estimated run time more accurate. The mAhr rating for NiMH or NiCd cells is specified on the



manufacturer's packaging and should be set to exactly what the manufacturer states. Setting the capacity higher or lower than the manufacturer's specifications will degrade performance rather than enhance it. To set the mAh's, press any ◀▶ until the reading matches the manufacturer's specification. Range is 400 to 5300 mAh's.

**Est. Run Time:** Calculated by the charger based on amount of charge in cells. New cells may require several charging/discharge cycles for charger to synchronize with the cells and make the estimate accurate.

**Battery Status:** Displays the voltage and charging (positive) or discharging current (negative). Normal voltages for the cells will range from 8.8 to 12.5. See the Battery Current Table for it's indication. NOTE: It may take 20 seconds after a power change (pwr ON, plugging in external pwr, etc.) for correct status values to display.

**Battery Temp:** If the batteries are too hot or cold they can not be charged. The charger reads their temperature constantly and adjusts for temperature changes. See the Troubleshooting Table for temperature related symptoms.

Charger Status: IDLE = No DC input power, alkaline cells detected or cells are already at full charge - charging will not start.

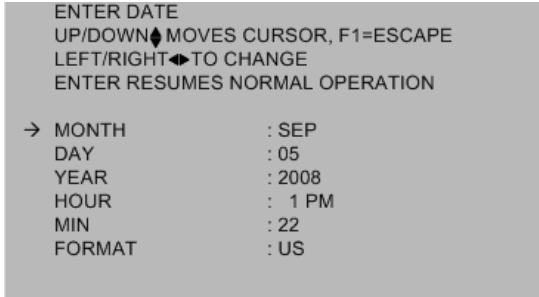
BATT CHK = Charger is checking batteries' condition

PRE CHRГ = Conditioning Charge

CHARGING = Normal Charging

TRICKLE = Batteries fully charged and being sustained

**DATE/TIME** – Displays the current date and time. If this display is not correct, press any ▶ key to enter the correct date and time.



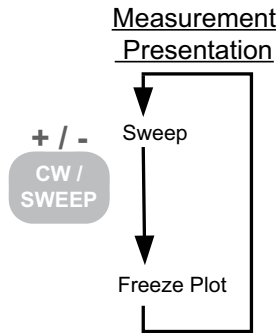
In this menu use the ▲▼ arrow keys to move between the items and ◀▶ arrow keys to cycle the Month, Day, Year, Hour or Minutes until the correct setting is reached. FORMAT – Refers to the time format and has two settings: US and METRIC. Set to US, time will appear with AM or PM, set to metric, time will appear in 24 hour format. Use ◀▶ to switch between US and metric.

NOTE: The Date and Time will continue to function for ONLY 60 seconds during a battery change. Be sure you have the fresh batteries ready to insert and move quickly when removing the old cells. If you exceed the 60 seconds, turn the unit back on with fresh cells and return to this menu to reset the Date and Time. If the batteries are fully discharged, the date and time is lost and will need to be re-entered.

## Measurement Screen Direct Controls

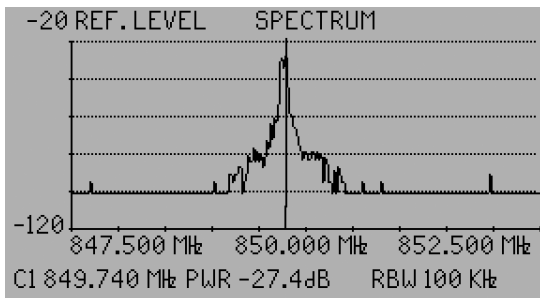
The direct controls refers to managing the Measurement Screen without having to go to the menus. The VIA Echo has been designed to place as much control as possible at the user's finger tips while in the Measurement Screen. To accomplish this, the Action Key group all have multiple functions as described in Section 2. Some keys actions changes depending on the mode selected by other keys (example: Pressing the **ENTER** key to activate the Cursors changes the action of both the **WIDTH** and **FREQ** keys to **CURSOR 1** and **CURSOR 2** respectively.

**CW/SWEEP** Key – In the Spectrum Analyzer's Measurement Screen, this key controls the Measurement Presentation by cycling between Sweep and Freeze Plot. See figure 4-2. The selected Measurement Presentation can be identified by looking at the Measurement Screen. See figures 4-3 and 4-4.



**Figure 4-2**

Spectrum Analyzer Measurement Screen Presentation in SWEEP



**Figure 4-3**

Spectrum Analyzer Measurement Screen Presentation in FREEZE PLOT

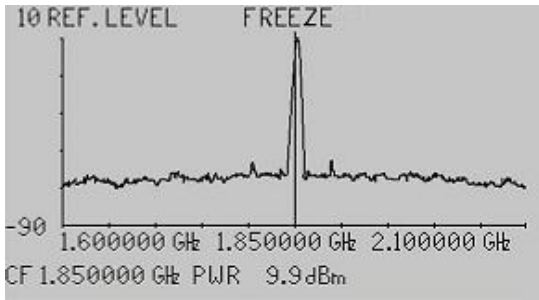


Figure 4-4



When the **CW / SWEEP** has the Measurement Presentation set to Sweep or Freeze, the ENTER key can cycle the Measurement Mode between Center Frequency, Cursor 1, Cursor 2 or Cursors  $\Delta$ . See figure 4-5 for the cycle sequence.

### Measurement Mode

Change Display Reading  
By Cycling

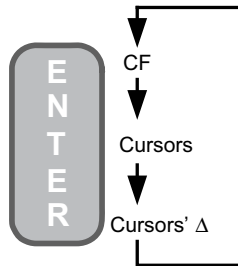


Figure 4-5

Measurement Screen in Sweep Presentation and Center Frequency Mode. The readings on the bottom line “CF” are at Center Frequency as shown in figures 4-3 and 4-4 above. Press the

ENTER key cycles to the Cursors and pressing CURSOR 1 will change the reading to that at Cursor 1's position on the Span. See figure 4-6.

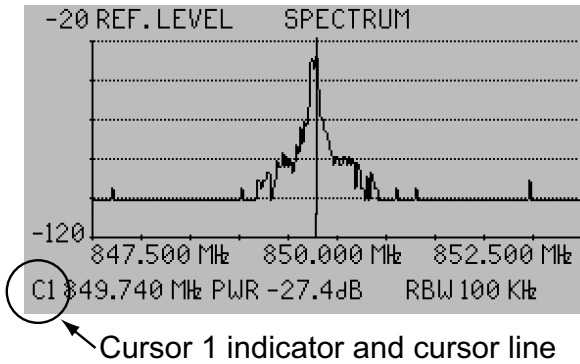


Figure 4-6

Measurement Screen in Sweep Presentation and Cursors Mode. The readings on the bottom



line "C1" are at Cursor 1's position. The CURSOR 1 WIDTH key is now in control of Cursor 1 and the data will change with its movement.



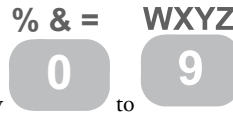
Pressing CURSOR 2 FREQ will activate the second cursor and the information on the screen's bottom line will change to "C2" data. Repeating CURSOR 1 will return the information to "C1" data.



Pressing the ENTER key again will change the Measurement Mode to Cursors' Δ. The bottom line of data will now reflect the difference or delta between Cursor 1 and Cursor 2 as indicated by the "C Δ" preceding it.

## Measurement Screen Direct Controls of Frequencies

Whenever the Measurement Screen is present, the VIA Echo permits changing the Center Frequency (CF), Frequency Steps, and Sweep Span Width via the Alpha-Numeric keypad and the use of the ENTER, WIDTH and FREQ keys.



To activate these Direct Controls press any key to the left of the Alpha-Numeric keypad. The Direct Control screen shown in figure 4-7 will appear.



Figure 4-7

Use the Alpha-Numeric keypad to enter either a new Center Frequency (CF), a new Sweep Span Width or a new Step Size. The numeric value will displayed in MHz (.500 = 500KHz,

1.000 = 1MHz, 1000.000 = 1GHz, etc.) Use the **F1** key to erase a mis-entered

number. Use **F5** key to escape without making a change. The range for setting these values is:

### Center Frequency

VIA Echo 2500	Range 4MHz to 2.5GHz
VIA Echo 1000SF	Range 4MHz to 1.0GHz
VIA Echo MRI	Range 4MHz to 1.0GHz

### Steps

< 1.1GHz	Range = Any multiple of 1kHz
> 1.1GHz	Range = Any multiple of 10kHz

### Sweep Span Width

VIA Echo 2500	Range 0Hz to 2.5GHz
VIA Echo 1000SF	Range 0Hz to 1.0GHz
VIA Echo MRI	Range 0Hz to 1.0GHz

**NOTE:** Setting Sweep Span to zero changes the display to Continuous Wave (CW) Presentation.

Once the desired frequency value has been entered, press one of the following:



to set the new Center Frequency (CF)

### CURSOR 1



to set the new Sweep Span Width

### CURSOR 2



to set the new Step size

**NOTE:** The Center Frequency (CF) and Sweep Span can be initially set in the F3 menu, but the Step size can only be set by using the Measurement Screen Direct Controls. The Step size will remain at whatever value was last set regardless of other frequency changes.

## 5. Frequency Domain Reflectometer (FDR)

The Frequency Domain Reflectometer (FDR) is designed to provide the user with information concerning the electrical length of a cable and distance to reflective events. The user enters the center frequency (CF), the total distance to display and the velocity factor of the cable. The FDR calculates the Sweep Width (displayed as  $\Delta F$ ) from this information. The FDR gathers Return Loss and converts it into distance information. As with all FDR's, some restrictions apply to the selection of center frequency and displayed distance. See the "Center Frequency vs Plot Length" chart (Figure 5-10) at the end of this section. Alternatively, the FDR plot can be displayed in SWR mode. See the F3 menu's Vertical Mode to select Return Loss or SWR mode.

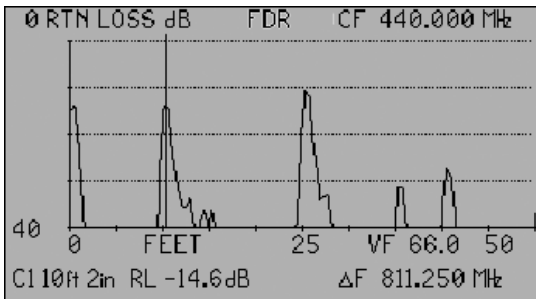


Figure 5-1

### Measurement Setups

First connect the antenna or antenna and feed line the VIA Echo's S11 port.

**F3**

Second, press the **F3** key to make the following basic selections:

**INSTRUMENT MODE:** ► **FDR**

**CENTER FREQ:** – Press any ► key to go to a Center Frequency numeric entry screen. Use the numeric key pad to enter the desired Center Frequency, then press ENTER to accept and return to the F3 Menu. If you make an error during the numeric selection, press the F1 key to erase the last digit entered. If the frequency is NOT in the valid zone for the range selected you will see and an error message momentarily. See the Center Frequency vs Plot Length Chart, Figure 5-10. Adjust either the Center Frequency or the Plot Length to match the valid zone in the chart.

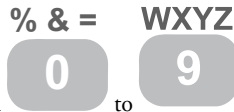
**LENGTH UNITS:** ◀▶ **FEET** or **METERS**

**PLOT LENGTH:** Press any ◀▶ key to go to a Plot Length numeric entry screen. Use the numeric key pad to enter the desired Center Frequency, then press ENTER to accept and return to the F3 Menu. If you make an error during the numeric selection, press the F1 key to erase the last digit entered.

NOTE: Always set this length longer than the cable's estimated length. If you are too short or too long the cable length display can be changed using the WIDTH key on the keypad. It is better to be longer than the cable than shorter. See "Frequency Folding Affect" note.

**VERTICAL SCALE:** ◀▶ to a preset dB level or preset SWR ratio

**CABLE Z<sub>0</sub>:** Press any ◀▶ key to go to the Cable Z<sub>0</sub> numeric entry screen. Use the numeric key pad to enter the desired Cable Z<sub>0</sub>, then press ENTER to accept and return to the F3 Menu. If you make an error during the numeric selection, press the F1 key to erase the last digit entered.



**VELOCITY FACTOR:** Use keypad 0 to 9 to enter three digit velocity. Example: Enter 71.0 for a velocity = .71c, then press ENTER to accept and return to the F3 Menu. If you make an error during the numeric selection, press the F1 key to erase the last digit entered. The Echo will round off the VF to the actual VF the Echo uses. VF can be set to within  $\pm 2\%$ .

**VERTICAL MODE** – The Vertical Scale can be viewed as SWR or Return Amplitude in dB. Press the ◀▶ keys to select the desired method to read the FDR's reflections. After selecting the Vertical Mode, set the Vertical Scale per the mode.



Finally, press ENTER to accept and exit to Measurement Screen.

### NOTE: Frequency Folding in FDR's

A TDR uses the reflection on the leading edge of a pulse or pulse sequence to display the end-of-cable event. It is not frequency or wavelength sensitive. However, an FDR uses inverse FFT to determine the electrical length of the cable and therefore reacts differently if the instrument's maximum length setting is shorter than the actual cable length. This phenomenon is referred to as "Frequency Folding" and here's how it affects the displayed length.

