Operating Manual

VIA Analyzer

Complex Impedance Analyzer

AEA Technology, Inc.

AEA Technology, Inc.

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Contents

SECTION 1 INTRODUCTION

What It Does

The VIA-HF Complex Impedance Analyzer combines a microprocessor-controlled direct digital synthesizer with an accurate low-power Impedance bridge to present a graphical display of SWR, Impedance, Resistance, or Reactance. To create these graphical displays, the Analyzer continuously sweeps and plots a user-selectable frequency range. Alphanumeric data blocks common to each graphing screen are updated after every frequency sweep.

Features

- Range from 100 kHz to 54 MHz.
- Graphical display of SWR, total Impedance, Resistance, and Reactance vs. frequency and Relative Field Strength.
- 1 kHz resolution (100 Hz/pixel).
- Four memories and control screen to store/retrieve SWR, Z, R, or X.
- Serial commands to access Stored memory data.
- Product speed-up due to faster microcontroller and related components. 1.2 seconds per sweep.
- Serial commands to recall SWR and Z with single command.
- Serial command to disable screen refresh during serial communication
- Windows 95/98/2000/ME/XP VIA Director available.
- Supertwist display
- Data screen which displays:
  - Real and Imaginary components of Impedance at a given frequency
  - Capacitance or Inductance value of Reactance at the plot's center frequency
  - Capacitance or Inductance value required to provide a complex conjugate match.
  - Q factor (F center ÷ 2:1 bandwidth)

- 2:1 and two user-selectable SWR bandwidths
- Auditory cues.
- Self-tests.
- Automatic off.
- Low voltage DC voltmeter (0 to 50v DC).
- Frequency Generator mode with trigger pulse on serial port.
- Display grid (F2).
- Optional AC-1 Wall Cube (available from Tempo/AEA).
- Optional softcase with shoulder strap and swivel hook (available from Tempo/AEA).

Specifications

Harmonics and Spurious	<-30 dB
SWR Impedance	50 ohms
SWR Range	1:1 to 20:1
Impedance Magnitude Ranges	0 to 100, 0 to 250, 0 to 1000 ohms
Reactance Ranges	0 to 100, 0 to 250, 0 to 1000 ohms
Resistance Ranges	0 to 100, 0 to 250, 0 to 1000 ohms
Return Loss Range	-1 to -40 dB
Phase Angle	-45° to +45°
Q Factor Range	1 to 1000 (defined as 2:1 Bandwidth/Fc)
Measurement Speed	Approximately 1.2 seconds/sweep
Antenna Connector	Type 'N'
Output Power	AV =4 mW (+5 dbm) into 50 ohms
DC Voltmeter	2.5 digits, ±10%

	accuracy, 25 volts maximum
Power Requirements	8 AA Alkaline cells; 12v minimum to 16 VDC @ <150 mA
Battery Saver Mode	Entered after 5 minute idle period
Size	4.3" W x 2.25" H x 8.5" L (including connector)
Weight	1 lb. 10 oz. (including batteries)

For additional Specifications, see page 45.

SECTION 2 QUICK START

To help you get started, we've included this brief tutorial which leads you through the general functions of the Analyzer.

First, press the ON key to activate the Analyzer. An introductory screen will flash briefly on the display, followed by a simple SWR plot. Since there is no antenna connected to the Analyzer, the plot is given an out-of-range value represented by a straight line across the top of the display.

Use the F5 softkey to toggle sequentially from the S (SWR) screen to the D (Data) screen. Notice that the boxed letter in the lower right corner changes as you toggle through the screens. This letter identifies the screen that is currently displayed (refer to Screens section). Before continuing, return to the S screen. Note: pressing ENTER reverses direction.

Use the F3 softkey to scroll through the data blocks displayed below the horizontal axis. Before continuing, return to the "W:100K:DIV Fc:14.200" data block. This data block provides the plot's default width (W:) and center frequency (Fc:) values. Change the center frequency to 1.900 MHz by entering 1 9 0 0 ENTER on the keypad. Now, press the WIDTH▼ key three times to set the width to 10 kHz. The data block should now read "W:10K:DIV Fc:1.900".

To observe actual operation, attach the feed line of an 80-meter antenna to the antenna connector on top of the Analyzer. The S screen and "W:10K:DIV Fc:1.900" data block should still be displayed. Set the center frequency to 3.900 MHz by entering 3 9 0 0 ENTER on the keypad. The Analyzer will now sweep around this center frequency value. Now, use the WIDTH keys to experiment with different frequency sweep ranges. Also, use the F4 softkey to adjust the vertical scale (zoom factor). A well-matched antenna will produce a typical "V" or "U"-shaped SWR curve. Use the F3 softkey to obtain exact SWR, Return Loss, and total Impedance readings, or press the EXAM/PLOT key to store the display into memory when an interesting plot appears.

SECTION 3 OPERATION

SetUp

Attach the load under test to the antenna connector, which is located on the top of the Analyzer. Press the ON key to activate the unit.

CAUTION: Do not connect any transmitting equipment directly to the antenna connector. Excessive RF at the antenna connector will damage the Analyzer. Damage may also occur when the load under test is near a transmitting antenna. In addition, never leave the Analyzer attached to an antenna after testing is complete; a lightning storm in the vicinity may damage the Analyzer's sensitive bridge network. Damage resulting from these situations is not covered under warranty.

NOTE: The Analyzer's sensitive instrumentation may cause erroneous readings (elevated minimum SWR values) to occur in the presence of RF fields (i.e. near commercial broadcast stations). To reduce the potential for interference, the Analyzer's output power is less than 5 mW. With a good antenna match, however, the reflected power can be up to 20 dB lower, a level that can be masked by other transmitters.

Screens

The Analyzer provides eight real time screens, which include two data screens, four graphing screens, and two reference screens.

The two real time data screens include the Data screen and the Numerical Entry screen. The Data screen consolidates much of the information displayed in the Data Box (described below).

The Data screen specifically displays: center frequency, SWR, Return Loss, Bandwidth 2.0, Q Factor, Resistance, Reactance, Impedance, Phase Angle, Capacitance, and Inductance values.

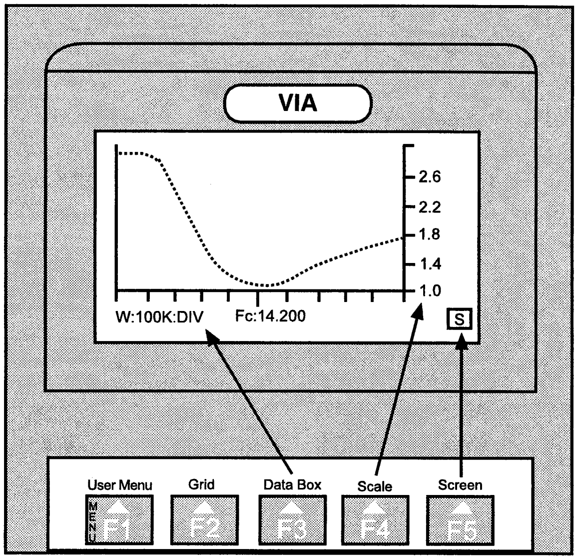


Figure 1
Real Time Graphing Screen

The Numerical Entry screen will automatically appear whenever you enter numbers on the keypad. The numbers will appear on screen as they are entered. To terminate an entry and resume normal operation, press the ENTER key or one of the FREQ keys (refer to Dedicated Keys section).

The four real time graphing screens include: SWR, Magnitude of Impedance, Reactance, and Resistance.

These screens contain a graphing area, Data Box, and Screen Logo Box (Figure 1).

The reference screens include the relative field strength and signal generator control screens. The reference screens are for real time monitoring only, and cannot be stored into memory.

The graphing area is 100 pixels wide. It is bordered on the right by a vertical axis containing a user-selectable scale, and on the bottom by a horizontal axis containing tick marks every ten pixels. The center (longest) tick mark represents the center frequency (center of the plot).

The Data Box, which contains 12 data blocks, is located below the horizontal frequency axis. The data blocks are updated after each frequency sweep, center frequency adjustment, or width adjustment.

