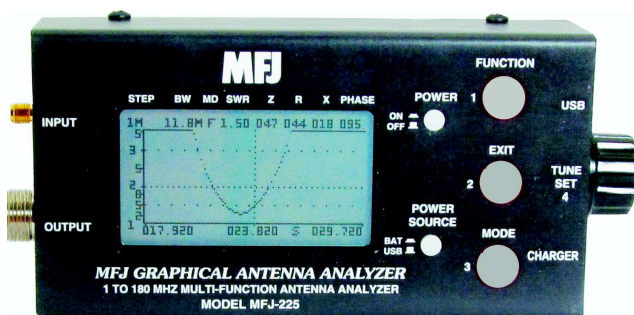


MFJ

MFJ Graphical Antenna Analyzer

Model MFJ-225



INSTRUCTION MANUAL

CAUTION: Read All Instructions Before Operating Equipment !

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1.0: Introduction to the MFJ-225 Analyzer

1.1 Manual Information: The MFJ-225 HF/VHF RF-Analyzer delivers all the popular measurement functions you've come to expect, plus it takes RF testing to a new level. Advanced features include full-screen LCD graphics, two-port VNA measurements, precise DDS frequency control, and direct PC interface running powerful IG-miniVNA freeware. These features are advanced, but actually less complicated to use because they reduce the number of steps needed to capture and view a wide range of data.

Before powering up your MFJ-225 for the first time, please read the manual, paying special attention to *Section-2.0, Powering Your Analyzer*. It contains essential information for installing batteries and supplying power correctly. In fact, the more you know about the MFJ-225 ahead of time, the sooner you'll be able to utilize all of its functions and features. Note that a "Quick Guide" reference is available in Section-9 to recap and help you review the essentials for operating your unit.

Important Warning: Read "2.0 - Powering Your Analyzer" before loading batteries or turning it on for the first time. Applying the wrong voltage, reversing polarity, or loading batteries incorrectly could permanently damage the unit.

1.2 General Features: The MFJ-225 is really two analyzers in one. By itself, it's a compact and completely self-contained handheld unit with a rechargeable battery pack and a back-lit 3-inch 128 x 64 dot-matrix LCD screen to display graphs and data. Using the Output port, you'll measure a wide range of reflection (S11) parameters including:

- [] SWR (1:1 to 9.9:1)
- [] Complex Impedance (R and X)
- [] Impedance Magnitude (Z)
- [] Return Loss (RL, 0 to -25 dB)
- [] Phase (0-180°)
- [] Capacitance (0-9999 pF)
- [] Inductance (.1uH-80 uH)
- [] Cable Length (0.5-45 m)
- [] Cable Loss (0-30dB)

Note that important data points like SWR, Impedance Magnitude, Resistance, Reactance, Return loss, Capacitance, and Inductance are displayed on the screen simultaneously, eliminating the need to search for them in sub-menus. You'll also get frequency-swept plots for SWR, Impedance Magnitude, Return Loss, Resistance, Reactance, and Phase Angle with full control over center frequency, tuning step, and scan width while viewing the plot.

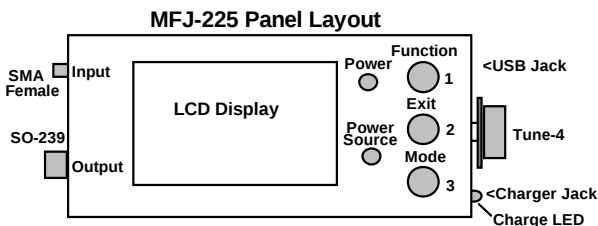
When paired up with a pc, the MFJ-225 becomes a two-port desktop analyzer capable of compiling and plotting S11 and S21 measurements. Download IG-miniVNA freeware to your PC from the web at no cost, then connect the analyzer

MFJ-225 Graphical Antenna Analyzer

using a Type-B USB interface cable. The USB cable carries both power and data. In no time you'll be measuring all the standard reflected power parameters (S11) *plus* forward-power transmission parameters (S21) such as gain, loss, pass-band slopes, and phase shift. Best of all, your pc captures these measurements, processes them, and presents stunning color-graphic plots you can print, store, or transmit electronically to document your work.