In the first example, figure 5-2, the instrument's length setting is correctly set longer than the 46 foot (14 meters) cable being measured. The electrical end of the cable for the set frequency is approximately 46 feet (14 meters).



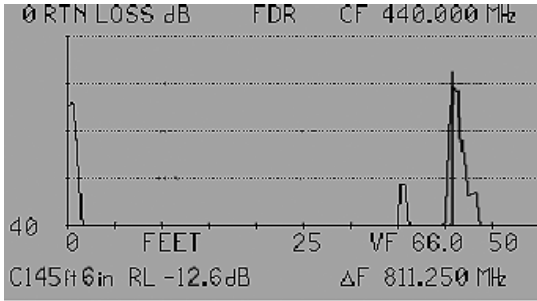


Figure 5-2

In the second example, figure 5-3, the Span length has been set too short for the 46 foot (14 meters ) cable being measured. The FDR will produce an end-of-cable reflection positioned 21 feet (6.4 meters) backward from the Span's maximum range setting 25 feet (7.6 meters).

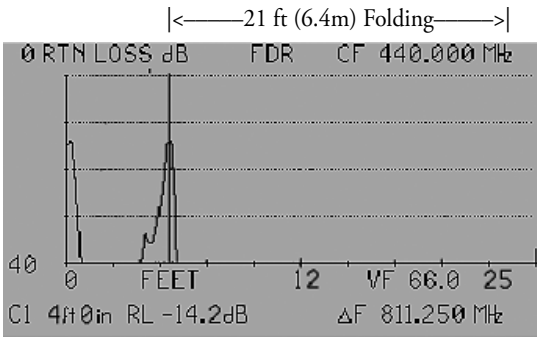


Figure 5-3

Obviously, the end-of-cable and the known estimated length vary too widely for the display to be correct. Opening the span length to 50 feet (15.2 meters) will resolve this false indication.

**F4**

Press key to display the Special Functions Menu.

**VIDEO FILTER** – This menu item sets the Video Filter level from 0 (OFF) to the settings in the following table shown below. Use either ◀▶ key to navigate the levels, then press ENTER to activate and exit to the Measurement Screen.

- 1=1000Hz
- 2= 500Hz
- 3= 200Hz
- 4= 100Hz

**AVERAGING FLTR** – This menu item sets the level of the Averaging Filter in dB. The range is from 0 (OFF) to the settings in the following table shown below. Use either ◀▶ key to navigate the levels, then press ENTER to activate and exit to the Measurement Screen.

- 1= 3dB
- 2= 6dB
- 3= 9dB
- 4=12dB
- 5=15dB
- 6=18dB
- 7=21dB

**SEARCH MODE** – This menu item turns on – Peak or + Peak. Press ◀▶ keys to navigate the selections.

**BATTERY MENU** – Use either ▶ arrow key to open a sub-menu of items in the Battery Menu. The Battery Menu item at this menu level will display the estimated time remaining as > X.X Hrs remaining. This is also shown in the Battery Menu.

```
BATTERY PARAMETERS
UP/DOWN⇅ MOVES CURSOR, F1=ESCAPE
LEFT/RIGHT⇄ TO CHANGE
ENTER RESUMES NORMAL OPERATION

-> BATTERY SAVER      : OFF
   BATTERY TYPE      : NICD NIMH
   BATT. CAPACITY     : 2000 MAHR
   EST. RUN TIME      : >2.7 HRS
   BATTERY STATUS     : 10.2V - 170MA
   BATTERY TEMP.      : TEMPERATURE OK
   CHARGER STATUS     : IDLE
```

To view the Battery Menu screen above Press the F4 key, then ▼ to select BATTERY MENU and press any ▶ key.

**Battery Saver:** Has two settings, ON or OFF. Use any ◀▶ key to switch between the settings. On will power down the VIA ECHO if no key is pressed in approximately 5 minutes.

**Battery Type:** Permits selecting between NONE, ALKALINE or NIMH NICD cells. “Alkaline” MUST be selected if carbon or alkaline cells are place in the unit or damage to the VIA ECHO and/or cells may result.

**Batt. Capacity:** This setting is required when new rechargeable batteries are installed to ensure the optimum recharge and operational times. This will also make the estimated run time more accurate. The mAhr rating for NiMH or NiCd cells is specified on the manufacturer’s packaging and should be set to exactly what the manufacturer states. Setting the capacity higher or lower than the manufacturer’s specifications will degrade performance rather than enhance it. To set the mAhrs, press any ◀▶ until the reading matches the manufacturer’s specification. Range is 400 to 5300 mAhrs.

**Est. Run Time:** Calculated by the charger based on amount of charge in cells. New cells may require several charging/dischARGE cycles for charger to synchronize with the cells and make the estimate accurate.

**Battery Status:** Displays the voltage and charging (positive) or discharging current (negative). Normal voltages for the cells will range from 8.8 to 12.5. See the Battery Current Table for it's indication.

**Battery Temp:** If the batteries are too hot or cold they can not be charged. The charger reads their temperature constantly and adjusts for temperature changes. See the Troubleshooting Table for temperature related symptoms.

**Charger Status:** IDLE = No DC input power, alkaline cells detected or cells are already at full charge - charging will not start.

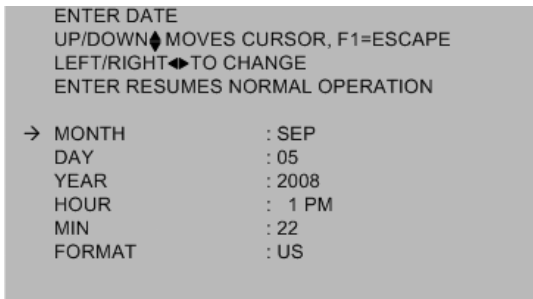
BATT CHK = Charger is checking batteries' condition

PRE CHR G = Conditioning Charge

CHARGING = Normal Charging

TRICKLE = Batteries fully charged and being sustained

**DATE/TIME** – Displays the current date and time. If this display is not correct, press any ► key to enter the correct date and time.



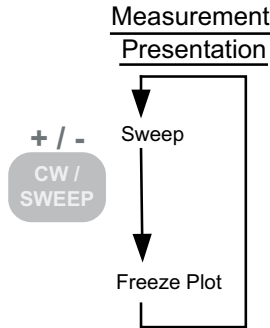
In this menu use the ▲▼ arrow keys to move between the items and ◀▶ arrow keys to cycle the Month, Day, Year, Hour or Minutes until the correct setting is reached.

**NOTE:** The Date and Time will continue to function for ONLY 60 seconds during a battery change. Be sure you have the fresh batteries ready to insert and move quickly when removing the old cells. If you exceed the 60 seconds, turn the unit back on with fresh cells and return to this menu to reset the Date and Time. If the batteries are fully discharged, date and time is lost and will have to be re-entered.

## FDR Measurement Screen Direct Controls

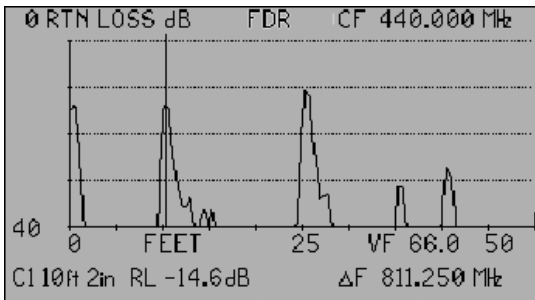
The direct controls refers to managing the Measurement Screen without having to go to the menus. The VIA Echo has been designed to place as much control as possible at the user's finger tips while in the Measurement Screen. To accomplish this, the Action Key group all have multiple functions as described in Section 2. Some keys actions changes depending on the mode selected by other keys (example: Pressing the ENTER key to activate the Cursors changes the action of both the WIDTH and FREQ keys to CURSOR 1 and CURSOR 2 respectively.

**CW/SWEEP Key** – In the Frequency Domain Reflectometer’s Measurement Screen, this key controls the Measurement Presentation by cycling between Sweep and Freeze Plots. See figure 5-4. The selected Measurement Presentation can be identified by looking at the Measurement Screen. See figures 5-5 and 5-6.



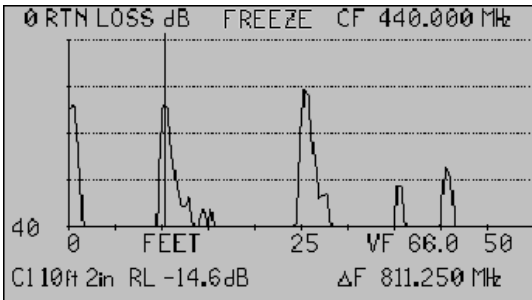
**Figure 5-4**

FDR’s Measurement Screen Presentation in SWEEP mode



**Figure 5-5**


FDR Measurement Screen Presentation in FREEZE PLOT



**Figure 5-6**

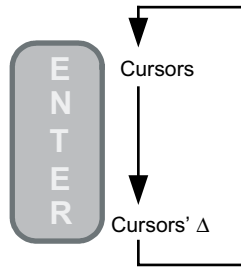
When the plot is in FREEZE mode the plot name, FDR, will be replaced by the word FREEZE. The cursors can still be used to display data about the plot, but the plot itself is locked as what is being displayed.



When the  has the Measurement Presentation set to Sweep or Freeze, the ENTER key can cycle the Measurement Mode between Cursors or Cursors Δ. See figure 5-7 for the cycle sequence.

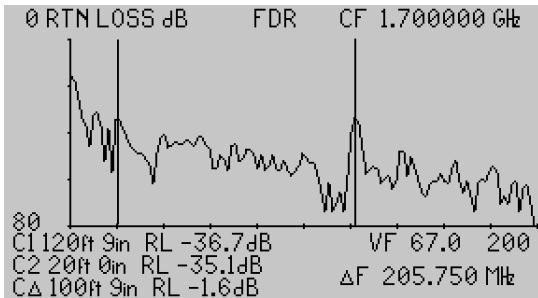
### FDR Measurement Mode

Change Display Reading  
By Cycling



**Figure 5-7**

When in the Measurement Screen and in Sweep Presentation, pressing the ENTER key cycles between Cursors and Cursors Δ presentation. When in Cursors, either Cursor 1 or Cursor 2 will be active and appear on the screen if that Cursor key is pressed. When in the Cursors Δ, both Cursor 1 and 2 will be active and display their data along with the Cursor's Δ readings.



**Figure 5-8**

Measurement Screen in Sweep Presentation and Cursors Mode. The readings on the bottom



line "C1" are at Cursor 1's position. The key is now in control of Cursor 1 and the data will change with its movement.



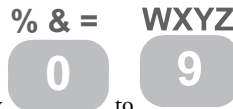
Pressing will activate the second cursor and the information on the screen's bottom line will change to "C2" data. Reprising Cursor 1 will return the information to "C1" data.



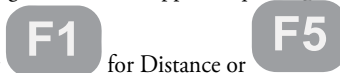
Pressing the key again will change the Measurement Mode to Cursors'  $\Delta$ . The bottom line of data will now reflect the difference or delta between Cursor 1 and Cursor 2 as indicated by the "C  $\Delta$ " preceding it.

## Measurement Screen Direct Controls of Frequencies

Whenever the Measurement Screen is present, the VIA Echo permits changing the Center Frequency (CF), or distance via the Alpha-Numeric keypad and the use of the ENTER, WIDTH and FREQ keys.



To activate these Direct Controls press any key to on the Alpha-Numeric keypad. A dialog screen, figure 5-9A, will appear requesting the desired entry,



Distance or Frequency. Press either for Distance or for Frequency.

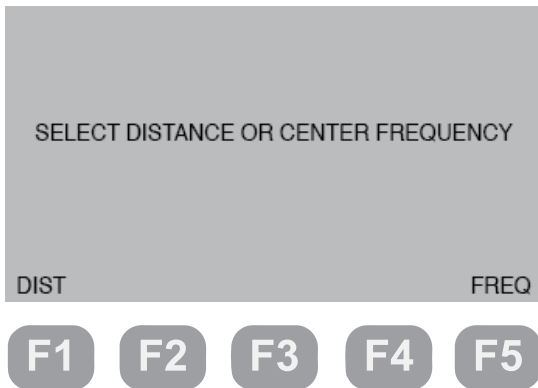


Figure 5-9A



Figure 5-9B

Use the Alpha-Numeric keypad to enter either a new Center Frequency. The frequencies numeric values will be displayed in MHz (.500 = 500KHz, 1.000 = 1MHz, 1000.000 = 1GHz, etc.). Distance entries are in feet or decimal meters. Distance entries may be modified by the

Echo due to synthesizer timing limitations. Use the **F1** key to erase a mis-entered digit.

Use **F5** key to escape without making a change. The range for setting these values is defined in the Center Frequency vs Plot Length Chart, Figure 5-10 at the end of this section.



Once the desired value has been entered, press **ENTER** to set the new Center Frequency (CF), or distance.

**NOTE:** The Center Frequency (CF) and distance can also be set in the F3 menu.

## Center Frequency vs Plot Length

Refer to the chart, figure 5-10, on the following page. The chart plots the maximum cable length being tested to the minimum Center Frequency (CF) that can be used for that length of cable. The Center Frequency range and Plot Lengths permitted are limited by the upper and lower frequency limits of the VIA Echo. Additionally, the cable's velocity plays a role in the minimum frequency that can be used. The chart shows three typical velocities plotted.