NOTE: A data block will display the acronym "NA" when numerical data is Not Available for a particular value. This usually occurs when the SWR is too high or the Magnitude of Impedance is too far from 50 ohms.

The Screen Logo Box, located in the lower right corner of the display, contains a letter that identifies the screen you are currently viewing. The following table lists the 'real time' screens and their iden tifying letters.

S. . . . SWR screen
Z . . . Magnitude of Impedance screen (value)
X . . . Reactance screen (absolute value)
R . . . Resistance screen (Value of Impedance)
F. . . . Relative Field Strength
G . . . Signal Generator screen
D . . . Data screen
N . . . Numerical Entry screen (displays numbers entered on the keypad)

Dedicated Keys

The dedicated keys, which include all but the F1-F5 softkeys, are used to adjust operational parameters.

The ON and OFF keys activate and deactivate the Analyzer.

In the real time graphing screens, the WIDTH keys determine the frequency sweep range represented in a plot (refer to Frequency Sweep Range section). To adjust this range, use the WIDTH▲ and WIDTH▼ keys to step through eleven preset width values (0 kHz, 1 kHz, 2 kHz, 5 kHz, 10 kHz, 20 kHz, 50 kHz, 100 kHz, 200 kHz, 500 kHz, 1 MHz). These correspond to the width per *division.* W:5K:DIV corresponds to 500 Hz per pixel (10 pixels per division).

When the width is set to 0 kHz, the unit will analyze SWR, Impedance, etc. at a single frequency (center frequency value). In addition, a beep will sound at a rate that is proportional to the SWR at the center frequency (i.e. a low beep rate indicates a low SWR). This auditory cue allows you to make antenna adjustments without having to visually consult the display. The audible tone can be disabled.

The center frequency of a plot, which defines the midpoint of the frequency sweep range, can be adjusted in three ways. One way is to use the FREQ▲ and FREQ▼ keys to step the center frequency value up and down in increments one-tenth the width value. For example, when the width is set to 500 kHz, the step size value will equal 50 kHz. Each time you adjust the width, the step size value will also change. This automatic feature enables fine tuning within a plot.
You can also use the number keys to enter new center frequency values. Simply input a value between 0.001 and 54.000 MHz, followed by the ENTER key. Since the decimal point is in a fixed position, zeros will precede any values that

are less than five digits long (i.e. 00.545). As soon as you begin inputting numbers, the Numerical Entry screen will appear (refer to Screens section). Once you press ENTER to terminate an entry, the Analyzer will resume normal operation according to the new center frequency value.

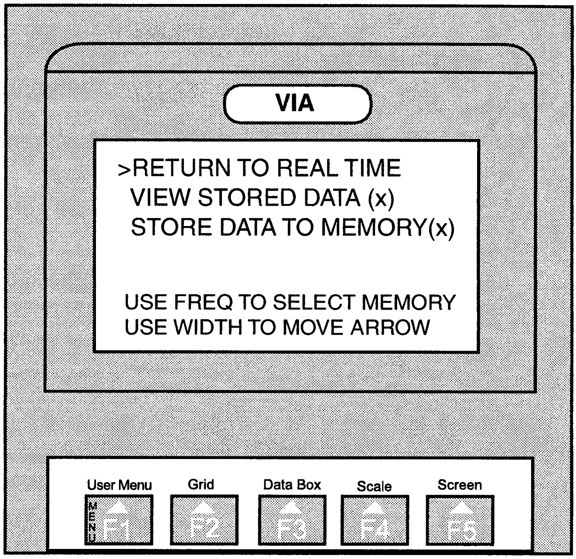
It is also possible to use the number keys in conjunction with the FREQ keys to add or subtract values from the current center frequency value. For example, entering 5 0 0 FREQ▲ will add 500 kHz to the current center frequency value. (The FREQ▼ key subtracts the input value from the center frequency.)

In the user Menu (described below), the WIDTH and FREQ keys perform different functions. The WIDTH▲ and WIDTH▼ keys allow you to scroll through the user Menu selections. The FREQ▲ and FREQ▼ keys allow you to adjust the CONTRAST level and SWR Bandwidth values once you have scrolled to these selections.

The ENTER key has multiple functions. In the Numerical Entry screen, it is used to terminate new center frequency values entered on the keypad. In the real time graphing screens, pressing the Enter key reverses the direction in which the F3-F5 softkeys scroll through data, scale values, and screens, respectively. A small minus (-) sign will appear in the Logo Box when the Analyzer is in the reverse scrolling mode. Press the ENTER key again to revert to forward scrolling. Once you become familiar with the sequence of data, scale values, and screens, you may find that backward scrolling is more efficient than forward scrolling.

Storing and Retrieving Data

A new menu screen has been added, which replaces the operation of the EXAM/PLOT key. When the EXAM/PLOT key is pressed, the following menu is shown.



Pressing the WIDTH KEY UP or DOWN will move the left arrow to one of three menu items. A subsequent ENTER key will perform the selected function. Pressing the FREQ key UP or DOWN will cycle through the possible memories. The (x) shown in the second and third menu items will toggle from A to B to C to D and back to A again, or the reverse. This selects which memory will be operated on for the VIEW and STORE functions.

After pressing the ENTER KEY, the screen will return to the real time screens, either showing real time data again, or showing saved memory. When the Analyst is displaying saved memory, a letter "M" will appear in the front of the character in the screen logo box.

When showing SAVED DATA, press the EXAM/PLOT

KEY followed by ENTER (RETURN TO 'REAL TIME') to get back to 'real time' data measurements. When viewing SAVED DATA, it is possible to scroll through all of the 12 data boxes, the 4 graphing screens, and the data screen. When viewing SAVED DATA, the user may optionally enter the maintenance menu, but will only be able to view the current settings therein.

When showing MEMORY data in any of the screens, some of the keys will not function. The keys that will not respond are WIDTH, FREQ, and NUMBERS.

NOTE: In the EXAM mode, power is removed from much of the Analyzer's circuitry. Enter this mode whenever possible to extend battery life.

Function Keys

The F1-F5 softkeys allow you to access different screens, data, and plot parameters.

• F1: User Menu

Use the F1 softkey to toggle between the real time screens and the user Menu screen. This screen contains a list of operational selections as well as a brief definition of each softkey. These definitions are located in boxes directly above their corresponding softkeys.
The list of operational selections includes: TEST, KEYS, CONTRAST:, SWR:3.0:, SWR:1.5:, METER, ZERO SWEEP TONE=ON(OFF), VF:.66 (OPEN) :. A flashing arrow cursor is automatically positioned next to the TEST selection whenever you enter this screen. Use the WIDTH▲ and WIDTH▼ keys to cursor through the list.

When the cursor is aligned with the TEST option, press ENTER to initiate a series of self-diagnostic tests. The word

"TESTING" will flash on the TEST line until the self-diagnostics are complete, whereupon one of three types of messages will appear. If the self-diagnostics do not detect any problems, the "PASSED" message will appear. If the Analyzer detects low battery levels, the "LO BAT" message will appear - refer to the Internal Access section for battery replacement information. Finally, if any problems are detected during the self-diagnostics, a failure message will appear. In this case, call AEA's technical support department for troubleshooting assistance (refer to In Case of Trouble section).

When the cursor is aligned with the KEYS option, press ENTER to display a new screen listing the function definitions of the number keys and softkeys. Press ENTER again to access the function definitions of the dedicated keys. Press ENTER a third time to return to the main user Menu screen.
When the cursor is aligned with the CONTRAST option, use the FREQ▲ and FREQ▼ keys to adjust the display contrast level.

The two SWR lines allow for input of specific SWR values between 1.2 and 3.5. The Analyzer will automatically display the corresponding bandwidths. When the cursor is aligned with either SWR selection, use the FREQ keys to adjust the displayed value.

Default SWR values: 1.5 and 3.0

When the cursor is aligned with the METER option, press ENTER to display the Analyzer's remaining battery voltage. The Analyzer will also measure and display the DC voltage of an external voltage source connected to the antenna connector.

CAUTION: Exceeding the maximum input of 50 VDC will damage the unit.