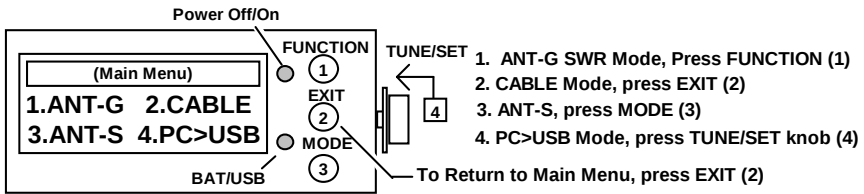
Unlike most low-cost analyzers, the MFJ-225 uses DDS (direct-digital synthesis) for signal generation. It covers the 1.0-MHz to 180-MHz tuning range (HF and VHF) without breaks or gaps. The constant-amplitude RF signal is virtually free of harmonics and spurious signals, a big advantage for delivering accurate results. In addition, you can connect to the OUTPUT port and use the DDS generator as a independent RF source for driving mixers and amplifiers, or even for measuring antenna patterns on a range. When paired with a precision step attenuator, it becomes a stable service generator for troubleshooting or tuning up receivers and preamps. Although the MFJ-225 will tune from 1 to 180MHz the accuracy of the SWR and the S11 and S21 measurements is best in the Amateur bands through the 2M Amateur Band. Above 160MHz the accuracy may be reduced.

1.3 Panel and Control Layout: The analyzer's RF jacks, screen, and controls are all configured for user-friendly (ergonomic) operation. Measurement cables exit from the left side where they won't interfere with hand movements. The LCD screen is centrally positioned for easy viewing. Three prominent push-button switches controlling most analyzer functions are located to the right of the screen, and the optical encoder Tune knob extends from the right-hand side of the case -- all perfectly positioned for right-handed operation. In addition to controlling the DDS, the Tune knob features a built-in press-on momentary switch that functions as the fourth selector for controlling analyzer functions.



1.4 Operating Modes: When you first power the MFJ-225, the MFJ Logo followed by a main Menu appear in sequence. Each mode is selected by pressing the appropriate selector switch. The analyzer's four operating modes are show below.

MFJ-225 Graphical Antenna Analyzer



ANT-G Mode: This screen presents a easy-to-view analog SWR bar-graph for making "on-the-fly" tuner or matching network adjustments. In addition, numeric readouts show *Test Frequency*, *DDS Tuning Step*, *Numeric SWR*, *Impedance Magnitude*, *Complex Impedance*, *Return Loss*, *C and L values*, plus *battery condition*. See Section 4.0 for a detailed rundown.

Cable Mode: On command, the DDS sweeps and calculates the open-stub resonant frequency of random lengths of cable, then applies a default velocity factor (**Vf**) to show an approximate measurement. To obtain final results, dial in the factory specified **Vf** for your cable. The exact length will be displayed in both feet and meters. You can also measure the **Vf** for a cable of known length. By advancing to Loss Mode, you can measure your cable's losses on any frequency from 1.0 to around 160 MHz. The screen displays test frequency along with the computed results. See Section 5.0 for step-by-step instructions.

ANT-S Mode: This mode renders graphic plots for *SWR*, *Impedance Magnitude*, *Resistance*, *Reactance*, *Return Loss*, and *Phase*. It also displays *Center Frequency*, *DDS Tuning Step*, and *Sweep Width* -- parameters you can edit in real time while viewing the screen. The top line of the display provides several center-frequency measurement parameters while bottom line shows the frequency scale plus an identifier for the type of plot. See section 6.0 for details.

PC>USB Mode: A built-in data link interfaces the analyzer with your PC to provide access to the functions and features of IG-miniVNA. See Section 7.0 for instructions to enter the pc interface mode.

2.0 Powering Your Analyzer

2.1 Power Sources: The MFJ-225 can run from either of two power sources. For handheld operation, it is self-powered by four (4) AAA NiMh cells that provide up to two hours running time. For desktop use, you may power it directly from your computer's USB port through a Type-B interface cable, or use an external USB AC-power adapter capable of providing 500 mA (not supplied). *Note the MFJ-225 will not function on the 12V battery charger. The 12V input is only for battery charging.*

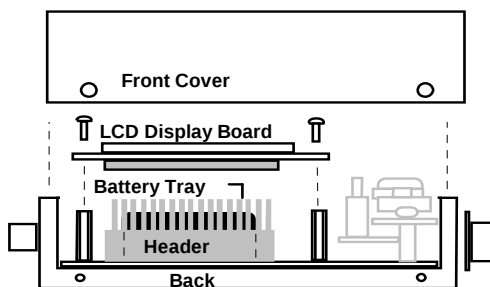
2.2 Power Switches: The unit's main **ON/OFF** switch and **USB/BAT** selector are located to the right of the LCD screen. Select **USB** (button up) when powering from your personal computer or from a USB adapter. You need not be running PC>USB to obtain power, simply turn on your pc. When operating on

internal power, switch the selector switch to **BAT**. *Note that USB power will not charge your battery pack.*