NOTE: See paragraph concerning "Frequency Folding" earlier in this section. Too short a plot length can result in "Frequency Folding".

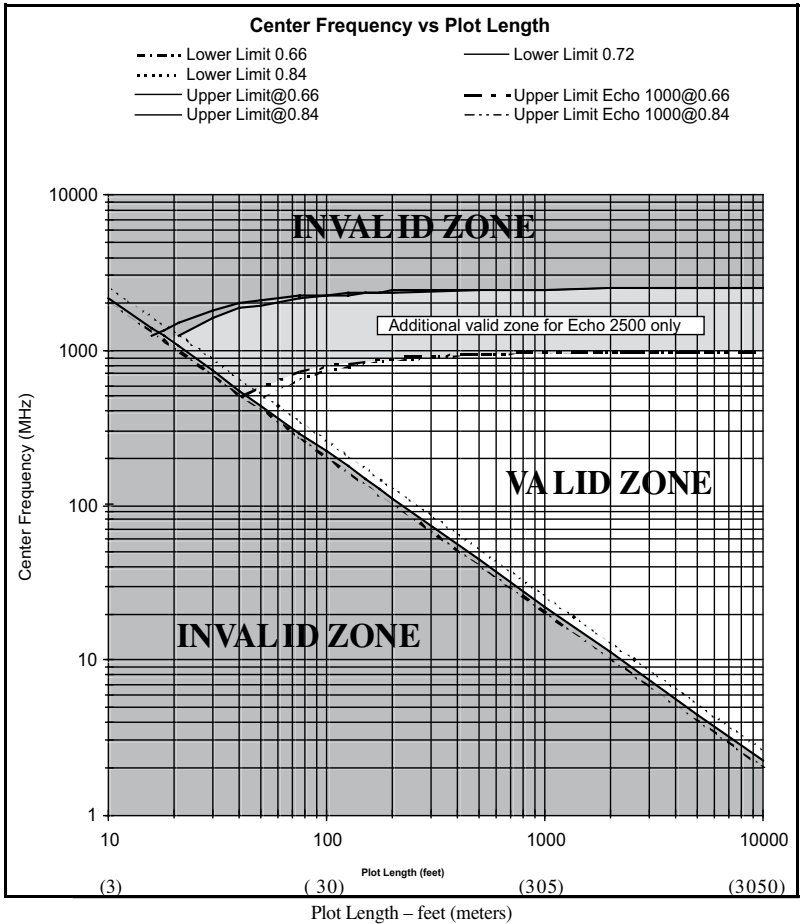
**Plot Length** – Shown in feet and meters and measured on the X axis refers to the selected display range. The selected Plot Length should always be longer than the cable's actual length or if unknown, its estimated maximum length. Although plot lengths to 30,000 feet (10,000 meters) can be selected, the nominal maximum recommended testing range is 10,000 feet (3,050 meters).

**Center Frequency** – Shown in MHz on the chart's Y axis. When the VIA Echo's FDR display range is selected and a Center Frequency CF entered the VIA Echo will check to ensure the CF and its calculated testing span will fall within the "Valid Zone" on the chart, figure 5-10. It will assume the cable is shorter than the selected display length and present a warning if a center frequency CF and its testing span are unacceptable for the Plot Length selected.

NOTE: If this warning is disregarded, the display maybe distorted and false information may appear concerning the cable's capability.

**Velocity** – Three typical cable velocities, 0.66c, 0.72c and 0.84c are displayed on the chart to show the effect velocity has on the cable's valid center frequency. Each is represented by a different type of line as shown in the legend box at the top of the chart.





e.g. For a center frequency of 100 MHz, the minimum allowable plot length would be approximately 250 ft.

**Figure 5-10**

**NOTE:** Performing an FDR test on shorter cables requires applying a wider differential frequency to obtain valid test results. See explanation in Application Note “AN205 FDR Comparison to TDR” on the enclosed CD or AEA Technology’s web site. The minimum distances shown in the chart above are based differential frequencies programmed in the VIA Echo. However, a shorter cable than the plot length can be clearly measured on the FDR plot display, particularly with plots uploaded to Echo PC Vision. For example: Because it is a log graph, the graph’s minimum distance is 10 feet (3 meters). To view a cable less than this length requires a longer plot range. This cable can still be seen clearly on plot ranges of 30 feet (10 meters) with a center frequency as low as 700MHz. At that center frequency the VIA Echo needs to apply a frequency differential of 1.213GHz, which will actually test the cable across the frequency range of 93.75MHz to 1.306GHz.

## 6. Saving and Recalling Plots in Memory

### General

The VIA Echo can save Vector Impedance Analysis (VIA) plots, Spectrum Analysis (SA) plots and Frequency Domain Reflectometer (FDR) Traces. It does not save Continuous Wave (CW) screens or Power Meter screens. To save the data from a specific frequency, select that frequency as the center frequency and set up the desire sweep span. All the CW information will be available from the Center Frequency's data points.

When a plot or trace is saved all the following information is saved concerning that file:

#### **Center Frequency**

**Plot Type: VIA, SA or FDR**

**Date/Time: MMM DD YYYY 12:00am(pm)**

Plot or Trace name entered at the time of the Save

All instrument set ups

VIA Sweep Span, SA Span or Distance for FDR

All the measurement data for the S11 port IF at least one S11 port measurement parameter was selected for plotting.

All the measurement data for the S21 port IF at least one S21 port measurement parameter was selected for plotting.

The bolded items appear in the RECALL menu list and can be used to sort the saved plots.

Plots or Traces can be recalled by scanning the entire list in the memory sorted by the first three categories shown in bold above, or by sorting and showing only one of the categories at a time. In other word, the user can select to look at only VIA plots or only plots dated on a single specific date. There are several levels of sort that can be performed to find the plot or plots desired.


The memory can hold up to 250 plots or traces. When all 250 memory slots are used the VIA Echo will overwrite the oldest plot or trace stored.

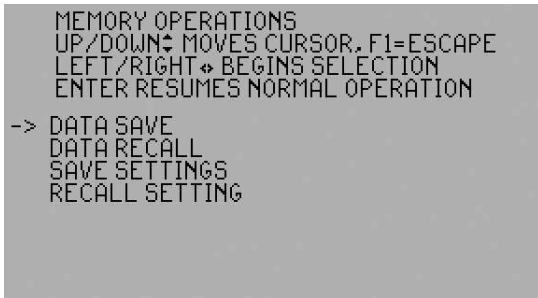
NOTE: AEA Technology uses a non-volatile memory to save plots and offer the highest degree of their protection in the event of battery failure. However, whether you save plots frequently or occasionally, it is highly recommended to make regular uploads to a PC using Echo PC Vision software. This back up will preserve the plots and traces to a secondary storage media.

### Saving a Plot

When you save a plot to memory you will also save all the instrument set-ups at the time of the save. When the plot is recalled later it will re-establish the instrument to the configuration at the time the plot was saved.

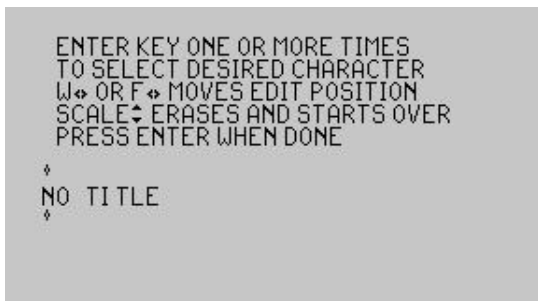
A dark grey rounded square button with the white text "F5" inside.

Press the  key to open the Memory Operations Screen as shown in figure 6-1



**Figure 6-1**

Next press any ► key to enter the Data Save Screen shown in figure 6-2.



**Figure 6-2**

Next enter a title for the plot you are about to save using the keypad similar to text entry on a cell phone. Press the desired key once for the number shown on the key, press the key twice for first character above the key, three times for the second character, etc. The key will cycle through the characters and return to the number with successive presses of the same key.

Use either ◀▶ keys (Width or Freq) to move the cursor left or right respectively and the Scale key's ▼▲ key to erase the entire title and start over. To erase just one character, cycle




the key to the “Space” character between the period and the comma (three presses on the key). The title does NOT appear in the memory sort windows (process of reducing sort list size) when viewing the sorted list (to select the desired plot). The titles also appear in the selection list in the Echo PC Vision software.

When the title is complete, press the ENTER key to save the plot. All plots are saved in the next available memory slot. There are 250 memory slots. When all 250 memory slots are full the Echo will go back to memory slot 1 and start the saves by overwriting the plot previously stored in that slot. This makes it important to upload and save plots regularly using Echo PC Vision. They are safer from accidental erasure stored on you PC’s hard drive.

## Recalling Saved Plots

**NOTE:** When recalling a saved plot all the instrument settings you are currently using will be changed to the instrument settings used when the plot was saved. If you wish to return to your current settings, save the current plot and recall it after you are done reviewing the saved plot. This will restore the VIA Echo to your current setting.

Press the  key to open the Memory Operations Screen as shown in figure 6-3

```
MEMORY OPERATIONS
UP/DOWN↕ MOVES CURSOR, F1=ESCAPE
LEFT/RIGHT↔ BEGINS SELECTION
ENTER RESUMES NORMAL OPERATION

-> DATA SAVE
   DATA RECALL
   SAVE SETTINGS
   RECALL SETTING
```

**Figure 6-3**

Scroll down to DATA RECALL and press any ► key to enter the Data Recall Screen shown in figure 6-4.

```
SORT LIST HAS 45 ITEMS
SELECT SORTING PARAMETER
THEN PRESS ENTER OR ↔

-> VIEW THIS LIST
   CENTER FREQ
   PLOT TYPE
   DATE/TIME
```

**Figure 6-4**

Since the VIA Echo can store up to 250 plots sequentially, the Data Recall screen permits viewing the entire list of stored plots or reducing the list by one or more parameters to pare the list down to only plot(s) of interest.

**VIEW THIS LIST** – Press either ► key, with no sorting parameter's selected, will present the entire list of stored plots in chronological order. The list will have the earliest stored plots at the top of the list and the latest stored plots at the bottom of the list and will display the list showing the latest plots stored. See figure 6-5

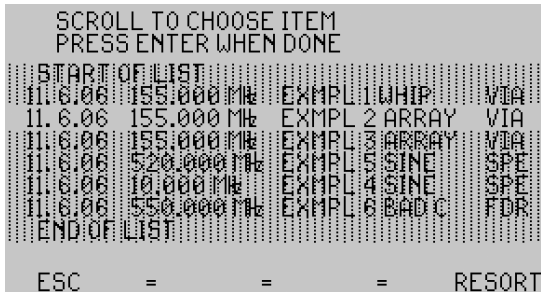


Figure 6-5

**CENTER FREQ** – Press either ► key to view the list of stored plots by Center Frequency (CF) with the lowest frequency plot saved at the top and the highest frequency plot saved at the bottom of the list. Once the list is presented you will be given sorting options using the F2 through F5 keys. The options appear at the bottom of the LCD screen and correspond to the F key located directly below the option.

**PLOT TYPE** – Press either ► key to view the list of stored plots by Plot Types. The List will start with VIA Plots in the following order S11, S21 and 2 PORT (S11 & S21) plots, then SPECTRUM ANALYZER, and finally FDR plots.

**DATE** – Press either ► key to view the list of stored plots by Date and Time. The list will display the date and time from the latest plot saved to the oldest plot saved from the top to bottom of the list respectively.

F5

To repeat the process and sort on a second or third recall field press the **RESORT** key. This will return the display to the Data Recall Screen, figure 6-4. Now select another category to sort on. This will limit the list to the categories selected. See the more detailed description about RESORT in the Memory List Screen's Soft Keys.

## Memory List Screen's Soft Keys

When in the memory lists, the F-Keys work as soft keys and correlate to the action items shown in the bottom row of the LCD. See figure 6-5.

**ESC** – Escape. Pressing F1 will exit the Memory Recall mode back to the Measurement Screen

**=** – Equals. This selects the highlighted plot on the display. The equals sign will appear on multiple F-Keys if no other sorting choices are available

**≤** – Equal to or less than. This option appears in the Frequency and Date/Time sorting screens to permit reducing the list to be viewed. By highlighting the highest frequency or latest date/time on the list you wish to look for and pressing the F2 key, the list will be reduced to only those Frequencies or Date/Times equal to or less than the plot highlighted.

>= - Equal to or greater than. This option appears in the Frequency and Date/Time sorting screens to permit reducing the list to be viewed. By highlighting the lowest Frequency or earliest Date/Time on the list you wish to look for and pressing the F4 key, the list will be reduced to only those Frequencies or Date/Times equal to or greater than the plot highlighted.

**RESORT** – To repeat the process and sort on a second or third recall field press the F5 key. This will return the display to the Data Recall Screen, figure 6-4. Now select another category to sort on. This will limit the list or reorganize the list to the list already sorted to the categories selected. (Example: The first category sorted was for Plot Type and VIA was selected. However, 70 VIA plots are listed in memory. Press RESORT and select either Frequency or Data Time depending on your sorting preference. If Frequency is chosen, the list will now show the Frequencies from the highest to the lowest for the VIA plots. If Date/Time is selected, the list will now show the Date/Time for the VIA plots and be organized by the latest Date/Time at the bottom and earliest Date/Time at the top.)

The sorting process can be repeated as needed to reduce the list of tests desired to be reviewed for recall.