• F2: Grid

While viewing the S, Z, R, or X real time screens, press the F2 softkey to superimpose a grid (graticule) over the plot. The grid allows for more precision in determining values within a plot. Press F2 again to remove the grid.

Default: Off

• F3: Data Box

Use the F3 softkey to scroll through the data blocks located in the Data Box. This key is useful because it allows access to data without having to exit the 'real time' screen. The data blocks that are available include:

W:xxx Fc:xxx	Width, Center Frequency
SWR:xxx RL:xxx	Standing Wave Ratio, Return Loss
Z:xxx R:xxx X:xxx <:xxx	Value, Real component, Reactive component, and Phase Angle of Impedance
L:xxx C:xxx	Inductance or Capacitance value relating to the Reactance at the center frequency; describes the complex conjugate value of the Inductance or Capacitance needed to resonate a load to the center frequency

BW2.0:xxx Q:xxx	2:1 SWR bandwidth in MHz, Q factor (Fc/2:1BW)
FL:xxx BW2.0: FH:xxx	Lower Frequency @ SWR 2:1, Higher Frequency @ SWR 2:1
FL:xxx BW3.0: FH:xxx	Lower Frequency @ SWR 3:1, Higher Frequency @ SWR 3:1
FL:xxx BW1.5: FH:xxx	Lower Frequency @ SWR 1.5:1, Higher Frequency @ SWR 1.5:1
MIN SWR:xxx at F:xxx	Lowest SWR, Frequency at which MIN SWR appears
NORMALIZED Z:xxx	50-ohm Normalized value of Z expressed as Real ±j Imaginary components
<xxx Fc:xxx xxx>	Minimum, Center Frequency, Maximum values in the frequency sweep range
-xxx Fc:xxx +xxx	Lowest frequency in the sweep range (Fc - half width), Center Frequency, Highest frequency in the sweep angle (Fc + half width)

Fc:xxx Vf : .xx FT: xx.x (S) or (O)

• F4: Scale

To change the vertical axis' scale factor in the S, Z, X, and R screens, use the F4 softkey to scroll through three sets of scale values. Use this feature to zoom in and out of a plot quickly.

Default values: 1.0-6.0

• F5: Screen

Use the F5 softkey to scroll through the 'real time' screens. Notice that the Logo Box will update as you scroll through the screens. The logo box will show S, Z, R, X, D, F, or G. This indicates that the VIA is showing 'real time' data, and is making measurements for those screens. When MEMORY data is being viewed, then the logo box will print out MS, MR, MX, MD, or MF, to indicate that this is MEMORY data.

Default: S screen

Field Strength Measurement

There is a new mode called the "F" screen. This mode allows for measuring relative field strength at the antenna port of the analyzer. The Field Strength is displayed both numerically and with a bar graph simultaneously. The numeric values range from 0 to 1000, with 1000 equating to -3 dbm into 50 ohms at 25 MHz. If the field strength is over 1000, then the bar graph will blink on and off, and the numeric indicator will show "OVER RANGE." The analyzer is subject to damage if the "OVER RANGE" occurs.

Sweep Generator Mode

There is a new mode called the "G" screen. This mode functions as a sweep generator with a maximum "Span" (sweep width) of 20 MHz. A single "CW" frequency signal is emitted on the indicated "center" frequency (Fc) when the minimum "Span" of 0 KHz is selected. The "G" screen displays "Span" and the "center" frequency, as well as the upper and lower limits of the "Span". There is also a synchronizing pulse provided on the 3.5 mm stereo jack used for the computer connection. This is covered in greater detail in the next section.

The normal "SWR" plotting modes of the analyzer perform the same function as the seep generator mode. However, in the normal "SWR" modes, the synchronizing pulse is not provided. As in the normal "SWR" modes, the "WIDTH" keys select the "Span" and the "FREQ" keys select the "center" frequency (Fc).

Signal Generator Syncronizing Pulse

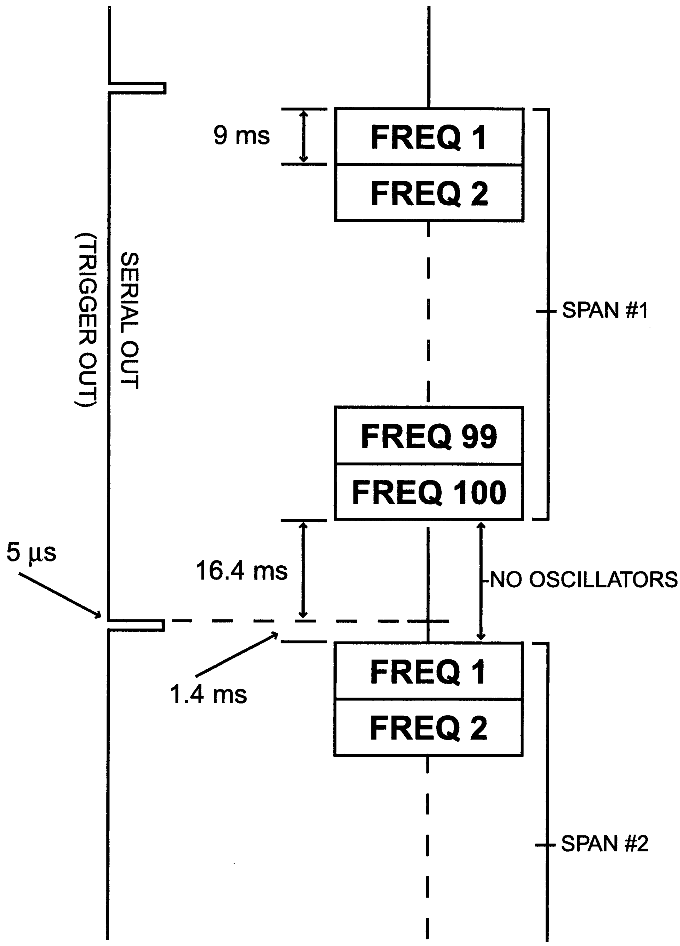
The VIA Analyzer has a unique feature in its Signal Generator Mode. There is a 5 micro second, positive going pulse that appears on the Serial Port output, 1.4 milli-seconds before the start of every sweep. The timing is better described in the figure on page 24. Basically, the 5 μs pulse starts the cycle, then there is a 1.4 ms pause before the sweep begins. The 'sweep' consists of 100 individual frequency steps, each taking 9 ms to complete before the next step. At the end of the 'sweep' there is another 16.4 ms pause after the last frequency. The cycle begins again with another 5 μs pulse. The 5 μs pulse occurs approximately every second. The actual timing is as follows: 1.4 ms from the positive going edge to the start of the sweep, +100 frequencies at 9 ms each (900 ms). +16.4 ms pause equals 917.8 ms. This positive going pulse is good for triggering an oscilloscope so that you might view the output of a filter or some other circuit. The pulse appears on the TIP of the Serial Port Tip, Ring, Shield connector and short enough duration to NOT effect any connected serial port connection.

NOTE - It is not possible to trigger the Sweep Generator from an external sync source.

NOTE - It is suggested that you disconnect your computer from the serial jack on the Analyst while in the Signal Generator Mode, as the synchronizing pulse may induce erratic operation in your software application.

Single Generator Mode Diagram

(times are approximate)



Resetting the Instrument

The current screen and plot settings (i.e. center frequency, frequency step size, scale value, and width) are saved when you turn off the Analyzer. This feature allows you to power back up to the same screen and settings. To reset the Analyzer to its factory default settings, press any of the number keys to enter the Numerical Entry screen. Then, simply power the Analyzer off. The next time you activate the Analyzer, it will operate according to the factory default settings: center frequency: 14.200 MHz, width: 100 kHz, frequency step size: 10 kHz, and scale: 1.0-6.

Automatic Off

The Analyzer is programmed to automatically power off after an idle period of five minutes, in order to conserve battery power. The Analyzer resets the idle period each time you press a key.

SECTION 4 APPLICATIONS

The following examples by no means describe the extent of the Analyzer's capabilities, but are intended as jumping off points.

Tuning Simple Antennas

Example: Tuning an 80-meter inverted "V" antenna to 3800 kHz.