2.3 Battery Selection: The MFJ-225 is specifically designed to use four (4) rechargeable NiMh (*Nickel Metal Hydride*) AAA batteries (not supplied). *Only use cells that are matched by manufacturer, charge capacity, part number, and date code* **Never substitute NiCd or Li-ion rechargeable cells** -- the analyzer's built-in "smart-charger" is designed to monitor only NiMh chemistry and will not work properly with other types. Alkaline cells may be used in a pinch but are not recommended because they can not be recharged and will have to be replaced often.

Important Warning: *Use only matched NiMh AAA batteries to power your analyzer. Observe polarity during installation. Never attempt to recharge alkaline cells or damage to the unit and even personal injury may result!*

2.4 Installing Batteries: The 4 x AAA battery tray is located underneath the LCD display board. Follow the instructions below for battery installation. Be sure to turn off the power switch and disconnect any cables before installing batteries.



- [] Remove the four screws securing the front and rear halves of the case.
- [] Carefully remove the front panel and set it aside.
- [] Remove the four screws securing the LCD display board.
- [] Carefully lift the LCD display board off its header and set it aside.
- [] Locate the 4 x AAA battery tray positioned directly underneath the LCD display.

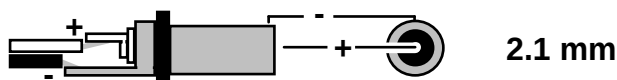
Important Warning: *Never install or remove batteries when the unit is powered up or when an external power source is connected. Doing so may cause permanent damage.*

- [] Confirm the power switch is OFF and all power sources are disconnected.
- [] Install the four AAA batteries, carefully observing polarity.
- [] Carefully align and reinstall the LCD display board on its header.
- [] Re-secure the pc-board hardware and re-install the front half of the case.

Important Note: When running the analyzer on battery power, the **USB/BAT** switch must be in **BAT** position (pressed down).

2.5 Battery Chargers: The analyzer's electronics runs on 4.25 volts, but the charge controller requires a minimum 9-VDC source to provide sufficient headroom to charge the battery pack. A 12-volt source will also work, but *never* apply more than 13.8 volts under any circumstance!

The charger input accepts a standard 2.1mm plug with a (+) positive center connection. Note that you cannot operate the analyzer while using the charger to "float" the battery pack. Inserting the plug disconnects the batteries and switches them over to the charge-controller. If you are uncertain about the specifications, polarity, or condition of your charging source, always check it with a voltmeter before plugging in. Reversing polarity or applying excessive voltage could damage your unit.



Important Warning: Never apply more than 13.8-volts DC to the charger jack (9-V is preferred) and confirm the center pin has positive polarity (+). Never connect an AC source to the charge jack -- doing so could damage the unit.

Important Warning: Do not attempt to apply 12V power to the charger jack when using Alkaline cells. THEY ARE NOT RECHARGABLE and will overheat possibly catching fire or explode and damaging the analyzer.

2.6 Initial Battery Charge: After installing new batteries, allow the pack to charge right away. The onboard smart-charger will monitor cell condition and adjust the charge rate accordingly. A red LED positioned above the charger power jack signals when charging is in progress, and will go out when the charge cycle is complete. Charging time is around 3-5 hours on average.

2.7 Long-Term Storage: When the analyzer is not in use for prolonged periods, either remove the batteries or recharge them at three-month intervals. To check your battery condition, turn the analyzer on and enter **ANT-G** mode. The voltage reading appears in the lower-right corner of the LCD display. When fully charged, expect readings in the 4.90-5.50 volt range.

2.8 Powering Via a USB Cable: Use a USB cable with a Type-B plug installed on the analyzer end. As long as your computer is turned on, the cable will supply power to the analyzer. A USB supply like those to charge cell phones will also power the MFJ-225.

Important Note: When powering from a PC or USB supply, the **USB/BAT** selector must be in **USB** (up) for the analyzer to turn on.