**DELETING SAVED TEST** - The Echo PC Vision software versions 2010.x and higher have a DELETE TEST feature in the Memory Catalog. After uploading the catalog, saved tests results can be selected and deleted from the VIA Echo's memory. NOTE: This action will permanently delete the selected test results and there is no un-delete feature so be sure any test results marked for deleting have been saved on the PC before using this feature. See the Operator Manual's section 7 for instructions.

## 7. Echo PC Vision

Echo PC Vision software is designed to operate on almost any MS Windows® platform and provide the VIA Echo user with methods to upload, archive, print or reformat VIA plots. It can also be used to operate the VIA Echo in remote control mode and examine the test results in as near real-time mode as the Echo and the USB 2.0 port will permit. Below are some highlights of Echo PC Vision's capabilities:

- Upload current plot or saved plots along with instrument settings
- View VIA plots in either Cartesian (X-Y) Charts or Smith Charts with markers.
- View Spectrum Analyzer and FDR plots on the PC screen.
- Save any of the plots as .EPV files, convert them to BMP, JPEG, GIF or TIFF file formats
- Export them as delineated variables directly into MS Word or Excel files.
- Operate the VIA Echo in remote control mode and view the plots directly as near “real time” as possible on a PC or laptop in full color.
- Customize instrument set ups in the PC and upload them to the VIA Echo

### Installation

Echo PC Vision software can be found on the CD-ROM enclosed with the Via Echo or on AEA Technology's web site at [www.aeatechnology.com](http://www.aeatechnology.com). When looking on the CD-ROM, open the “Echo PC Vision” folder to locate the installation files. Installation can be performed from the CD or by copying the folder's files to a directory on your PC or Laptop's hard drive.

PC recommendations:

Operating System: MS Windows XP or Vista 32 bit PC's or MAC with Windows emulation.  
Free Disk Space: 10MB  
RAM: 384 minimum, 512 recommended  
Communications: USB 2.0

NOTES: 1. Echo PC Vision software is not compatible with 64 bit processor PC's.  
2. Some Windows XP and Vista operating systems do NOT have all the dll files required to operate Echo PC Vision software. If during installation you receive a message that indicates files are missing or if the installation fails to complete properly, exit the SETUP routine and run the “DOTNETFX.EXE” application. This application is included on the CD in the Echo PC Vision folder or can be downloaded directly from Microsoft's web site. DOTNETFX is not on AEA's web site as part of the download because it is a very large file that most people will not require.  
3. Be sure to read the latest README file included with each version of Echo PC Vision to stay updated on the changes and operating system requirements.

### Installation Steps

1. Place AEA Technology's CD in your PC's CD-ROM drive.
2. Use Windows Explorer to view the CD's directory and open the folder labeled “Echo PC Vision Software.” The files in this folder will appear as shown in figure 7-1.



**Figure 7-1**

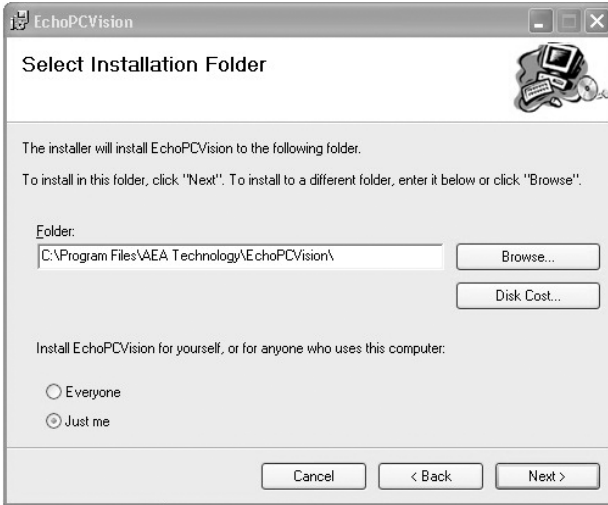
3. Double-click on the Setup file shown in figure 7-1. (Optional is to copy the contents of the “Echo PC Vision” folder or to a directory on your PC hard drive and start the installation from that directory. In either case the results should be a dialog box as shown in figure 7-2



**Figure 7-2**

4. Click on the “Next” key to start the installation. The next dialog box will be a shown in figure 7-3





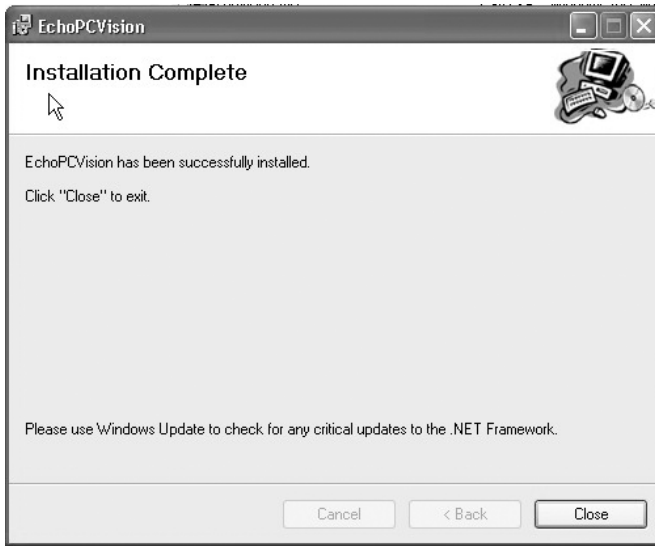
**Figure 7-3**

5. AEA Technology recommends accepting the default installation folder (Figure 7-3), however the Select Installation Folder dialog box offers an option to select a different folder for installation. Enter a folder or click on “Browse” to choose a folder for installation.

The “Disk Cost...” button will display a list of available disks for installation along with the memory space available and the required space for installation.

Select either “Everyone” or “Just Me” depending on your preference as to who should have access to Echo PC Vision on your PC. Everyone will let all logins have access, Just Me will limit access to your login only.

Press the “Next” key when ready to start the installation.



**Figure 7-4**

6. Follow any installation dialog or error messages that may be presented. As successful installation will be ended with the “Installation Complete” box shown in Figure 7-4. Press the “Close” key to exit the installation process.

NOTES: 1. If a desktop icon (shown in figure 7-5) does not automatically appear on your PC, it can be created by using Windows Explorer to locate and open the application in folder: C:\Program Files\AEA-Technology\Echo PC Vision ver x.x. Right click on the file “Echo Vision.exe.” In the menu presented position the mouse on “Send To” and in the sub-menu select “Desktop (create shortcut).”

2. Due to Windows Vista requirements, the default folder, for both Windows XP and Vista, for included demo plots and saving new plots is now MYDOCUMENTS\AEA ECHO FILES.



**Figure 7-5**

## Getting Started

To open Echo PC Vision, double-click the desktop icon. If the VIA Echo is connected via the USB port, turned on and at any measurement screen Echo PC Vision will automatically establish communications with the instrument. If the VIA Echo is not attached or is attached and OFF or ON, but in the Menus, Echo PC Vision will present a communications error dialog box. If the desire is to work only with archived plots, select “Ignore” and Echo PC

Vision will open with no options available from the VIA Echo. This permits working with plots already stored on the PC or a CD. All the plot saved in original format will be labeled as .EPV files. AEA Technology files (AEA or EPV) can only be opened using AEA Technology's appropriate PC Vision software. This is dependent on the instrument used. Use Bravo PC Vision to open VIA Bravo files. TDR PC Vision to open 20/20 TDR traces and use Echo PC Vision to open VIA Echo files.

All the screens needed to operate Echo PC Vision and the VIA Echo are available through the tabs shown along the top of the Echo PC Vision window. See Figure 7-6. Clicking on the desired tab will open a customized screen for uploading, working, storing or exporting VIA Echo plots.

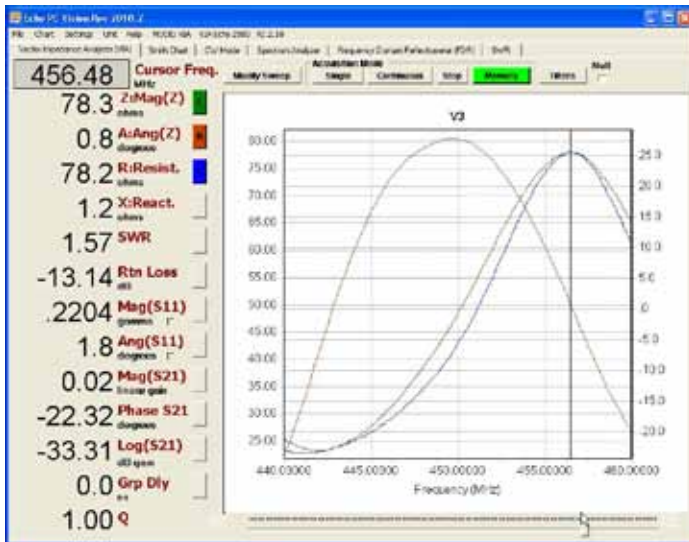


Figure 7-6

## Vector Impedance Analysis (VIA) Mode Screens

### VIA Tab

The tab or screen is divided into three distinct areas. Numerical Data, Graphical Data and Control Actions. The graphical data presentation can be modified by using the Chart and/or Settings Menu items. See the Menu Bar instructions later in this section.

### Numerical Data

**Cursor Freq – Cursor Frequency.** All the other readings and calculations presented in the Numerical Data column are based on the Cursor Freq reading. When data is first acquired the Cursor Freq will be at Center Frequency (CF). Moving the slide bar at the bottom of the tab will move the cursor left or right of the Center Frequency and all the numerical data will change correspondingly. **Note: Moving the cursor does NOT change the Center Frequency or Sweep frequency. It only changes the point in the sweep at which you are displaying**

**numerical data. To change the actual Center Frequency or Sweep Frequency use the “Modify Sweep” button.**

**Z:Mag(Z) – Impedance.** Measured in Ohms. The impedance of the antenna or device under test should match the design of the system at the center or resonant frequency. Impedance is the combined effect of resistance and reactance.

**A:Ang(Z) – Impedance Angle.** ArcTangent angle of the reactance vs resistance ratio expressed in degrees.

**R:Resist. – Resistance.** Measured in Ohms. This test measures the series or parallel resistive component of the antenna and/or feed line. Resistance is the property of resisting or impeding the flow of AC and DC signal current.

**X:React. – Reactance. Measured in Ohms.** Reactance is the property of resisting or impeding the flow of AC current that is not accounted for by Resistance in an antenna or device under test. There are two types of reactance, inductive and capacitive. Inductive is denoted by a positive reactance, and capacitive is denoted by a negative reactance.

**SWR – Standing Wave Ratio.** Usually, SWR is defined as the ratio of the maximum radio-frequency (RF) voltage to the minimum RF voltage along the line. The SWR has to be at an acceptable level across the frequency band. 1:1 is considered the ideal reading but is not usually attainable.

**Rtn Loss – Return Loss.** Measured in decibels (dB). There is a direct relationship between Return Loss and SWR. Return Loss is the amount of signal reflected back towards the transmitter expressed in decibels (dB).

**Mag(S11) – Gamma Magnitude.** S11 port reflected amplitude expressed as a fraction of the incident amplitude.

**Ang(S11) – Gamma Angle** – S11 port reflected signal angle measured in degrees.

**Mag(S21) – Linear Gain** – S11 to S21 ports path gain (loss) expressed in volts per volt.

**Phase S21 – Phase Gain** – S11 to S21 port path phase delay in degrees.

**Log(S21) – S11 to S21 ports path gain (loss) expressed in dB.**

**Grp Del - Group Delay** – S11 to S21 ports path delay expressed in units of time.

**Q** – The Q is computed at -3dB off the peak reading for topmost measurement parameter selected for graphical presentation from the list above Q. If Z:Mag (Z) is selected that will be the peak reading used. If R:Resistance is desired for the Q measurement, select R:Resist. and deselect Z:Mag (Z) and A:Ang(Z).

## Graphical Data

The graph is capable of displaying from 1 to 12 plot parameters each with their own color code. See the legend at the right of the graph for color translation. To select the parameter(s) to be plotted, click the blank button(s) to the right of the desired parameter(s) located between the numerical data and the graph. The button will change to the color code of the parameter on the graph and will indicate an “L” or “R.” L indicates the plotted parameter’s vertical scale is on the Left side of the graph and R indicates the plotted parameter’s vertical scale is on the Right side of the graph. The vertical scale’s side of the chart and other plot parameter information can be changed using the “Chart” menu and “Enable Plots” described later in this section.

## Zoom/Un-Zoom on Graphs

To zoom in on an area of interest on the graphs use the mouse to define a rectangle as follows. Select the start point at the upper left corner, left click the mouse, hold and drag to the lower right corner, then release. The graph will expand (Zoom) on the defined rectangle. To Un-Zoom, left click the mouse on the lower right corner of the rectangle, hold and drag it to the upper left corner. The expanded rectangle will collapse and restore the original graph. This feature works anywhere on the graph for any size rectangle defined.

## Control Actions

**Modify Sweep** button opens the Modify Sweep window shown in Figure 7-7. The Modify Sweep button is only active when the Data Source button is Active (green). The Sweep for Archived files or VIA Echo’s Memory plots can NOT be modified. This button will appear grey when Archived or Memory plots are presented.