Process:

1. Insert the feedline of the 80-meter inverted "V" antenna into the Analyzer's antenna connector.
2. Turn the Analyzer on. When the S screen appears, press 3 8 0 0 ENTER to change the default center frequency value to 3800 kHz. Maintain the default width value.
3. A "V" or "U"-shaped SWR curve will appear.
4. Using the F4 (zoom factor) softkey, select the lowest scale values that maintain the bottom of the SWR curve below the scale's midpoint. (You may have to experiment a little to determine which scale values work.)
5. Determine on which side of the center frequency the bottom of the SWR curve rests. The bottom of the curve should indicate the antenna's resonant frequency.
6. To confirm the value of the resonant frequency, press F3 to scroll through the data blocks until "MIN SWR:xxx at F:xxx" is displayed. This data block indicates the location of the minimum SWR.
7. Press F5 to enter the Z screen. A "V" or "U"-shaped curve will appear, indicating the absolute value of Impedance versus frequency.
8. Press F5 again to enter the X screen. The Reactance plot will dip down toward 0 ohms (on the vertical scale) at the resonant frequency.

If the resonant frequency is higher than the center frequency in the SWR plot, you can assume the Reactance is Capacitive. To tune the antenna to resonance, you either need to add equal lengths of wire to each side of the "V" antenna, or add an inductor, in series with the center conductor of the antenna's feedline, at the feedpoint. Press F3 until the Data Box displays the "L:xxx C:xxx" data block. The "C:" value indicates the antenna's equivalent series Capacitance at the center frequency. The "L:" value indicates the series Inductance (conjugate value) needed to resonate the antenna at the center frequency. You will likely have to experiment with the Inductance value to find an exact match. Depending on both the Impedance mismatch at the antenna feedpoint and the length of the feedline, you can use either an inductor or capacitor, in series with the center conductor of the feedline, to tune for resonance.

If the resonant frequency is below the center frequency, you can assume that the Reactance is Inductive (i.e. the antenna is TOO LONG). In this case, perform the reverse of the operation described in the above paragraph.

Tuning 1/2 and 1/4 Transmission Lines and Stubs

Example: Using a standard Wilkenson power divider to stack two 15-meter Yagi antennas with two 3/4 wave sections of RG-11, 75-ohm coax lines. The 3/4 wavelength cable is used in this example because two 1/4 wavelength cables would not be long enough to allow optimum stacking distance between the two antennas.

Process:

1. Use the following equation to determine the length of coax cable needed for 1/4 wave phasing lines. (For solid polyethylene coax, assume a velocity factor of 0.6.)

$$\frac{246}{F} \times Vf = \frac{246}{21.250} \times 0.6 = 6.61 \text{ feet}$$

For 3/4 wave phasing lines, plug 6.61 feet into this equation:

6.61 x 3 = 19.8 = 19 feet 9 5/8 inches

2. Cut two, 22 foot-long lengths of coax cable (the lengths of coax cable are cut approximately 10% longer than the computed length to allow for fine tuning).
3. Solder a coax "PL-259" connector to one end of each cable.
4. Attach the "PL-259" connector to a "T" connector already attached to the Analyst's antenna connector. Attach a 50-ohm load to the other end of the "T" connector (Figure 2).
5. Turn the Analyzer on. At this point, follow the steps for either the 1/2 Wave Cutting Method or the 1/4 Wave Shorting Method.

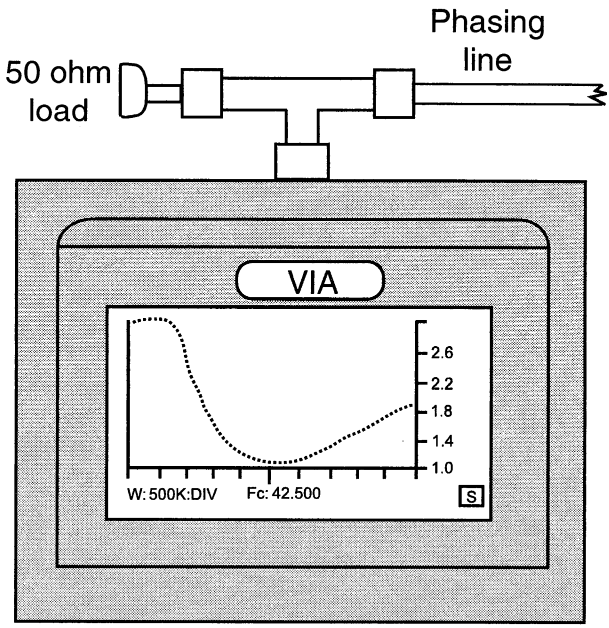


Figure 2
"T" Connector

1/2 Wave Cutting Method

1. When the S screen appears, press the WIDTH▲ key twice to select an initial width of 500 kHz. Enter 4 2 5 0 0 ENTER to set the center frequency to 42.500 MHz (the frequency at which the tuned phasing lines will be 1.5 wavelengths). This center frequency value is twice the 21.250 frequency value used in the above equation.
2. A "V" or "U"- shaped SWR curve will appear.
3. If the calculations for determining the length of coax cable were correct, the SWR curve should dip at a frequency of approximately 38.250 MHz. You are now ready to start tuning the phasing line.
4. Begin cutting inch-long pieces off of the unterminated end of the phasing line. The resonant frequency of the

SWR curve will increase as the line is shortened.

5. As the SWR dip descends lower in the plot, shorten the cuts to 1/4 inch long. This allows you to finely tune the line. In addition, use the WIDTH▼ key to increase the display resolution. Use the F4 softkey to zoom in on the dip. Once the SWR dip reaches a minimum, your antenna is tuned.
6. Repeat this process for the second phasing line. It is imperative that the bottom of the two SWR curves are aligned on the same frequency. If the bottom of one of the curves is at 0 over a narrow group of frequencies, average the two extreme frequencies where the SWR is at a minimum.

1/4 Wave Shorting Method

1. Enter 2 1 2 5 0 ENTER to set the center frequency to 21.250 MHz.
2. Starting from the unterminated end of the line, use a very sharp ice pick to short through the coax cable.
3. Determine the position that produces the lowest SWR point at the center frequency. Cut the cable at this point and install a coax connector. Your cable is now tuned.
4. Repeat this process for the second phasing line.

You can also use the 1/2 Wave Cutting or 1/4 Wave Shorting methods described above to tune phasing lines any number of degrees for a particular frequency. For example, if you want to cut a transmission line for 21° at 3.795 kHz, simply use the following equation to determine the frequency for 180°:

$$\frac{180}{21} \times 3.795 = 32.529 \text{ MHz}$$

Since 21° at 3.795 kHz is equivalent to 180° at 32.529 MHz, simply use the 1/2 Wave Cutting Method to tune the line for 32.529 MHz.

Measuring Inductors and Capacitors

When measuring inductors and capacitors, it is highly recommended that you assemble an accessory connector to maximize Analyzer accuracy. To do this, solder one end of a 50-ohm resistor onto the center pin of a coax PL-259 connector. Then, splice an alligator test lead to the resistor; solder a second test lead to the connector shell (Figure 3).

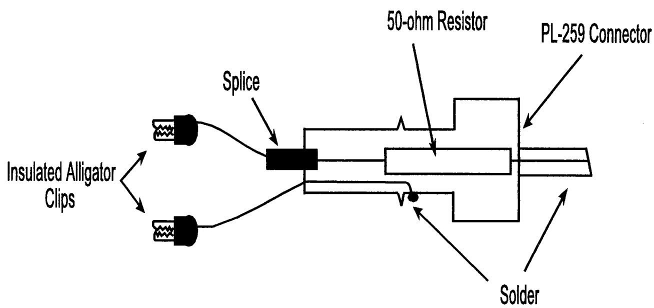


Figure 3
50 ohm accessory connector

For best results, when determining the value of an inductor or capacitor, take measurements at the frequency where the Reactance of the load is equal to the 50-ohm resistor in the accessory connector.

• Inductors

Example: Determining the Inductance of a relatively small coil.