3.0 About DDS Frequency Control

3.1 Tune Encoder Functions: DDS frequency control is a little different from conventional band-switched tuning, so take a few minutes to practice some frequency entries and gain familiarity with how the synthesizer works. The analyzer's main **TUNE** knob is a rotary digital encoder that provides 20 "soft" indentations per revolution. Each indent adds or subtracts one increment (or step) from your operating frequency. The **TUNE** encoder is assignable and performs three functions.

[] **Frequency (F):** Sets operating frequency, or for graphic functions, the display's Center Frequency. The analyzer's tuning range is from 1.0MHz to 180MHz.

[] **Tuning STEP (S):** Steps are 1kHz, 10kHz, 100kHz, 1MHz, and 10 MHz. Small steps work best for precise tuning while large steps are more useful for changing bands.

[] **Bandwidth (W):** Sets the frequency span for swept displays. Choices are 118kHz, 590kHz, 1.18MHz, 2.36MHz, 5.90MHz, 11.8MHz, and 23.6MHz.

The function of the **TUNE** knob (**F**, **S**, or **W**) is assigned using prescribed control switches. The encoder's assignment will always be displayed on the LCD screen.

3.2 Rounding Off: When setting up a new tuning **Step**, *the increment you select is added to (or subtracted from) the analyzer's current frequency setting.* For example, if you are tuned to **3.920 MHz** and switch to a **1-MHz** step to change bands quickly, the display will read **3.920 > 4.920 > 5.920....etc** as you rotate the **TUNE** knob up in frequency. This sequence occurs because **1 MHz** is added to the *original frequency* of 3.920. For some users, uneven numbers are disorienting, so you might begin by tuning from **3.920 MHz** to **4.000 MHz** using a **10-kHz** step, and then switch to a **1-MHz** tuning step. Having rounded off the frequency display, the tuning progression now becomes **4.000 > 5.000 > 6.000 >....etc.**

Once you arrive at the new band, switch back to a **10-kHz** or **100-kHz** step again to navigate around. Rounding off before changing bands isn't mandatory, but it may prove helpful -- especially at first.

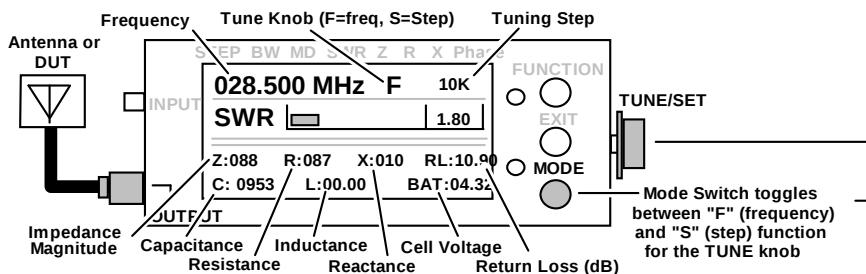
When creating graphic plots, keep in mind that you can re-assign the **TUNE** control at any time to change your center frequency and sweep width in order to create a display that offers the best visual rendition of your data.

4.0 ANT-G Mode

4.1 Accessing Ant-G: To select the **ANT-G** mode, press the **FUNCTION (1)** switch. This mode generates a test signal on a *single frequency* and feeds it to the **OUTPUT** port. The unit's directional coupler then measures forward and reflected power, and feeds that raw information to the processor where it is

converted into usable data. For virtually all stand-alone measurements, the antenna or device under test (DUT) will be installed on the SO-239 **OUTPUT** connector. The SMA female input jack is only used in conjunction with PC>USB S21 measurements.

4.2 ANT-G Screen: In ANT-G mode, the LCD screen displays a wide range of information, as outlined below:



Top Screen - DDS Setup Information:

- [] **Test Frequency:** Displayed on the top line (**28.500 MHz**)
- [] **Tuning Knob Assignment:** Toggle between **F** and **S** using the **MODE** switch.
- [] **Tuning Step Window:** Shows current Tuning Step. Step indicators are: **1K**=1-kHz step, **10K**=10-kHz, **100K**=100-kHz, **1M**=1MHz, **10M**=10-MHz.