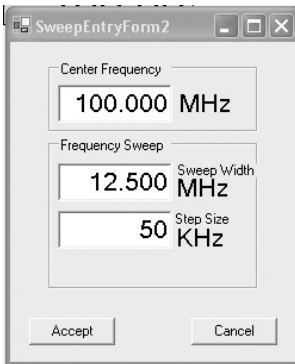


Figure 7-7

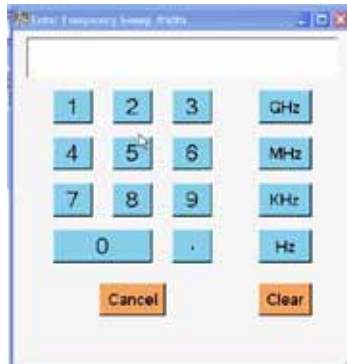


Figure 7-7A

To change the Center Frequency, Sweep Width, or Step Size click on the numeric window and use the on screen keypad (figure 7-7A), or your keyboard’s numeric keys. Then click on GHz, MHz, KHz, or Hz button to complete each numeric entry. When all parameters desired are set, click on the **Accept** button to use the changes or **Cancel** button to return to the prior settings. NOTE: Exceeding the instrument’s maximum frequency for Center Frequency will result in an error message. The Sweep Width and Step Size have limits varying with Center Frequency and may automatically adjust if input selection exceeds those limits.

## Data Acquisition

The buttons shown in Figure 7-8 determine how the data will be uploaded to the PC and presented.



Figure 7-8

**Single** – When the Single button is pressed the Echo PC Vision will upload one snap-shot of the data from the VIA Echo. The button will turn green indicating the presentation is a single look at the sweep data. The presentation will be all available data as the test was set up in the Echo. In other words, if no S21 port test was selected then no S21 port data will be present. If filters were selected then the filter button will also turn green indicating they are ON.

**Continuous** – When the Continuous button is pressed it will start the upload of a continuous flow of sweep data to Echo PC Vision. The button will turn Green to indicate the acquisition mode is active. To stop the continuous flow of data press the green Stop button. This will freeze the Echo PC Vision's presentation with the last complete string of uploaded data. To restart the continuous flow of data press the Continuous button again. **NOTE: When the Continuous button is green you are locked from changing tabs and many other actions to permit Echo PC Vision and the PC to maintain the presentation to as close to real-time as possible.**

**Stop** – Use this button to turn off the continuous flow of data.

## Data Source

The two buttons shown in Figure 7-9 are used to determine if the data being presented will be Active data from a current instrument reading or Memory data from a plot stored in the VIA Echo's memory.



Figure 7-9

**Active** – Pressing the Active button will disable the presentation of any plot from the VIA Echo's memory. The button will turn green indicating any presentation is current readings, with an Acquisition Mode of either Single or Continuous.

**Memory** – Pressing the Memory button will open a list of plots stored in the VIA Echo's memory. See Figures 7-10A and 7-10B. The Memory button will turn green indicating the presentation you are about to select or have selected is from the VIA Echo's memory as opposed to active current measurements. When plots from memory are being recalled and presented the Modify Sweep, Single and Continuous buttons are not usable.

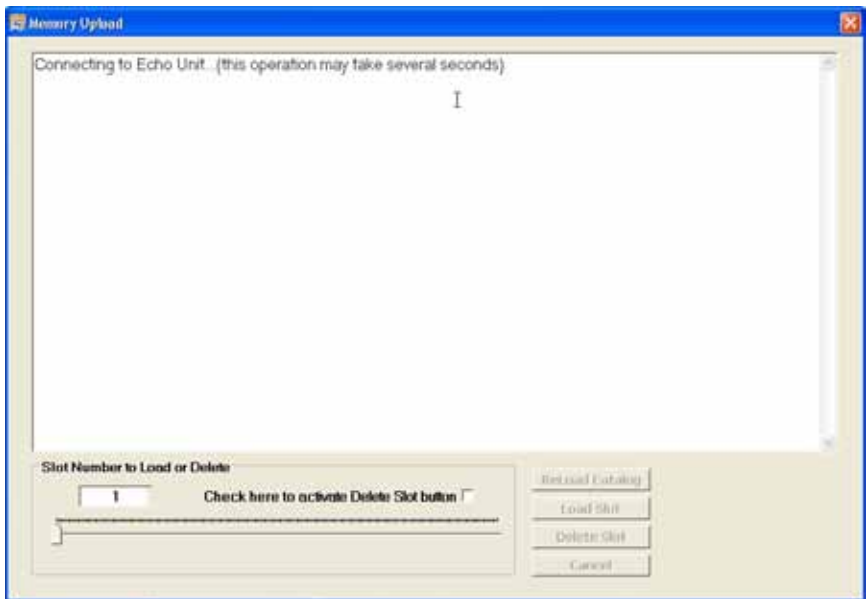


Figure 7-10A

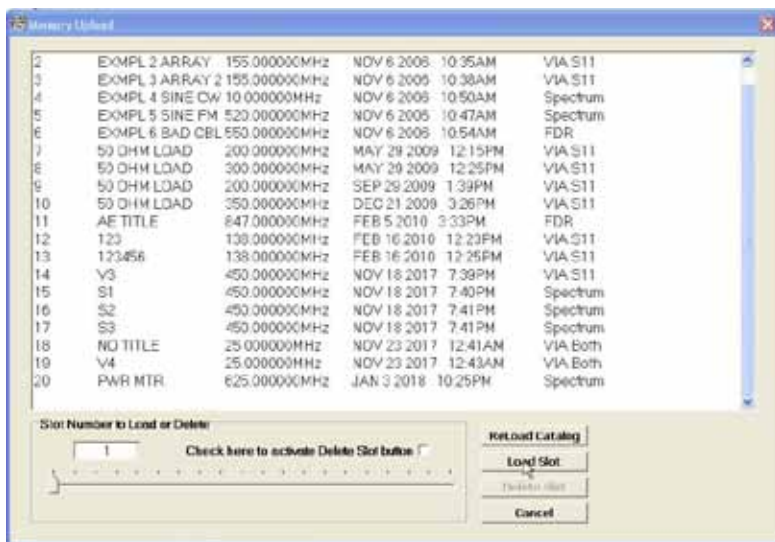


Figure 7-10B

The first time the VIA Echo’s memory list is uploaded to Echo PC Vision it will remain temporarily saved in Echo PC Vision. Successive pressing of the “MEMORY” key will recall the uploaded list. Either of two actions will clear the list and require it be reloaded:

1. Disconnecting the VIA Echo from the PC.
2. Closing Echo PC Vision software.

**Reload Catalog** – Click on this button to refresh or reload the Memory Upload list from the Echo connected to the PC. This only needs to be done if a test has been saved in the Echo memory after this list was uploaded.

**Slot Number to Load or Delete** – Use the slide bar to select the saved test desired on the Memory Upload list by memory slot number. Slot numbers are shown in the left-most column.

**Load Slot** – Click on this button to execute the memory slot retrieval

**Delete Slot** – First click on the check box to make the Delete Slot button active. Then press to delete the selected memory slot in the VIA Echo’s memory. **CAUTION** – THERE IS NOT UNDELETE FEATURE. BE SURE THE MEMORY SLOT YOU DELETE HAS BEEN UPLOADED AND SAVED ON THE PC OR IS COMPLETELY UNWANTED. Memory slots numbered higher than the one deleted will now re-assigned in the memory slot list.

**Cancel** – Click on cancel to exit and return to the last measurement tab opened.

**Filters** button, figure 7-11, opens the Filters menu shown in figure 7-12. The Filters button will turn green indicating one or more filters has been selected. When a stored plot is presented either from Archived Plots or from the VIA Echo’s memory, and filters were on at the time of testing the Filters button will turn green and opening the filters menu will display the filters that were on.

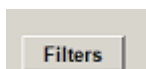


Figure 7-11



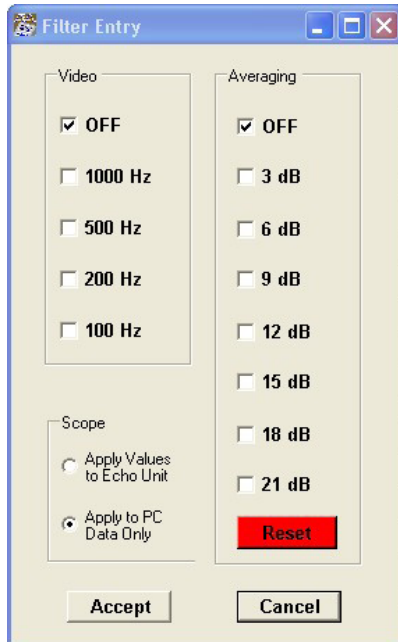


Figure 7-12

**Filters Menu** – This menu serves two purposes:

1. When the Data Source is Active and Single or Continuous Data Acquisition is to be selected Filters can be selected in this menu and can be applied at the VIA Echo or in the PC Vision plot only by user selection under **Scope**.
2. When an Archived or VIA Echo memory plot is presented this menu will display the filters used at the time the readings were taken. In this second application the Averaging Filter is locked and can not be changed on archived data.

## Pull Down Menus

**File Menu** – as shown in Figure 7-13

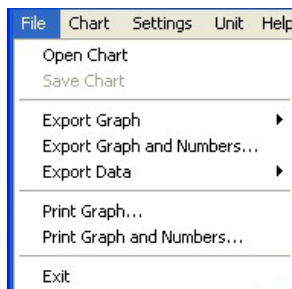


Figure 7-13

**Open Chart** – Offers standard Windows Open File options. Use this menu item to retrieve previously saved charts on the PC or on a CD.

**Save Chart** – Offers standard Windows File Save options. Files will save with the default (\*.EPV) extension unless otherwise specified. The default folder for AEA Technology demo files and saving plots is My Documents\AEA Echo Data for both XP and Vista operating systems.

**CAUTION: Only the last plot read is available for saving. If you desire to archive a plot, this MUST be accomplished prior to reading another plot from the VIA Echo. A similar caution applies to resaving archived plots.**

**Export Graph** – Sub-menu offers exporting the graph ONLY (no cursors or parameters data) in BMP, JPEG, GIF or TIFF format. Graph information includes all information contained in the white graphical section of the selected tab.

**Export Graph and Numbers** – Opens a “SaveAs BMP” sub-window to save the graph, left and right scales, cursor position and readings in the numerical data. If the cursor is not enabled the numerical data will be for center frequency.

**Export Data** – Sub Menu offers exporting the graph and cursor’s parameter data as delimited text, Excel, HTML, or XML format.

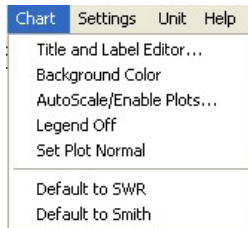
**Print Graph** – Prints the graph with left and right scales and show cursor position.

**Print Graph and Numbers** – Prints the graph, left and right scales, cursor position and cursor’s parameter readings as shown to the left of the graph.

**Exit** – Exits plot display.

## Chart Menu

The Chart menu, figure 7-14, provides controls to set which test parameters to display, option to add or amend the title and presentation control over the plot.

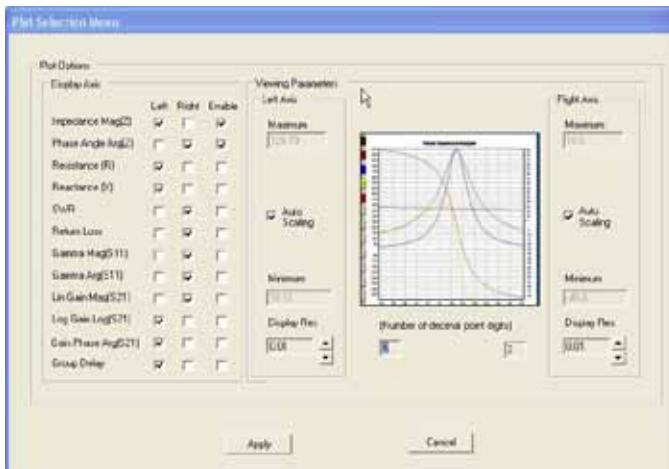


**Figure 7-14**

**Title and Label Editor** – Opens a sub-window that permits typing a title or label on the chart.

**Background Color** – Opens a color pallet for choosing a background. Since all the graphic plots are in different colors, be careful not to choose a background that causes one or more plots to disappear in the background.

**AutoScale/Enable Plots** – Opens a sub-window “Plot Selection Menu” Figure 7-15 that permits turning AutoScaling on or off, selection of which test parameters will be plotted and on which side of the chart their scale will appear. It also permit adjusting the left or right scales and their resolution for a custom appearance.



**Figure 7-15**

**Legend Off/On** – Permits hiding or exposing the plot legend. Hiding the legend will make the chart larger.

**Maximize/Minimize Plot** – Maximizing the plot will cover the numerical data display to the left of the chart. In minimize, both the numerical display and the chart will be displayed.

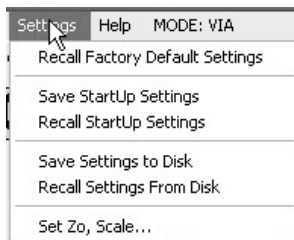
**Default to SWR** – Automatically opens the SWR tab when a test result is uploaded or when Echo PC Vision is opened.

**Default to Smith** – Automatically opens the Smith Chart tab when a test result is uploaded or when Echo PC Vision is opened.