Process:

1. Plug the 50-ohm accessory connector into the Analyzer and clip the coil between the two test leads.

2. Turn the Analyzer on and use the F5 softkey to scroll to the X screen. Enter 2 5 0 0 0 ENTER to select an initial center frequency of 25 MHz. Press the WIDTH▲ key until the width is set to 1 MHz. Also, use the F4 softkey to set the scale to the 0-250 ohms range.
3. Unless you select a higher frequency, low Reactance will probably cause the plot to flat line near the bottom of the screen. If Inductance is relatively high in higher frequencies, the Reactance plot will flat line near the top of the scale.
4. Experiment with different center frequency values until you find the point at which the Reactance plot reaches approximately 50 ohms.
5. Use F5 to scroll to the Data screen. The Phase Angle (<:) should read approximately 45°. If it does not, press the FREQ▲ or FREQ▼ key until it does. Now, identify the Inductance (L:) value within the Data screen.

• **Capacitors**

Example: Determining the Capacitance of a small capacitor (approximately 1000 pF).

Process:

1. Plug 50-ohm accessory connector into Analyzer, and clip the capacitor between the two test leads.
2. Turn the Analyzer on, and use the F5 softkey to scroll to the X screen. Enter 5 0 0 0 ENTER to select an initial center frequency of 5 MHz. Press the WIDTH▲ until the width is set to 1 MHz.
3. The Reactance plot will sweep down from the left side of the display, leveling out as it approaches the right side.
4. Adjust the center frequency value until you determine the point at which the Reactance is approximately 50 ohms.
5. Press F3 until the "Z:xxx X:xxx R:xxx <:xxx" data block is displayed. The Phase Angle (<:) should read

approximately 45° since the R and X values are roughly equal. If it does not, adjust the center frequency until it reads as close to 45° as possible.

6. Press F3 to scroll to the "L:xxx C:xxx" data block. Refer to the "C:" value to determine Capacitance.

Tuning Antenna Traps

Example: Using the 50-ohm accessory connector constructed for the above example to tune an antenna trap (composed of a coil in parallel with a capacitor).

Process:

1. Leave the coil and capacitor of the trap connected at one end, separated at the other.
2. Clip one test lead of the accessory connector to the coil, the other test lead to the capacitor.
3. Turn the Analyzer on. Maintain the default S screen and plot values.
4. Determine on which side of the center frequency the bottom of the SWR curve rests. The bottom of the curve should indicate the antenna's resonant frequency.
5. To confirm the value of the resonant frequency, use F3 to scroll through the data blocks until "MIN SWR:xxx at F:xxx" is displayed. This data block indicates the location of the minimum SWR.
6. Press F5 to enter the Z screen. A "V" or "U"-shaped curve will appear, indicating the absolute value of Impedance versus frequency.
7. Press F5 again to enter the X screen. The Reactance plot will dip down toward 0 ohms (on the vertical scale) at the resonant frequency.
8. Refer to the analysis paragraphs following the "Tuning A Simple Antenna" procedure.

Determining Resonant Frequency

Example: Using the 50-ohm accessory connector constructed for the above example to determine the resonant frequency of an LC-tuned circuit.

Process:

1. Use the test leads of the 50-ohm accessory connector to connect the inductor and capacitor in series.
2. Turn the Analyzer on. Maintain the default S screen.
3. Find the resonance point of the circuit by locating the lowest SWR point.
4. Use the FREQ keys to center the lowest SWR point.
5. Access the Data screen to read the 2:1 SWR bandwidth and Q factor directly.

Determining Characteristic Impedance

For this type of measurement, you will need to assemble another accessory connector using a 500-ohm potentiometer (Figure 4).

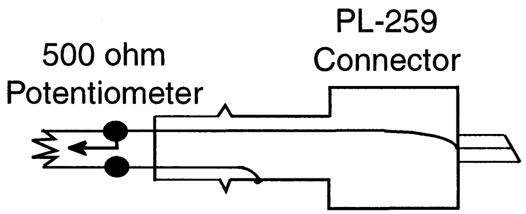


Figure 4
5000 ohm potentiometer connector

Example: Determining the characteristic Impedance of an unknown coax cable.

Process:

1. Attach the unknown cable to the Analyzer's antenna connector. Attach the potentiometer accessory connector to the unterminated end of the cable using a PL-258 barrel connector.
2. Use the F5 softkey to scroll to the R screen. Press 2 5 0 0 0 ENTER to select a new center frequency value of 25 MHz, and press the WIDTH▲ key until the width is set to 1 MHz. Use the F4 softkey to set the vertical scale to 100 ohms full scale.
3. Depending on the length of the cable (hopefully at least 25 feet), two or more sine waves will appear on the display.
4. Use the potentiometer to adjust the plot for minimum amplitude variance on the sine waves.
5. Now, disconnect the potentiometer from the cable. Use a volt-ohmmeter to determine the Resistance of the potentiometer. Usually a 50-ohm cable will read between 49 and 52 ohms of Resistance. It is also possible to read the Resistance value of the potentiometer by disconnecting it from the cable and plugging it directly into the Analyzer. Use the F5 softkey to scroll to the Data screen; once there, identify the Resistance (R:) value.

<u>Testing Baluns</u>

Example: Using the 500-ohm potentiometer accessory connector constructed for the above example to determine the output (or input) Impedance of an unknown balun.

Process:

1. Insert the 50-ohm port of the balun into the Analyzer, and the potentiometer connector into the balun's vacant port.
2. Turn the Analyzer on. Maintain the default S screen.

3. Adjust the potentiometer for minimum SWR. (The balun may not flat line over a wide range of frequencies.)
4. To identify the balun's useful range, experiment with different center frequency and width values. You may see larger SWR values at the extreme lower and upper frequencies.
5. To determine the balun's Resistance, disconnect the potentiometer from the balun and plug it directly into the Analyzer. Then, access the Data screen (F5 softkey) to identify the Resistance (R:) reading.

Adjusting Antenna Tuners

Example: Adjusting an antenna tuner without transmitting a signal on the air.

Process:

1. Connect a cable from the input of your antenna tuner to the center connector of a two-position coax switch (be sure to use a switch that shorts the unused position).
2. Connect the open position of the switch to the output of your transceiver.
3. Connect a cable from the closed position of the switch to the antenna connector on the Analyzer.
4. Turn the Analyzer on. Set the center frequency and width to values of your choice. Use the F5 softkey to scroll to the Z screen.
5. Adjust the tuning on the antenna tuner (with the proper antenna connected to the antenna tuner output) until the center frequency displays an Impedance value of 50 ohms.
6. Use the F5 softkey to scroll to the X screen to make sure Reactance is zero.
7. Use F5 to scroll to the S screen. Note the low SWR value at the center frequency. Flip the coax switch to the transceiver. The low SWR presented to the Analyzer will now be presented to the transceiver.

Remote Operation

There are several commercial software packages available (including VIA Director from Tempo) designed to allow for remote operations. For details on the commands and responses of the serial port, refer to Appendix B.

More Applications Ideas for the VIA-HF

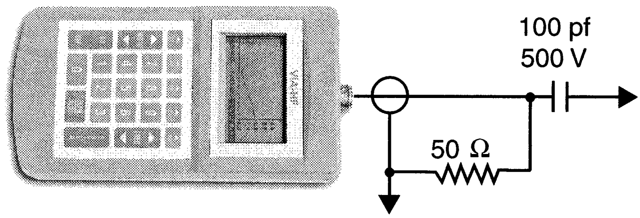
The VIA-HF makes an outstanding substitute for a grid dip meter with the following advantages:

- Excellent frequency accuracy
- Excellent frequency stability
- No backlash
- Graphical presentation of the Q Factor

To utilize the VIA-HF as a grid dip meter, simply use a short piece of RG-58 Coax about a foot or two long. Place a Type N connector on one end of the coax. Make a shorted turn about 1.5 inches in diameter out of the other end of the coax. The shortened turn can be used as a probe to look at resonant circuits. You may also use it to look at the self-resonance of RF chokes, etc. The use for this capability of the VIA-HF is really limited only by your imagination. The short turn probe may also be used for inductively inserting signals into a receiver at strategic locations to check mixers, oscillators and amplifiers.