Middle Screen - SWR Data:

- [] **Bar Graph:** Relative **SWR** to aid tuning and matching adjustments. Range 1.0:1 to 9.9:1.
- [] **SWR:** 3-digit display shows precise SWR (example. **1.50** = 1.5:1)

Bottom Screen - Numeric Data for Load Parameters and Battery Condition:

- [] **Impedance Magnitude (Z):** 3-digit load impedance in Ohms (ex **075** = 75Ω)
- [] **Resistance (R):** 3-digit resistive load component in Ω (ex **075** = R75)
- [] **Reactance (X):** 3-digit reactive load component in Ω (ex **005** = j5)
- [] **Return Loss (RL):** 4-digit return loss measured in dB (ex **10.96** = -10.96 dB)
- [] **Capacitance (C):** 4-digit capacitive load component in pF (ex **0572** = 0572 pF)
- [] **Inductance (L):** 4-digit Inductive load component in uH (ex **00.00** = 0 uH)
- [] **Battery Voltage:** expressed as a 4-digit number (ex **04.25** = 4.25 VDC)

4.3 Test-Signal Generation: Use the **ANT-G** (single frequency) operating mode for test-signal generation. Output power is leveled at -5 dBm (0.13 Vrms or 0.32 mW into a 50-Ω load).

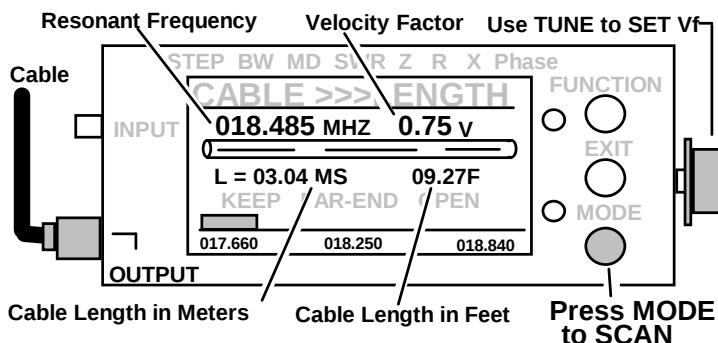
Never connect a cable or load carrying an external energy source to the **OUTPUT** port -- permanent damage to the analyzer's detector diodes and bridge circuitry will almost certainly result! Also, avoid connecting the analyzer's -5 dBm signal directly into sensitive preamp or receiver circuitry that might become overloaded and damaged. Whenever possible, install an in-line attenuator or pad between the generator and sensitive circuitry.

Important Warning: Never connect transmitters, external RF sources, cables carrying DC bias, or loads charged with a high static potential to the Analyzer's **OUTPUT** connector. Doing so will damage the analyzer's detector and sensitive coupler circuitry!

5.0 Cable Mode

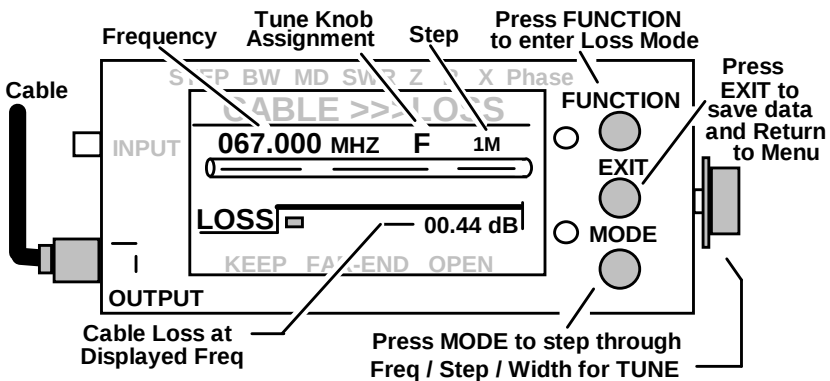
5.1 Accessing Cable Mode: Press **EXIT (2)** to enter **CABLE** Mode. This feature scans and measures the open-stub frequency of unknown lengths of coaxial cable, then calculates Cable Length, Vf, and RF Loss. Connect your cable to **OUTPUT** and lay it out flat with no tight bends or close proximity to large metal surfaces. Confirm that the far is *open*. Testing is conducted in two steps or stages:

5.2 Resonance, Length, and Velocity Factor: Connect your unknown (DUT) cable to the **OUTPUT** port, then press the **MODE** control button to start a DDS scan to determine the cable's open-stub resonant frequency. The bar-graph at the bottom of the screen tracks the progress of the scan as the analyzer tunes up in frequency. Once the resonant point is found, the scan stops and the processor computes an approximate length based on a default velocity factor (**Vf**). To obtain final results, dial in the manufacturer's specified velocity factor (**Vf**) for your cable using the **TUNE** knob. Once entered, the precise cable length will appear on the display in feet and meters (see below).