NOTE: Echo PC Vision normally opens to the VIA Chart tab. Selecting either alternative default will save that setting when Echo PC Vision is closed and open to the selected default tab the next time.

## Settings Menu

The Setting Menu, figure 7-16, permits control of all the settings on the chart, saving the Echo's current settings and recalling them when finished, or lets the user return to factory default settings.



**Figure 7-16**

**Recall Factory Settings** – This selection will reset the settings in Echo PC Vision back to the original factory setting that were in the software when it was initially installed.

**Save StartUp Settings** – Permits saving all the current setting in the VIA Echo so they can be recalled and reloaded into the Echo the next time Echo PC Vision is started.

**Recall StartUp Settings** – Click on this feature restores all the settings saved with “Save StartUp Settings” into the VIA Echo.

**Save Settings to Disk** – Saves the plot settings so that the setting can be restored at a future time.

**Set Z<sub>0</sub>, Scale** – The Z<sub>0</sub> Scale Form, Figure 7-17 permits setting the chart’s Z<sub>0</sub> impedance and Scale. Click on a box to select a standard Z<sub>0</sub> value or select “Custom Value” and type in the Z<sub>0</sub> desired. Now perform the same for the S<sub>21</sub> Scale. If you wish to save and use this setting repeatedly go to “Save Settings to Disk”

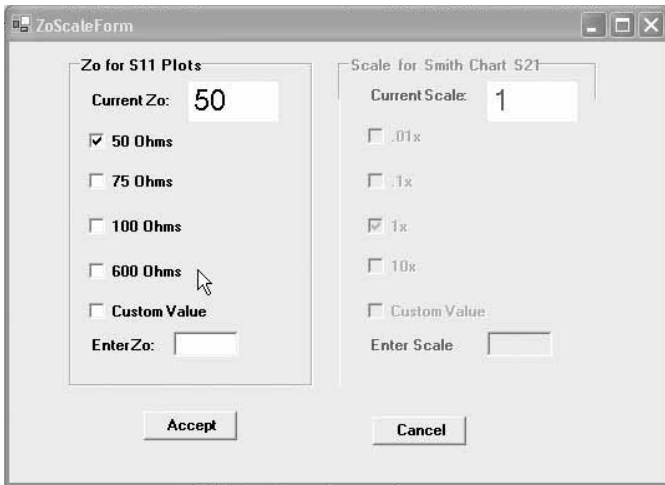


Figure 7-17

## Unit Menu

The Unit Menu permits viewing and changing selected settings on the VIA Echo instrument connected to the PC.

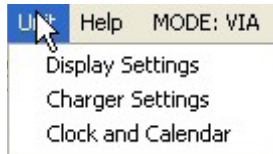


Figure 7-17A

**Display Settings** – Opens a sub-menu to change the Echo’s LCD contrast, brightness, backlight timer, persistence and audio settings.

**Charger Settings** – Opens a sub-menu to read the current battery charger status and change battery type and mAh rating if required. NOTE: Selecting Alkaline or None for battery type turns OFF the charger. The Echo will operate normally on the AC adapter/charger, but will not charge the batteries.”

**Clock and Calendar** – Opens a sub-menu to view and reset the time and date.

## Help

The Help menu, figure 7-18, does not have any operator information. All operating information is contained in this section of the manual. The “About” shows current version number and date produced

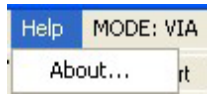


Figure 7-18

## MODE: VIA/Spectrum Analyzer/FDR

The MODE: indicator, also shown in figure 7-18, is not a menu item, but does indicate Echo PC Vision’s operating which changes with the tab selected. The VIA, CW and Smith Chart Tabs will all indicate VIA Mode. The Spectrum Analyzer and FDR will indicate their operating modes.

NOTE: Not all menu items are available or applicable in all modes or all tabs. Example: the Chart Menu’s Enable Plots function is only applicable to the VIA Tab.

## CW Tab

The CW (Continuous Wave) Tab, figure 7-19, should be used when the VIA Echo is operating in the CW Mode. Since there is no sweep in this mode only the numerical data for the single frequency is available. The presentation control buttons at the top of the screen all operate the same as those in the VIA Tab with the exception of “Modify Sweep” which is not applicable in CW Mode. The recommended Data Acquisition mode is “Continuous.” While in continuous, data will be constantly uploaded from the VIA Echo to Echo PC Vision as fast as the USB port can deliver. This will keep all the testing data as current as possible.

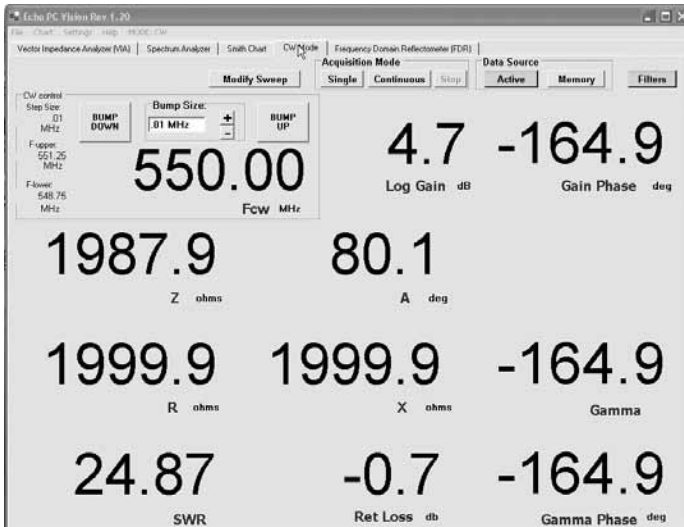


Figure 7-19

## CW Control

The CW Control box presents the single frequency the Echo is using to obtain the data presented. Additionally, this box permits changing the frequency by using the “Bump Up” or “Bump Down” keys. The “Bump Size” controls the amount of frequency jump per button press. The “Bump Size” can be altered by clicking on the “+” and “-” buttons in the “Bump Size” box. The bumping action is limited by the Center Frequency and Sweep Width that is set in the VIA Echo. Those limits are shown on the left-hand side of the “CW Control” box as F-Upper and F-Lower. To expand or change the limits make a change in the Center Frequency and/or Sweep Width at the VIA Echo or in the software’s VIA tab’s Modify Sweep. See Figure 7-7.

## CW Test Data

The test data presented is all related to the test frequency shown in the “CW Control” box. This permits focusing on one or two testing parameters of the users choice, and reduces the lag time associated with transferring and displaying an entire sweep.

## Smith Chart Tab

The Smith Chart Tab, figure 7-20, re-computes the graphical data for Impedance and Reactance from the Cartesian Chart (XY Chart) to the Smith Chart format. The purely resistive component (R) is plotted along the horizontal line on the chart with  $Z_0$  at the center (point 1). Infinite Ohms is to the right and zero Ohms is to the left. As the frequency of a sweep changes the Z will plot left or right of  $Z_0$ . The reactive component (X) plots along the circular arcs on the chart with all inductive readings above the horizontal center-line and all capacitive readings below the center-line. As the frequency changes the antenna’s or circuit’s test results will become more capacitive or more inductive and plot accordingly. A perfect antenna or circuit would be an arc representing the swept frequency range with the Center Frequency CF crossing the horizontal center-line at 1.0 or  $Z_0$  and even amounts of the arc above and below the center line. For more information about Smith Charts see AEA Technology’s Application Note AN-104 “Smith Charts 101”

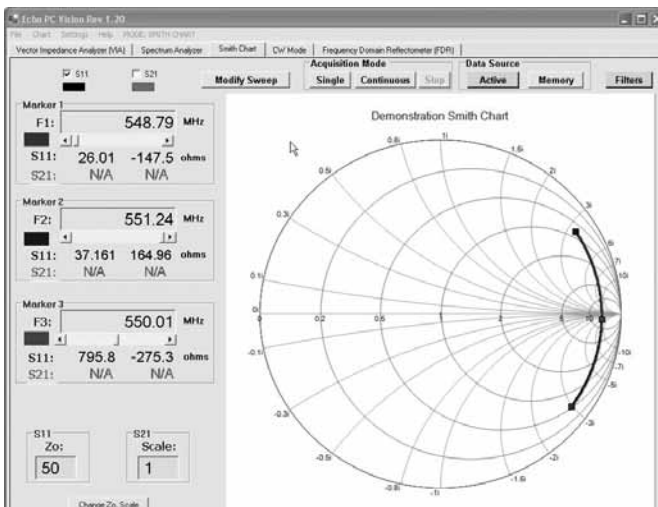


Figure 7-20

**S11 and S21** – Plots for either or both S11 and S21 are color coded black and red respectively. The plots can be turned on by clicking the check boxes next to their labels. A check mark will appear when they are active. Click the check mark to hide the plot.

**Control Buttons** – All the top row control buttons are usable in the Smith Chart Tab. See the VIA Tab covered earlier in this section for information about their use.

**Markers** – Echo PC Vision has three markers that can be used to provide reference points on the Smith Chart. The markers may be optionally disabled by checking the “Hide” box. The frequency of the markers can be changed using the slide bar or fine tuning arrows at the ends of the slide bar. The frequency can not be adjusted outside the swept frequency range set in the VIA Echo. Use the Modify Sweep button to adjust the sweep range if required.

**S11 Z<sub>0</sub> and S21 Scale Indicators** - The “S11 Z<sub>0</sub>” and “S21 Scale” are indicated in the boxes below their titles. To change these click the “Change Z<sub>0</sub>, Scale” button. This will call the “ZoScaleForm” Figure 7-17, covered earlier in this section.

NOTE: The S21 data displays the gain/loss vector on a polar plot. The Smith Chart axes do not apply.

## SWR Chart Tab

The SWR Chart Tab, figure 7-20A, plots only the SWR readings across the selected band. If the SWR Chart is the selected default tab, uploading any VIA reading from the Echo live or from memory will automatically jump to the SWR Chart.

**PASS/FAIL Limit** - When in the SWR Chart Tab a PASS/FAIL line can be added by going to the “Chart Menu.” After entering a VSWR limit and selecting the line to appear, the line will appear on the next sweep.

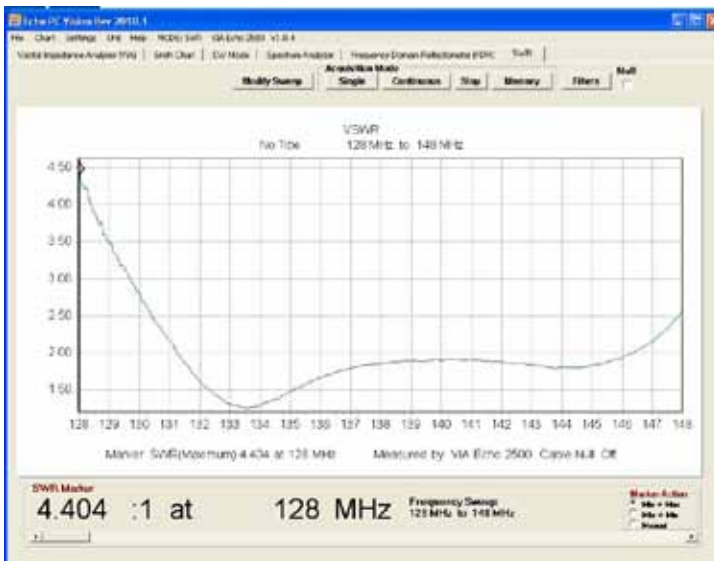


Figure 7-20A

**SWR Marker** – The SWR Marker box at the bottom displays the SWR reading and frequency at the marker and permits control of the marker via the slide bar or Marker Action box.

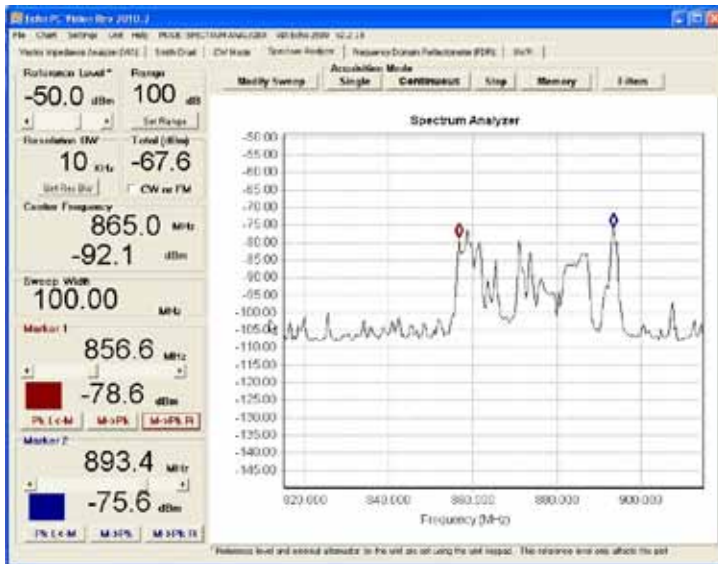
**Marker Action** – Permits automatic movement of the marker to the maximum reading, minimum reading, or manual control of the marker across the plot's band using the slide bar at the bottom of the box.

**NOTE:** Marker readings that change in the box will also be posted in the graph for saving or printing.”

## Spectrum Analyzer Tab

The Spectrum Analyzer Tab, figure 7-21, is designed to present data from the VIA Echo Spectrum Analyzer's active plot, memory or archived plots saved on the PC.