Signal Tracing

The VIA-HF has a precision signal generator of excellent frequency stability with approximately 5 mW of output power. This makes the perfect test instrument for signal tracing in troubleshooting HF communications receivers. To protect the VIA-HF when using it in this mode, it is necessary to build a simple test probe so that high voltages you encounter will not damage this test instrument. A suggested circuit is shown. **Do not attempt to signal trace using the VIA-HF without using a protective probe!**



The VIA-HF is also suitable for calibration of receivers and signal peaking/alignment.

Tuning Cavity Filters

The VIA-HF can be used for tuning cavity filters by simply connecting the VIA-HF to the input of the cavity and tuning it to the appropriate frequency using the SWR screen. Then connect to the output connector of the cavity filter and tune it to the appropriate frequency. You may have to juggle back and forth a few times because of interaction, but you should be able to get reasonably close.

Signal Source

The VIA-HF makes an ideal portable signal source for checking the relative sensitivity of receivers in the field or the performance of an antenna. Simply place the VIA-HF at an appropriate distance from the receiving antenna with a short piece of wire connected to the output connector. Place the VIA-HF into the signal generator mode (single-frequency sweep) tuned to the frequency of interest. You will have up to an hour before the auto turn-off mode is activated. If you need more signal, try lengthening the probe antenna on the VIA-HF. To lessen the signal, simply shorten the probe.

Relative Field Strength

You can use the VIA-HF to determine the relative field strength of electromagnetic radiation in any given environment. To get a relative field strength reading, where you suspect high levels exist, simply connect a short piece of wire to the VIA-HF connector and place the instrument in the Field Strength mode. As you use this mode in known environments, you will gain a distinct feel for what the relative field strengths are in new environments.

SECTION 5 GLOSSARY

Capacitive Reactance - The Reactance of a circuit resulting from Capacitance, or the property of a device or component that enables it to store energy in an electrostatic field and release it later.

Center Frequency - The frequency corresponding to the center of a plot; defines the midpoint of the frequency sweep range.

Data Box - Displays the data blocks described in the Function Keys section; located below the horizontal axis in the real time graphing screens.

Graticule - A dotted grid superimposed on a plot to aid the user in discerning numerical values.

Idle Period - The amount of time that elapses between user inputs; the Analyzer will power off after a five minute idle period in which no keys have been pressed.

Impedance - The total passive opposition offered to the flow of an alternating current; total (absolute) Impedance consists of Resistance plus either Capacitive or Inductive Reactance.

Inductive Reactance - The Reactance of a circuit resulting from the presence of Inductance, or the property of an inductor that opposes any change in a current that flows through it.

Logo Box - Displays a letter identifying the currently displayed screen; located in the lower right corner of each real time graphing screen.

Plot - The analog display of various antenna values relative to frequency.

Q factor - As it relates to the Analyzer, this value, which is calculated by dividing the center frequency by the 2:1 SWR bandwidth, provides a relative indication of how sharp an antenna or tuned circuit is.

Reactance - The part of total Impedance resulting from Inductance or Capacitance.

Real Time - A term applied to the eight primary graphing and data screens; indicates that there is no significant delay between data capture and display.

Resistance - The opposition of a material to the flow of electric current; Resistance is equal to a voltage drop through a given material, divided by the current flow through it. The standard unit of Resistance is the ohm.

Return Loss - The approximate loss that a signal experiences when traveling "round-trip" through a cable, expressed in decibels (dB).

Scale - The values displayed on the Y (vertical) axis of the graphing area.

Screen - A display containing either real time plots or data:

S: Real time sweep display of a test load's SWR curve.

Z: Real time sweep display of a test load's Impedance (absolute value) vs. frequency curve.

R: Real time sweep display of a test load's Resistance vs. frequency curve.

X: Real time sweep display of a test load's Reactance vs. frequency curve.

F: Incicates the intensity of the ambient raditaion field emitted by nearby transmitted stations.

D: Consolidates a number of the data blocks displayed in the Data Box; these data blocks are displayed and updated in real time.

N: Displays numbers as they are entered on the keypad.

Standing Wave Ratio (SWR) - The ratio of the maximum to minimum voltage on a transmission line connected to an antenna.

User Menu - A display screen (separate from the eight primary screens) used to define keys, initiate self-diagnostic tests, set the display contrast level, select special functions, enter the voltmeter mode, etc.

SECTION 6.: INTERNAL ACCESS

BATTERY REPLACEMENT

Confirm that the Analyzer is off before replacing the batteries. Then remove the two screws behind the rubber foot to access the battery compartment. To avoid damaging the Analyzer, be sure to insert the batteries according to the markings located on the inside wall of the case. Replace all eight batteries at the same time. Make sure the foot's pegs are securely positioned in the slots in the top of the battery cover before reinstalling the screws.

SECTION 7.: LIMITED WARRANTY

AEA Technology, Inc., warrants to the original purchaser that the VIA-HF Complex Impedance 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.

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Section 8 · In Case Of Trouble

If your Analyzer doesn't seem to be working properly, please try the following suggestions before sending the unit in for repair:

- When the Analyst is being used as a portable instrument, low batteries are the most likely cause of difficulty. Run the TEST Function in the user Menu screen to check battery levels

- If the Analyst is plugged into an external power source, determine whether or not your power supply is capable of providing 12 to 16 volts DC while the unit is on If you're not sure, use a known good 12VDC Power supply. Also make sure the center pin of your power cable is positive or you may risk damage to the Analyzer.

- Make sure All Cables Are securely connected. Check cable continuity with an ohm meter

Note A tilde (') in front of the Character in the Screen logo box indicates that the analyzer may have lost its internal calibration data from memory.

If you can't solve the problem yourself, our Technical Service staff may be reached at 800-258-7805 or +1-760-931-8979 7AM-4PM M-F Pacific Time, or by e-mail at **techsupport@aeatechnology.com**. Users are also encouraged to check the Application Notes and Software for updates using the "Literature and Software" button in the tool bar at **www.aeatechnology.com**.

Please let us try to help you over the phone before sending the unit in. Many of the products we receive for service are in perfect working order when we receive them. Calling us for technical assistance can save you both time and money.

Section 8 · In Case Of Trouble

If you call for assistance, please have The Analyzer serial *number available. Also, have the Analyzer connected to a load and powered on.*

The technician you speak with may ask you to perform certain functions to aid in diagnosis. You will also need to identify the nature of any other equipment connected to the Analyzer.

If the Analyzer needs to be returned to the factory, please call (760) 931-8979 for a Return Material Authorization (RMA) number. Also, please include a statement giving a complete description of the problem, including the conditions under which it occurred. Complete return information (name, company, address, and daytime phone number) should be included with each unit.

Units should be sent to:

AEA Technology, Inc.
Repair Department, RMA No._____
5933 Sea Lion Place
Suite 112
Carlsbad, CA 92010

APPENDIX A ADDITIONAL SPECIFICATIONS

The Real(Z) reading, Im(Z) X reading, and Phase reading are for indication only. They are considered derived from SWR and mag-Z reading. See the notes below on the derivations.

SWR and mag-Z reading resolution

-In the range of 100 kHz to 2 MHz

	typical	max.
SWR range of 1.0 to 1.5 SWR	±0.1	±0.35
SWR range of 1.5 to 20 SWR	for indication only	
Z - mag with SWR<1.5	±5%	±15%
Z - mag with SWR<2.0	±10%	±35%
Z - mag with SWR>2.0	for indication only	

-In the range of 2 MHz to 38 MHz

	typical	max.
SWR range of 1 to 2 SWR	±0.07	±0.2
SWR range of 2 to 3 SWR	±0.12	±0.4
SWR range of 3 to 5 SWR	±0.35	±1.0
SWR range of 5 to 20 SWR	for indication only	
Z - mag with SWR<1.5	±5%	±15%
Z - mag with SWR<2.0	±10%	±35%
Z - mag with SWR>2.0	for indication only	

-In the range of 38 MHz to 50 MHz

	typical	max.
SWR range of 1.0 to 2 SWR	±0.15	±0.35
SWR range of 2 to 3 SWR	±0.3	±0.8
SWR range of 3 to 5 SWR	±0.5	±1,2
SWR range of 5 to 20 SWR	for indication only	
Z - mag with SWR<1.5	±5%	±15%
Z - mag with SWR<2.0	±10%	±35%
Z - mag with SWR>2.0	for indication only	

A high SWR error or a high Z error in each range, typically, has either a low Re(Z) or a high X/R ratio for that range.