To determine velocity factor (**Vf**) for an unknown cable, physically measure its length, then rotate **TUNE** until the closest length appears on the display. The correct **Vf** for the cable will be displayed in the **V** window.

5.3 Cable Loss: Press **FUNCTION (1)** to advance to cable-loss mode, and rotate **TUNE** to view your cable's loss performance at any frequency. To assign the **TUNE** knob to **F** (frequency), use the **Mode (3)** switch. You may also reset Step (**S**) as needed for a comfortable tuning rate. Pressing **EXIT (2)** will capture your data and return the analyzer to the main menu (see below).

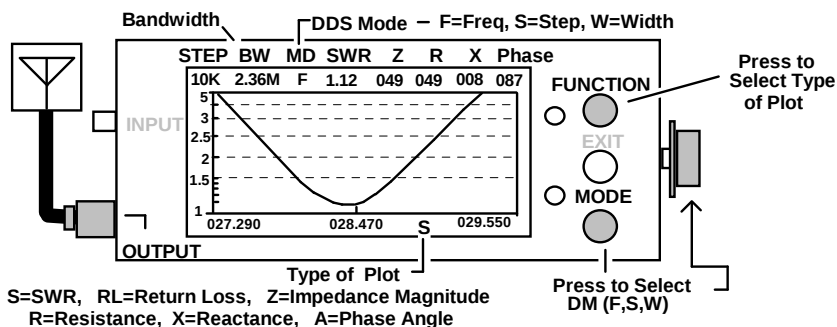


In cable loss mode, the analyzer is not capable of saving the current data to its eeprom. The testing frequency always begins from 10MHz whenever you enter this mode.

The data is saved into the internal memory only when exiting the "Cable Length", "ANT-S" and "ANT-G" modes.

6.0 ANT- S Mode

6.1 Accessing ANT-S Mode: To enter **ANT-S**, press the **MODE (3)** button. In this mode, the DDS sweeps continuously across a pre-selected bandwidth to measure multiple data points. The processor then compiles the data and draws a graphic picture for the load parameter you've selected. Six different plots are available: SWR, Impedance Magnitude, Resistance, Reactance, Return Loss, and Phase Angle. To step through each display screen in sequence, press **Function (1)**. A plot identifier on the bottom data line of the screen identifies the current display (**S**=SWR, **RL**=Return Loss, **Z**=Impedance Magnitude, **R**=Resistance, **X**=Reactance, and **A**=Phase Angle).



6.2 Frequency Setup for Graphic Displays: The **MD** window at the top of the screen displays the **TUNE** knob assignment: **F** = Center Frequency, **S** = Tuning Step, and **W** = Bandwidth. To change the **TUNE** knob assignment (**F,S,W**), press **MODE (3)**. Frequencies are displayed along the bottom line of the display and a vertical measurement scale for your selected parameter appears in the left margin.

6.3 Graph Parameters and their Ranges:

SWR (S): Log scale, SWR over 1:1 to 5:1 range.

Return Loss (RL): 0dB to -25dB

Impedance Magnitude (Z): 0-300 Ohms

Resistance (R): 0-300 Ohms

Reactance (X): 0-300 Ohms

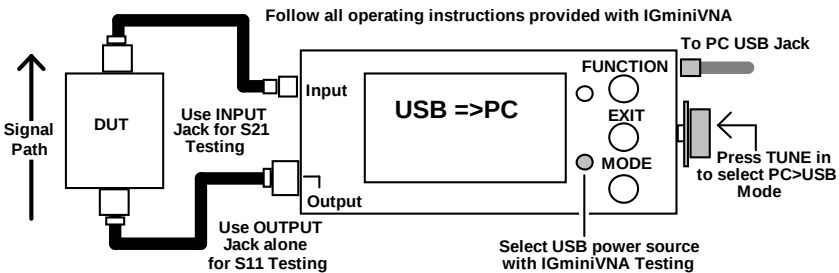
Phase Angle (A): 0-180 degrees

To exit **ANT-S** and return to the main menu, press **EXIT**.

7.0 USB>PC Mode

7.1 PC Interface: The MFJ-225 is compatible with IGminiVNA software. In this mode, the analyzer's signal source and directional coupler are utilized by that program to compile data and render plots on your personal computer. To interface with the MFJ-225, use a USB cable with a Type-B plug installed on the analyzer end. The Type-B interface jack is located just above the **TUNE** knob (see below).