**NOTE:** Be sure the antenna and/or input cable is connected to the S21 port on the VIA Echo.



**Figure 7-21**

**Control Buttons** – All the top row control buttons are usable in the Smith Chart Tab. See the VIA Tab covered earlier in this section for information about their use.

**Ref Level** – The Reference Level sets the reading for the top of the chart. It is slide bar adjustable from +80dBm to -110dBm.

**Range** – The Range sets the vertical range for the chart with the top of the chart being set to the Reference Level. Range has six selections from 2 to 100dB. Example: If the reference is set to +10dBm and the Range is Set to 50dB the charts top and bottom readings will be +10dBm and -40dBm respectively.



**Resolution BW** – The Resolution Band Width sets the IF bandwidth of the Spectrum Analyzer.

**Total (dBm)** – This is the total power across the selected bandwidth. Default display is digital power (GSM, PCM, Noise). Click on the CW or FM to select analog power.

**Markers** – Echo PC Vision has two markers that can be used to provide reference points on the Spectrum Analyzer. The markers are always present. The frequency of the markers can be changed using the slide bar, ends of the slide bar or the peak detection buttons. The frequency can not be adjusted outside the swept frequency range set in the VIA Echo. Use the Modify Sweep button to adjust the sweep range if required. Once the frequency is set the marker will jump to the Spectrum Analyzer's plot line for that frequency and provided the dB reading at that frequency.

The peak detection buttons work as follows:

**Pk L<-M** – Move Left to the next Peak

**M ->Pk** – Move to the Maximum Peak reading in the band

**Pk R->M** – Move Right to the next Peak

## Frequency Domain Reflectometer (FDR) Tab

The Frequency Domain Reflectometer (FDR) Tab, figure 7-22, is designed to present the plot from the VIA Echo FDR's active plot, memory or archived plots saved on the PC.

**PASS/FAIL Limit** - When in the FDR Chart Tab a PASS/FAIL line can be added by going to the "Chart Menu." After entering a limit and selecting the line to appear, the line will appear on the next sweep.



Figure 7-22

**Control Buttons** – All the top row control buttons are usable in the FDR Tab except Continuous. See the VIA Tab covered earlier in this section for information about their

use. The **Modify Sweep** button has been altered **Modify Parameters** as the FDR has some different entries, but it operates in a similar manner.

**FDR Graph** – The FDR Graph plots the swept frequency reflections and displays Return Loss or SWR on the vertical axis in dB or ratio and the range of the event on the horizontal axis in feet or meters. In order for the horizontal axis's distance information to be accurate the correct Velocity Factor (VF) must be entered.

**Center Frequency** – The CF shown will be uploaded from the VIA Echo. If Echo PC Vision is in control of a live plot the **Modify Parameters** button can be used to change the CF and bandwidth (distance) of the sweep. This is shown on the VIA Echo's LCD as "Δ Frequency"

**Distance** – The Distance indicates the distance of the plot in the X Axis. The distance shown will be uploaded from the VIA Echo. If Echo PC Vision is in control of a live plot the Modify Parameters button can be used to change the distance of the plot.

NOTE: The distance you enter, either on the VIA Echo or through Echo PC Vision may be altered slightly as the VIA Echo's algorithms involving distance, CF and VF affect the display.

**VF Entry** – The VF Entry permits changing the Velocity Factor to obtain the correct distances to events on the cable. the cable. Use the slide bar or fine adjustment arrows at the ends of the bar to change the VF.

NOTE: Velocity Factor is also known by several other abbreviations, VP or VoP meaning Velocity of Propagation or NVP meaning Nominal Velocity of Propagation. All are referring to the same parameter. It is expressed as a fraction of the speed of light in a vacuum.

**Plot Type and Units** – Both the "Plot Type" and "Units" are uploaded as set in the VIA Echo for both live plots and memory plots

**Cursor** – The cursor will automatically jump to the highest reading (presumed electrical end of cable) when the sweep plot is posted. Use the slide bar at the bottom of the graph to move the cursor to the desired position. FDR cursors should be positioned at the peak value of reflections to obtain the correct distance to events or the end of the cable.

## 8. Maintenance, Service and Warranty

### Operating Precautions

Although the VIA Echo is a rugged instrument, care should be taken to avoid exposing it to excessive external RF or DC voltage (either from a nearby transmitting site or from your own installation).

Before attaching the VIA Echo to a cable leading to an antenna, it's a good practice to briefly ground the feed line in order to shunt any accumulated static charge to ground.

### External DC Power

If you wish to power the VIA Echo from an external DC source (other than the AEA's AC-1 wall adapter), ensure that it meets the following requirements :

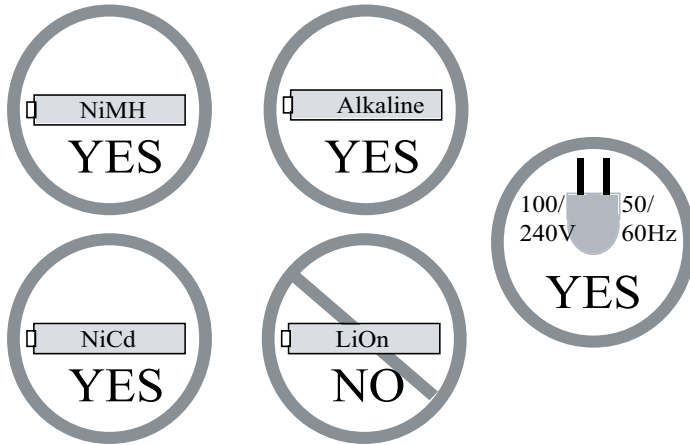
- 2.1 mm (+) center pin DC power connector.
- Minimum 12 VDC (650 ma)
- Nominal 13.6VDC (650 ma)
- Maximum 20VDC (650 ma)

**Note:** Quarter VGA Display performance is impaired when input is below 12VDC. Positive polarity must be applied to the center pin of the power jack for proper operation.

### Powering the VIA Echo

All the VIA Echo models are capable of operating with NiMH or NiCd rechargeable batteries, AA alkaline batteries, or operating from external power with or without batteries installed. The internal charger is designed for NiHM batteries, but can recharge NiCd batteries. The VIA Echo MRI models use a single lead acid battery rather than NiCd or NiMH AA cells which have magnetic properties. See Section 2 of this manual "Powering the VIA Echo" for more information on proper charging of the VIA Echo MRI's battery.

**NOTE:** Whichever type power source you choose, it is very important to press the F-4 key, scroll to the BATTERY MENU and enter both the battery type or none for AC power only. Additionally, you can optimize the rechargeable batteries' life and recharge cycles by selecting CAPACITY and entering the MilliAmp Hour (MAHR) rating.



VIA Echo 1000/2500 units should be charged in a non-operational state for 6-10 hours prior to use. This will ensure a good initial charge on the NiMH batteries. Per the nature of NiMH batteries it will require three to four uses and full recharging cycles before the NiMH batteries reach their maximum operational capacity.

Typical recharging time non-operational	4-6 hours
Typical recharging time operational	30 hours
Continuous Operation on battery	2½-3½ hours

The backlight timer and battery saver feature should always be used when operating on battery power to obtain the maximum operational hours. See the F4 functions for setting the timer.

If the batteries require changing follow these steps:

1. Place the VIA Echo face down on a clean soft surface.
2. Remove the two battery compartment screws at the base of the compartment under the fold-out stand.
3. Once the compartment cover is off, use a flat blade screwdriver to pry loose the batteries for removal.
4. Replace the batteries paying strict attention to the polarity indicators in the compartment wells. Slide the upper four batteries under the retaining strap. You may require the flat blade screwdriver to assist with replacement of the lower four batteries.
5. Replace and close the battery compartment cover.
6. If the batteries installed were AA alkaline you can turn on the VIA Echo and start operational use immediately. If the batteries were NiMH or NiCd replacements you should plug in the charger and start an initial non-operational 6-10 hour charge cycle. **In either case, immediately power the unit on, when it reaches the Measurement screen press F4, BATTERY MENU and set the battery type and if rechargeable, enter the MAHR.**

If the VIA Echo 1000/2500 is to be stored for more than 30 days, the batteries should be removed. Battery leakage can seriously damage the VIA Echo's battery compartment and other circuits. Damage from battery leakage is not a factory workmanship issue and therefore not covered under warranty. If the VIA Echo MRI is to be stored for more than 30 days the lead-acid battery should be fully charged. Additionally, storage longer than 6 months could result in a serious loss of capacity or a completely dead battery that will not take a charge.

## Cleaning

The VIA Echo is designed to operate in a variety of conditions and dirty environments. Cleaning on regular basis should be accomplished with a soft, water moistened cloth. If dirt must be removed, use a mild detergent sprayed on the cloth first. Do NOT spray detergents or water directly on the instrument. Avoid using solvents or ammonia based glass cleaners that can discolor the LCD protective cover and that may attack the plastic case or test lead insulation. Use orange based liquid or gel cleaner on a clean soft rag to remove cable gel from the instrument, test leads or carrying case.

The soft case should be cleaned in the same manner as the instrument, but a soft brush will help remove dirt, grime or cable gel. Always remove the carrying case from the instrument first. Washing in a machine or total immersion in soap and water is NOT recommended. Drying in a clothes drier or oven is also NOT recommended. Dry overnight on a clean cloth in fresh warm air.

The following are recommended cleaning agents for specific contamination:

Soil or light oily soil marks	Household glass cleaner (non-ammonia based) or diluted 409° liquid cleaner
Cable gel	Orange based gel or liquid cleaner non-abrasive
Tar, creosote or sticky adhesives	WD40 followed with household cleaner

NOTE: Always spray cleaners and rinse water on the cloth NOT the instrument. Wiping dry with a soft lint free cloth will improve appearance over air drying.

## Contact Us and Return Material Authorization (RMA's)

If you have any questions concerning instrument operation, care, cleaning or feel you need to return an instrument to AEA Technology, Inc. please contact us through our web page, [www.aeatechnology.com](http://www.aeatechnology.com), or via our telephone/fax numbers shown on the back cover.

RMA numbers are required for all instruments being returned to AEA Technology to ensure everyone from Shipping/Receiving, Sales and Repair understand how to handle your instrument expeditiously. Once you receive an RMA number from AEA Technology please ship the instrument to our address shown on the back cover. Be sure to include the RMA number in the "To" or "Attention" line of the address label and waybill. Thank you.

## **Specifications**

Specifications for the VIA Echo models are contained in Appendix B.

## **Limited Warranty**

AEA Technology, Inc., warrants to the original purchaser that the VIA Echo Analyzer shall be free from defects in material or workmanship for a period of one year from the date of shipment. All units returned to the factory, delivery charges prepaid, and deemed defective under this warranty, will be replaced or repaired at this company's option. No other warranties are implied, nor will responsibility for operation of this instrument be assumed by AEA Technology, Inc

There are no warranties that extend beyond express warranties stated herein.

No other warranties are express or implied. AEA TECHNOLOGY SPECIFICALLY DISCLAIMS ALL IMPLIED WARRANTIES, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. AEA TECHNOLOGY SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

Remedies for any breach of warranty, either express or implied, are limited to repair, replacement, or return of the instrument, at the option of AEA Technology. Any warranty is valid for the original purchaser only.

All warranties of performance are disclaimed.

AEA Technology assumes no liability for applications assistance or customer product design.