-In the range of 50 MHz to 54 MHz

	typical	max.
SWR range of 1.0 to 1.5 SWR	±0.15	±0.35
SWR range of 1.5 to 20 SWR	for indication only	
Z - mag with SWR<1.5	±8%	±15%
Z - mag with SWR<2.0	±15%	±35%
Z - mag with SWR>2.0	for indication only	

Frequency resolution

Each *frequency/div* has ten *bins* or *pixels*. The resolution would be the greater of ±2 *bins* or ±40*(freq. MHz) Hz. Example: 50 MHZ at 50 k/div→2 *bins* =
±10 k or 40*(50) Hz = 200 Hz.

Temperature specifications

Temperature Range is 10° C (50° F) to 35° C (95°F). With de-ratings, the effective Temperature Range is
0° C (32° F) to 60° C (140° F).

The de-rated Spec. between 35° C (95° F) to 60° C (140° F)

Specification between 35° C to 60° C expect the SWR to read typically 10% (near 40° C) to 20% (near 60° C) less than a room temperature reading, for SWR between 1.0 - 2.5. The mag-Z typically reads 5% (near 40° C) to 10% (near 60° C) less than a room temperature reading, with SWR <2.5. This is an error in addition to the standard resolution, assuming SWR <2.5. Outside this range (SWR>2.5), the readings are for indication only. As noted, the temperature increases only cause these readings to be slightly lower than room temperature readings.

The de-rated Spec. between 0° C (32° F) to 10° (50° F)

Specification between 0° C to 10° C expect the SWR to read typically 10% (near 0° C) above a room temperature reading, for an SWR between 1.0 - 2.5. The mag-Z typically reads 5% (near 0° C) above a room temperature reading. This is an error in addition to the standard resolution, assuming SWR<2.5. Outside this range (SWR>2.5), the readings are for indication only. As noted, the temperature decreases only cause these readings to be slightly higher than room temperature readings.

Definition of "indication only"
The phrase **"indication only"** means that the instrument will be useful in adjusting a system in which one brings the signal into an SWR range of 1.0 to 2.0. This instrument will indicate the direction of the adjustments for the user. This assumes that there is not a high ratio of reactance over real resistance, nor a low real resistance (R<20).

Definition of "max. error reading"
The **"max. error reading"** means that for testing, the technician uses a frequency of a long cable with a resistive termination that will give several cyclic readings in SWR and in mag-Z.

The cyclic swings covering most of the SWR range under test for the frequency range being tested. At least 99% of all the recorded sequential data points in the sweep would be within the limits listed.

Notes on Real(Z) R reading, Im(Z) X reading, and Phase angle reading.
The Real(Z), R scale and Im(Z) X scale are considered derived from SWR and mag-Z readings from the detection bridge.

One can estimate the error from the following equations used to calculate these values.

$Re(Z)=R = (50^2+magZ^2)*SWR/(50*(SWR^2 -1))$ in ohms

Note that small errors in SWR do not give large R errors. Example: if true R=60 and true X=50→SWR=2.46. If we add 0.4 to the SWR, and have the correct Z=78, R would calculate out at 54 ohms→, a 6 ohms error.

$Im(Z)\ X = \sqrt{(magZ^2-R^2)}$ **The sign of X is not determined by this equation.**

With the information from the data sweep in frequency, a logical value of the sign is applied to the results, if that data meets certain software criteria in that data sweep (typically a clean dip or peak). The criteria is not an exact solution for the correct sign. It is for indication only.

Phase = ArcTan(X/R)

For indication only if displayed. There can be large errors when X is small or when X/R ratio is large. When X is small the normal errors lead to large Phase error. When X/R ratio is large, the detection bridge has larger errors. When the sign of "X" is not determined, the sign of Phase reading is not determined.

Related Equations

ρ = V(reflected)/V(transmitted) [a ratio ρ <=1]

$$\rho = ABS\left[\frac{50 - Z}{50 + Z}\right]$$

the value for a 50 ohm system and Z complex load

Return loss (dB) = $-20*\text{Log}_{10}(\rho) = 20*\log_{10}(1/\rho)$

The negative sign is added because ρ<0 and the dB value is assumed to be a loss (negative) so the negative sign is not shown in a return loss dB number for cables [*engineering convention*] (as opposed to optical fiber systems in which the negative sign is used [*physics convention*] to show it is a loss).

$$SWR = \frac{1 + \rho}{1 - \rho}$$

or

$$Re(Z) = \frac{50^2+Zmag^2*SWR}{50*(SWR^2 +1)}$$

$$Re(Z) = \frac{50^2+Zmag^2*(1-\rho^2)}{50*(1+\rho^2)}$$

Frequency Range	0.1 to 54 MHz (optional higher frequencies)
Frequency Resolution	Increments of 1 kHz
Frequency Accuracy	±200 Hz
Display Width	0 to 20 MHz

APPENDIX B SERIAL PORT PROTOCOLS

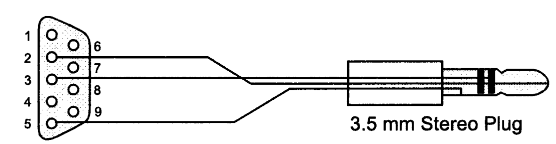
This Appendix describes the hardware and software protocols for using the serial port. These protocols are contained withing several commercial software packages, including VIA Director from Tempo. This Appendix is included for reference purposes.

Serial Port Protocol
9600 baud
8 data bits
no parity
1 stop bit

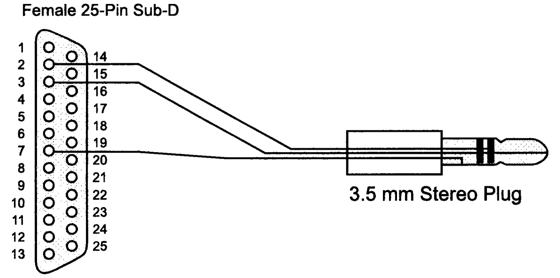
Power Up

To perform remote operation, you will need to connect the Analyzer to your PC via a serial interface cable. You have the option to assemble a cable yourself or purchase the 9-Pin Sub-D serial interface cable displayed below, directly from AEA.

Female 9-Pin Sub-D



Female 25-Pin Sub-D



The Analyzer can be powered up manually, using the On key, or remotely, using your PC. To remotely power up the Analyzer, simply send the letter "K" until you receive a "?" in response. At this point, you can begin sending commands. When the Analyzer is already powered on, it will automatically time out after a five-minute idle period in order to conserve batteries. It will power back up when it detects an incoming serial stream.

Rules for Commands

- All commands must be in upper case letters. Lower case letters are invalid.

- All incoming commands to the Analyzer must be terminated with the letter "K". If the Analyzer detects an incoming stream containing ten or more characters, that is not terminated with the letter "K", it will output a "?" and discard the characters. All commands contain fewer than ten characters.

- All outgoing responses from the Analyzer are terminated with either a "K" or a "?". the letter "K" indicates that the incoming command was properly executed and that no further information is outgoing. The "?" indicates that the Analyzer did not understand the incoming command. Re-enter the proper command.

- The Analyzer will accept commands manually entered on its keypad **or** remotely transmitted from a terminal (serial commands). **DO NOT ATTEMPT TO USE BOTH METHODS AT THE SAME TIME. THE ANALYZER WILL NOT ACCURATELY RESPOND TO MIXED MANUAL AND SERIAL COMMANDS.**

NOTE - The "G" screen, when entered for the keypad, will output pulses on the serial port line. This may be erroneously interpreted by any software running on the host computer connected to the serial cable.

Commands

The following serial commands direct the Analyzer to perform certain functions. Remember, each of these commands must be terminated with a "K", as shown.