7.2 Accessing USB>PC: To enter the **USB>PC** Mode, press in **TUNE (4)**. A **USB =>PC** prompt will appear on the screen along with a MFJ identifier.



7.3 Port Assignments: In **USB>PC** Mode, the MFJ-225 directional coupler supports both S11 and S21 functions.

OUTPUT: The SO-239 jack connector serves as the Transmission Port for both S11 and S21 measurements.

INPUT: The SMA female connector serves as the Through-Port (or receive port) for S21 measurements.

7.4 IG-miniVNA Freeware: IG-miniVNA freeware and the operating instructions to support it are available online free of charge (<http://clb.site.free.fr/articles.php?pg=art4>). Note this site is in french. This software will enable you to measure reflected power parameters (S11) *plus* many forward-power transmission parameters (S21) such as gain, loss, pass-band slopes, and phase shift. Your pc captures these measurements, processes them, and presents color-graphic plots you can print, store, or transmit electronically to document your work. **Note that MFJ does not supply the IG-miniVNA program or instruction for its use.**

8.0 Measurement Accuracy and Limitations

8.1 General: The MFJ-225 will serve as your eyes and ears when working with RF systems, and its measurement results are competitive with rival units costing thousands of dollars more. However, all handheld analyzers share certain

limitations, and being aware of them will help you to achieve more meaningful results.

8.2 Local Interference: Like most hand-held units, this analyzer uses a broadband directional coupler that is open to receiving signals across the entire radio spectrum. Most of the time, the unit's built in RF generator is powerful enough to overcome any lack of front-end selectivity and override stray pickup. However, a powerful transmitter located nearby could inject enough RF energy through an antenna under test to overload the directional coupler and disrupt readings. If this condition occurs, performance may become erratic and SWR readings may appear higher than they really are.

8.3 Coupler Loss and Directivity: The MFJ-225 uses a high-quality dual-core ferrite as the platform for its directional coupler. Although widely used, all couplers of this type may exhibit accuracy limitations, especially at the higher end of the frequency spectrum. Although they are accurate enough for amateur radio applications, they typically lack the high degree of precision and linearity needed for testing antennas and RF devices to commercial or laboratory standards.

8.4 Calibration Plane Error: The *Calibration Plane* is the point of reference where all measurements have the greatest accuracy (Gain Reference = 0dB and Phase Shift = 0 degrees). For a basic handheld like the MFJ-225, the calibration plane is fixed at the **OUTPUT** connector. Any time a transmission line is installed, it displaces the load from this calibration plane and introduces error. For SWR readings, the error is caused by losses in the cable (the more loss, the greater the error). Generally, this condition isn't a problem because your radio and the analyzer see the same reduction in SWR. However, if you're documenting antenna SWR for design purposes, the analyzer should be connected directly to the feedpoint through a short pigtail.

Calibration-plane error has much more significance when measuring impedance because of phase rotation in the cable. In fact, impedance readings may swing dramatically, depending on the cable's electrical length and the severity of the load's mismatch when referenced to 50 Ohms. For accurate impedance data, always connect the analyzer directly to the DUT you're testing using the shortest cable possible.

8.5 Sign Ambiguity ($\pm$): Most handheld analyzers, including the MFJ-225, lack the processing capability to directly calculate the reactance sign for complex impedance ($Z = R \pm jX$).

8.6 Calibration: Calibration is needed very seldom but is easy to execute. To run a Calibration check remove any loads from the OUTPUT and while in the Main Screen rotate the Tune knob *clockwise* rapidly till the screen says "Calibrating..." and the backlight turns off. When it is finished it will say "Done". The internal calibration settings are stored in memory. At that point turn the MFJ-225 off and back on for normal use. There are no manual internal adjustments.

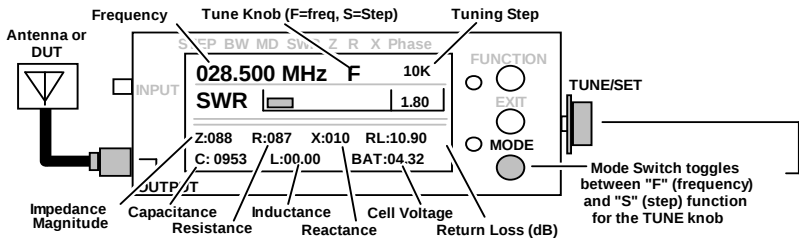
9.0 Quick Guide to Controls and Functions

External Power: Type-B USB jack, accepts power from pc or USB power adapter.