# User Troubleshooting Guide

Some problems may be identified and solved by the operator. More involved problems will require factory service. To try to solve a problem yourself, refer to the chart below:

## Operation Troubleshooting Guide

Symptom	Possible causes	Solutions
On power up there is no visible display	Display contrast setting	<ol style="list-style-type: none"> <li>1) Press F2 twice</li> <li>2) Press ▲ 7-8 times</li> <li>3) Press ▼ twice</li> <li>4) Press ◀ to lighten, ▶ to darken</li> <li>5) Press ENTER when done</li> </ol> Alternate Solution: Perform soft reset by pressing the ENTER key repeatedly while powering ON.
On power up there is no visible display	Power source or batteries	Try a second power source. If on batteries try the AC wall power if on AC wall power try a different outlet or changing to good batteries.
On power up, any of the following abnormal conditions are noted: <ol style="list-style-type: none"> <li>1. Does not come out of Calibration and display a plot.</li> <li>2. Display appears, but there appears to be no activity or jumbled characters.</li> <li>3. Menu items do not have a cursor arrow (&gt;) appear.</li> <li>4. The instrument is non-responsive to input actions.</li> </ol>	Illegal instrument state	Turn OFF, then repeatedly press the ENTER key 3-4 times while turning ON. This is a built in factory reset.
Instrument will not turn off.	Power down lockout condition	Press and hold down the ON/OFF key for 15 seconds then release ON/OFF key
USB interface will not operate	USB Communications lock up	Corrective Steps: <ol style="list-style-type: none"> <li>1. Unplug power &amp; USB Cable from Echo and turn Echo OFF &amp; close Echo PC Vision on the PC.</li> <li>2. Reconnect Echo to power and turn on.</li> <li>3. Plug USB Cable into Echo.</li> <li>4. At PC restart Echo PC Vision</li> </ol>
USB Lock up correction fails	Other USB Interface Issues	Look for Echo interface at PC <ol style="list-style-type: none"> <li>1. Go to My Computer, Properties, Hardware, Device Manager.</li> <li>2. Look for Human Interface Devices.</li> <li>3. 2 drivers should add/remove when Echo USB cable is plugged/unplugged.</li> <li>4. USB HID shows Echo USB</li> </ol> IF NO <ol style="list-style-type: none"> <li>1. Try a different USB Cable and click re-entry.</li> <li>2. Try a different PC</li> </ol>
Incorrect data on USB transfer	Data out of sync from Echo	Unplug and replug the USB cable at the Echo or the PC to reset

## Battery/Recharger Troubleshooting Guide

Symptom	Possible Cause(s)	Correction
Operational time is getting shorter with each use.	Cells may be at or near mfg limit for number of recharges (nominal 750 times).	Lengthen recharge time, if no improvement replace cells with 8 new AA rechargeable cells
Not very old cells stop recharging	<ol style="list-style-type: none"> <li>1. Battery Type: NONE or ALKALINE selected.</li> <li>2. Charging power is not sufficient or not on.</li> <li>3. Battery Temperature too HOT or COLD.</li> <li>4. Batteries are damaged, missing, or have dirty contacts</li> </ol>	<ol style="list-style-type: none"> <li>1. Set Battery Type and Battery Capacity to match cell type</li> <li>2. Correct AC or DC input to Echo</li> <li>3. Recharge at room temperature or remove from case to reduce overheating</li> <li>4. Examine batteries and contacts correct any issues</li> </ol>
VIA ECHO auto powers down when batteries still workable	<ol style="list-style-type: none"> <li>1. By design to protect the cells &amp; Echo from damage by operating at too low voltage</li> <li>2. BATTERY SAVER mode is ON causing an auto power-down at 5 minutes after last key press</li> </ol>	<ol style="list-style-type: none"> <li>1. Operate on external power or change to fresh cells</li> <li>2. Select F4, BATTERY MENU, and BATTERY SAVER, then press any  key to turn BATTERY SAVER to OFF</li> </ol>
Charger goes directly to IDLE or TRICKLE	Cells may already be fully charged	Use battery power only & check Battery Status for full charge
External power is applied, but Status is always IDLE or stuck in BATT CHK (Some of these symptoms are more likely to occur when a new set of batteries are installed)	<ol style="list-style-type: none"> <li>1. Battery Type: NONE or ALKALINE previously selected.</li> <li>2. Batteries may be damaged, defective, missing, improperly installed or have expired shelf life</li> <li>3. Contacts may be dirty or corroded</li> <li>4. External power may not be properly connected.</li> <li>5. Non-AEA recommended power pack</li> <li>6. Cells may be alkaline or carbon</li> <li>7. Deeply depleted cells may take longer to condition</li> </ol>	<ol style="list-style-type: none"> <li>1. Set Battery Type and Battery Capacity to match cell type.</li> <li>2. Replace with new set of batteries or install cells per polarity guides</li> <li>3. Clean or replace contacts</li> <li>4. Check external power (wall switch off, bad plug, broken cord, etc.)</li> <li>5. Use correct power pack</li> <li>6. Set battery type to ALKALINE</li> <li>7. Have patience, recheck status In one hour</li> </ol>
Charger Status jumps from BATT CHK to IDLE	<ol style="list-style-type: none"> <li>1. Cells may be missing, damaged or defective</li> <li>2. One or more cells is installed with polarity reversed</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace with new set of batteries.</li> <li>2. Reinstall cells per polarity guides</li> </ol>



# Appendix A

## AEA Technology's Included Testing Accessories

### INCLUDED ACCESSORIES/REPLACEMENT ITEMS

Each model has different included accessories suited to that model. Refer to Section 1, Accessory Matrix for identifying which accessories are included with which VIA Echo model. Items like PC Vision software, Operation Manual, Quick Start Guide and Application Notes are listed on our web site for download. Go to [www.aeatechnology.com](http://www.aeatechnology.com).



#### “N” Style Terminators (male)

Shorting P/N 0070-1135 (flush top)  
Matched P/N 0070-1138 (nubbed top)  
Set of Both P/N 6015-1301



#### “N” Terminator Set

P/N 6025-0270  
Included with Echo 2500 only



#### Belt Case

Includes: Protective Padding, Belt Loop,  
Strand Hook & Shoulder Strap  
P/N 5001-1002



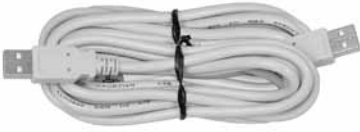
#### Soft Carrying Case

Reinforced sides, closed cell foam insert and  
shoulder strap  
P/N 6015-1002



#### USB Cable

6 feet (2 meters) A-to-A Connectors  
P/N 0070-1206  
Included with Echo 1000, 1000SF and 2500  
Models



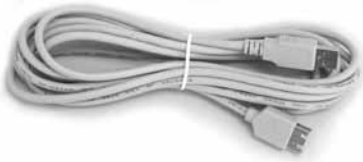
**USB Cable**

15 feet (4.6 meters) A-to-A Connectors  
P/N 0070-1207  
Included with Echo MRI Model



**Universal Power Adapter**

100-240 VAC, 50/60 Hz to 15VDC  
P/N 5001-0202



**USB Cable**

10 feet (3 meters) A-to-A Extender Cable  
P/N 0070-1210  
Included with Echo MRI model



**DC Power Cable Extension**

20 ft ( 6 meters) Included with MRI Models  
only  
P/N 0070-1200



**Rechargeable Batteries**

8 AA Pack of NiMH 2000mAh each.  
P/N 0010-0218  
Not included in Echo MRI models

## OPTIONAL ACCESSORIES

Available from AEA Technology or through your local AEA Rep or Distributor



### Hard Carrying Case

Rugged weather tight with closed cell foam insert, padlock holes & pressure vent  
P/N 6015-1003



### N-to-TNC Adapter

P/N 0070-1134



### N-to-SO-239 (UHF)

P/N 0070-1195



### “N” Style Terminators (female)

Shorting P/N 0070-1136

Matched P/N 0070-1137

Set of Both P/N 6015-1302

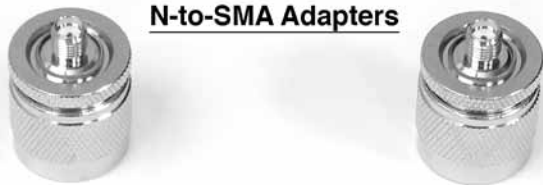


### N-to-BNC Adapter

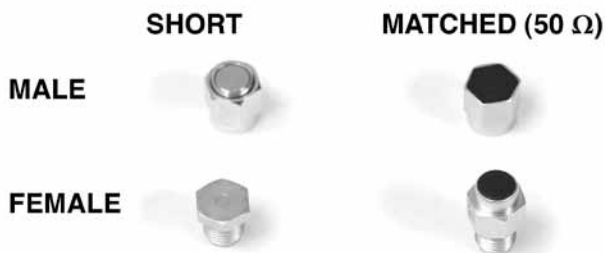
P/N 0070-1190

2 each included with Echo MRI model

### N-to-SMA Adapters



### SMA Terminators



### **SMA-to-N Adapter Kit**

P/N 6025-0260, INCLUDES:

2 – SMA-to-N style adapters

2 – SMA Male terminators - 1 short, 1-50 Ohm

2 – SMA Female terminators - 1 short, 1-50 Ohm



### **DC Vehicle Adapter**

P/N 6025-0250

### **BNC Style Terminators**

Shorting P/N 0070-1140

Matched P/N 0070-1150

Set of Both P/N 6015-1303

Included with Echo MRI model



### **30dB Attenuator**

Attenuator has N-Type connectors,  
Female input and Male output  
with an average 50W, 2.5GHz rating  
P/N 6025-0265



**Pre-Amplifier**

P/N 0070-0290

Specifications

Gain	44 dB nominal
Bandwidth	2.2GHz nominal
Noise Figure	3.5 dB nominal
Power	7-15 VDC, 60mA
Size including N connectors	3.75 x 1.375 x 1.375 in (94x33x33mm)
Weight	4.5 oz (126 grams)

NOTE: Pre-Amplifier applicable with Echo Version 2.2.12 and higher.



# Appendix B

Characteristic	Specifications
Frequency Range	4MHz to 1.0GHz & 4MHz to 2.5GHz models
Frequency Stability	2PPM + 1PPM/year
Tuning/Display Resolution	1KHz up to 1.1GHz 10KHz for ~1.1GHz-2.5GHz
Connector Types	N female, single or dual ports (S11 & S21) SMA optional connector kit
Vector Impedance Analyzer	All models
Accuracy	Actual Return <sub>Loss</sub> = $-20\log[10 - \frac{\text{Measured } R_L}{20}] \pm .02$ (R <sub>L</sub> expressed as a positive number) (+.02 for minimum, -.02 for maximum) If measured R <sub>L</sub> < 34dB; the maximum actual R <sub>L</sub> calculation will fail; maximum actual R <sub>L</sub> can be 80dB or even higher.
<b>VIA Measurements (S11)</b>	
Resistance	
Range:	0 to 2000 Ohms
Resolution:	0.1 Ohm
Reactance	
Range:	0 to 2000 Ohms
Resolution:	0.1 Ohm
Total Z	
Range:	0 to 2000 Ohms
Resolution:	0.1 Ohm
Z Angle	
Range:	0° to + 90°
Resolution:	0.1°
Gamma Magnitude	
Range:	0 to 1.0
Resolution	0.0001
Gamma Angle	
Range:	0° to + 180°
Resolution	0.1°
SWR	
Range:	0 to 21
Resolution	0.01 for readings below 10.0

<b>Return Loss</b>	
Range:	0 to 80 dB
Resolution	0.1 dB
<b>Gain/Loss Formats (S21)</b>	
<b>Linear Gain</b>	
Range:	0 to 3.0
Resolution	0.0001
<b>Log Loss</b>	
Range:	0 to 20dB
Resolution	0.1 dB
<b>Phase Delay</b>	
Range:	0° to + 180°
Resolution	0.1°
<b>Group Delay</b>	
Range:	0 to 30 microseconds
Resolution	0.1 nanosecond
Swept Frequency Output	YES
Frequency Display Width	250 points x N x resolution (N=integer)
Sweep Time	2 Seconds
Sweep Trigger Mode	Free Run
Single Frequency Output	YES
Number of Ports	2
Impedance Range	2 to 2000 Ohms
Impedance Plotting Scales	0-50 Ohms minimum 0 to 2000 Ohms maximum
Phase Angle Scales	± 15 to ± 180 degrees
Harmonic and Spurious	>15dB below fundamental
<b>Output Power</b>	
Echo 1000, 1000SF, & 2500	+3dBm @ 50 Ohms typical
Echo MRI	-7 to -10dBm @ 50 Ohms typical
<b>Spectrum Analyzer</b>	Simplified Spectral Display Selected models only
Resolution Bandwidth	10KHz – 10MHz
Tuning Resolution	10KHz minimum



Input Range	+20dBm to -75dBm without Pre-Amplifier or attenuator. See Section 4-1A for reference and ranges with Pre-Amplifier and /or attenuator attached
Input Sensitivity	-75dBm @ 50kHz Resolution Bandwidth
<b>Frequency Domain Reflectometer (FDR)</b>	Selected Models only
Range @ .66c VF	Echo 2500 15 ft (4.6m) min. Echo 1000SF 40 ft (12.2m) min. to 30,000 ft (10,000m) max.
<b>Display</b>	Quarter VGA, Backlit
<b>Memory</b>	250 instrument presets & data plots
<b>External Communications</b>	USB 2.0
<b>PC Software</b>	Echo PC Vision™ software
<b>Echo 1000, 1000SF &amp; 2500</b>	
<b>Power</b>	8AA Alkaline, NiMH or NiCd, 2½-3½ hrs continuous,
<b>Environmentals</b>	External 100-240VAC, 50-60Hz supplied with unit Operating -18° to 50°C (0° to 122°F), storage -20° to 70°C (-5° to 158°F), RH=0-95% non-condensing, rain & dust resistant, drop resistant
<b>Physical</b>	Size 8.5" x 4.3" x 2.25" (216 x 109 x 57mm), weight 1.9lbs (699g) with softcase
<b>Echo MRI model only</b>	
<b>Power</b>	Sealed Lead/Acid Battery, 12V, 1700mAh 2 hrs continuous use less 10% for backlight & significant reduction in magnetic fields External
<b>Environmentals</b>	100-240VAC, 50-60Hz supplied with unit Operating 50-122oF (10-50°C) Storage -4-158°F (-20-70°C) Relative Humidity 0-95% non-condensing
<b>Size</b>	13.25x11.25x5 inches (34x29x13cm) Weight 9.5 lbs (4.3Kg)

\*See Cold weather operations in Section 2.

NOTE: Batteries will not accept a charge below 0° C (32°F)



# Appendix C

<b>Tesla-to-Frequency Table</b>			
<b>Tesla</b>	<b>Frequency</b>	<b>Tesla</b>	<b>Frequency</b>
	<b>MHz</b>		<b>MHz</b>
0.7	29.75	11	467.5
1.0	42.5	12	510.5
1.5	63.75	13	552.5
3.0	127.5	14	595.0
4.7	199.75	15	637.5
5	212.5	16	680.0
6	255.0	17	722.5
7	297.5	18	765.0
8	340.0	19	807.5
9	382.5	20	850.0
10	425.0		



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