SK Send 100 SWR data points
ZK Send 100 Z (Impedance Magnitude) data points
XK Send 100 X (Reactance) data points
RK Send 100 R (Resistance) data points

NOTE - The SK, ZK, XK, and RK commands will cause the Analyzer to shift to the respective realtime graphics screen.

GK This command tells the VIA not to update the screen. Instead of screen updates, the screen will say "SERIAL CONTROL", indicating that the unit is under serial control. There are two ways to get the screen back. One way, is to hit any key. The second way is to use the HK command. This command is used to speed up the serial control process.

HK This command tells the VIA to update the screen, for each serial command (F changes, W changes, etc.)

IK This is an "I"ntegrated command. It will return BOTH S and Z data pairs for the current Frequency and Width. The format of the data is:

I =	101 499,	(SWR, Z)
	101 499,	(SWR, Z)
	...	
	...	
	101 499,K	(last SWR and Z pair, Termination character "K")

This speeds up the overall serial communications path by only using a single command to gather both S and Z data.

WxK or WxxK	Set the WIDTH to the following values: x = 0 width set to 0 kHz per data point xx = 11 width set to .1 kHz per data point xx = 12 width set to .2 kHz per data point xx = 13 width set to .5 kHz per data point x = 1 width set to 1 kHz per data point x = 2 width set to 2 kHz per data point x = 3 width set to 5 kHz per data point x = 4 width set to 10 kHz per data point x = 5 width set to 20 kHz per data point x = 6 width set to 50 kHz per data point x = 7 width set to 100 kHz per data point
UxxK	Set the User #1 SWR threshold to xx xx must be in the range of 12 to 35
VxxK	Set the User #2 SWR threshold to xx xx must be in the range of 12 to 35
AxxK	xx = 00 gather real-time data xx = 01 Use MEMORY "A" data xx = 02 Use MEMORY "B" data xx = 03 Use MEMORY "C" data xx = 04 Use MEMORY "D" data This command allows retrieval of SWR, Z, X, R, etc. data from the MEMORY, previously stored by the user. When commands A01K, A02K, A03K, and A04K are active, i.e., any of the memory commands, subsequency F(Frequency), W(Width), U(User #1 SWR threshold) or V(User #2 SWR threshold) will

return ?K. This is because changing frequency, width, or SWR thresholds on MEMORY data is not allowed.

BxxK (Directs the DATA BOX Field to retrieve the data contained in the Analyzer's Data Box. Refer to the F3: DATA BOX section for more detailed information on the responses you will receive.)

Set the Data Box to xx, where xx must be the following:
xx = 00 Report width, and center frequency
xx = 01 Report SWR, and Return Loss
xx = 02 Report the Z, R, X, and Angle at the center frequency
xx = 03 Report equivalent L, C at center frequency
xx = 04 Report 2:1 Bandwidth Q
xx = 05 Report lower (2:1) frequency, 20, upper (2:1) frequency
xx = 06 Report lower (X:1) frequency, X, upper (X:1) frequency
xx = 07 Report lower (Y:1) frequency, Y, upper (Y:1) frequency
xx = 08 Report minimum SWR, frequency @ minimum SWR
xx = 09 Report Normalize R, ±j Normalized X
xx = 10 Report frequency low, center frequency, frequency high
xx = 11 Report -offset, center frequency, +offset
xx = 99 Power off Analyzer

FxxxxxK

Set the center frequency to xxxxx. xxxxx must be in the range of 00400 to 54000. Leading zeros are required.

Responses

Below is a list of "live" serial commands and responses (left column) and the information communicated by each command/response (right column).

IK	; Illegal command sent
?	; Response from Analyzer
f12345K	; Illegal command sent (lower case "f")
?	; Response from Analyzer
F12345K	; Command sent to Analyzer: set center frequency to 12.345 MHz
F12345K	; Response from Analyzer: center frequency set to 12.345 MHz
BOOK	; Command to Analyzer: report width and center frequency
B=10,12345K	; Response from Analyzer:
	; Response: width = 10kHz per data point, center frequency = 12.345
W7K	; Command to Analyzer:set width to 100 kHz per data point
W7K	; Response from Analyzer: width set to 100 kHz per data point
F08000K	; Command sent to Analyzer: set center frequency to 08.000 MHz
F08000K	; Response from Analyzer: center frequency set to 8.0 MHz
B01K	; Command to Analyzer: report SWR and Return Loss at center frequency
B=107,294K	; Response from Analyzer:
	; Response: SWR = 1.07, Return Loss = 29.4 dB

B02K	; Command to Analyzer: report Z, R, X, and Angle
B=501,501,0,-0K	; Response from Analyzer:
	; Response: Z = %0.1, R = 50.1, X = 0, angle = -0°
B05K	; Command to Analyzer: report frequency low, high for 2:1 bandwidth
B=6550,20,9650K	; Response from Analyzer:
	; Response: frequency (low) = 7.3 MHz, BW = 1.5:1, frequency (high) = 9.65 MHz
B06K	; Command to Analyzer: report frequency low, high for USER #1 bandwidth
B=7300,15,8900K	; Response from Analyzer:
	; Response: frequency (low) = 6.85 MHz, BW = 1.5:1, frequency (high) = 8.9 MHz
U18K	; Command to Analyzer: set the USER #1 Bandwidth to 1.8
U18K	; Response from Analyzer: USER #1 Bandwidth set to 1.8
B06K	; Command to Analyzer: report frequency low, high for USER #1 bandwidth
B=6850,18,9350K	; Response from Analyzer:
	; Response: frequency (low) = 6.85 MHz, BW = 1.8:1, frequency (high) = 9.35 MHz
B08K	; Command to Analyzer: report minimum SWR and frequency at the minimum SWR
B=105,8100K	; Response from Analyzer:
	; Response: minimum SWR detected = 1.05, at 8.1 MHz

B10K	; Command to analyzer: report lower, center, and upper frequency
B=3000,8000,13000K	; Response from Analyzer:
	; Response: frequency (low) = 3.0 MHz,
	center frequency = 8.0 MHz, frequency (high) = 13.0 MHz
SK	; Command to Analyzer: send the SWR data points
S=	; Response from Analyzer:
1278,	; Response: data point #1 (@ 3.0 MHz) SWR = 12.78
1204,	; Response: data point #2 (@ 3.1 MHz) SWR = 12.04
1130,	; Response: data point 3# (@ 3.2 MHz) SWR = 11.30
1072,	; Response: data point #4 (@ 3.3MHz) SWR = 10.72
...	;
...	; Response: data points #5 - #95...
...	; (not shown here, for clarity)
...	;
464,	; Response: data point #96 (@ 12.6 MHz) SWR = 4.64
477,	; Response: data point #97 (@ 12.7 MHz) SWR = 4.77
488,	; Response: data point #98 (@ 12.8 MHz) SWR = 4.88
502,	; Response: data point #99 (@ 12.9 MHz) SWR = 5.02
515,K	; Response: data point #100 (@ 13.0 MHz)

	SWR = 5.15, END
ZK	; Command to Analyzer: send the SWR data points
Z=	; Response from Analyzer:
2006,	; Response: data point #1 (@ 3.0 MHZ) Z = 200.6 ohms
1952,	; Response: data point #2 (@ 3.1 MHz) Z = 195.2 ohms
1852,	; Response: data point #3 (@ 3.2 MHz) Z = 185.2 ohms
1787,	; Response: data point #4 (@ 3.3 MHz) Z = 178.7 ohms
...	;
...	;Response: data points #5 - #95...
...	; (not shown here for clarity)
...	;
1116,	; Response: data point #96 (@ 12.6 MHz) Z = 111.6 ohms
1138,	; Response: data point #97 (@ 12.7 MHz) Z = 113.8 ohms
1160,	; Response: data point #98 (@ 12.8 MHz) Z = 116.0 ohms
1180	; Response: data point #99 (@ 12.9 MHz) Z = 118.0 ohms
1205,K	; Response: data point #100 (@ 13.0 MHz) Z = 120.5 ohms, END
B99K	; Command to Analyzer: power off
	; No response, Analyzer is powered off

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