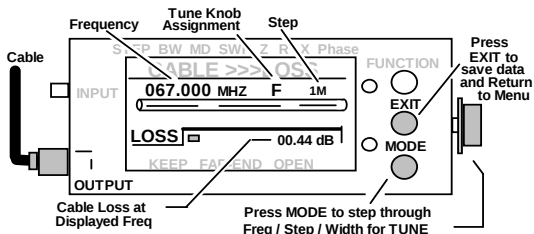
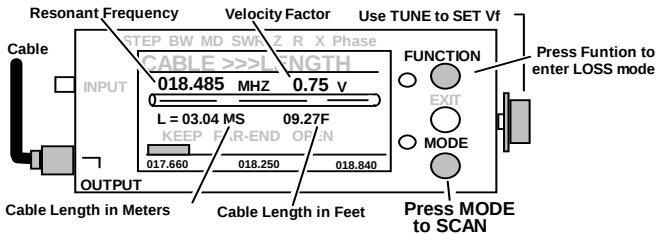
Battery Charger: 9-12VDC, 2.1mm plug, (+), center pin. Red LED indicates charge in progress.

Turn on Analyzer: Select power source (*BATT* or *USB*), then press *Power* to *ON*.

ANT-G Test Mode: For single-frequency SWR measurement and external signal generation.

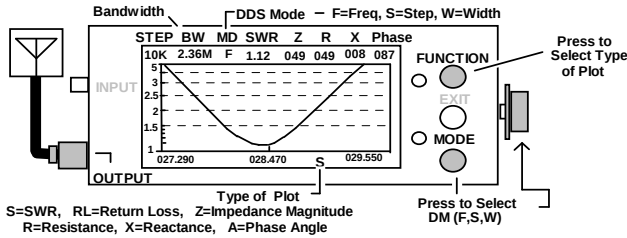


CABLE Mode: For open-stub frequency, cable length, and loss.

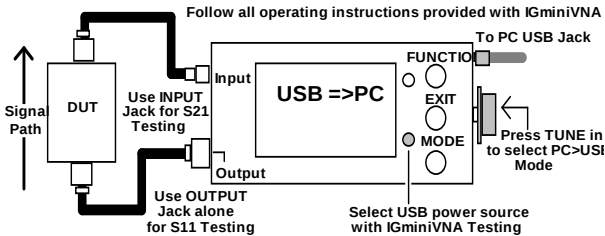


MFJ-225 Graphical Antenna Analyzer

ANT-S Mode: Swept mode for graphic display of six load parameters:



USB>PC Mode: For S11 and S21 measurements using IG-miniVNA freeware:



TECHNICAL ASSISTANCE

If you have any problem with this unit first check the appropriate section of this manual. If the manual does not reference your problem or your problem is not solved by reading the manual, you may call *MFJ Technical Service* at 662-323-0549 or the *MFJ Factory* at 662-323-5869. You will be best helped if you have your unit, manual and all information on your station handy so you can answer any questions the technicians may ask.

You can also send questions by mail to MFJ Enterprises, Inc., 300 Industrial Park Road, Starkville, MS 39759; by facsimile (FAX) to 662-323-6551; or by email to techinfo@mfjenterprises.com. Send a complete description of your problem, an explanation of exactly how you are using your unit, and a complete description of your station. Also include the firmware version number of your unit.

12 MONTH LIMITED WARRANTY

MFJ Enterprises, Inc. Warrants to the original owner of this product, if manufactured by MFJ Enterprises, Inc. and purchased from an authorized dealer or directly from MFJ Enterprises, Inc. to be free from defects in material and workmanship for a period of 12 months from date of purchase provided the following terms of this warranty are satisfied.

1. The purchaser must retain the dated proof-of-purchase (bill of sale, canceled check, credit card or money order receipt, etc.) describing the product to establish the validity of the warranty claim and submit the original or machine reproduction of such proof-of-purchase to MFJ Enterprises, Inc. at the time of warranty service. MFJ Enterprises, Inc. shall have the discretion to deny warranty without dated proof-of-purchase. Any evidence of alteration, erasure, or forgery shall be cause to void any and all warranty terms immediately.
2. MFJ Enterprises, Inc. agrees to repair or replace at MFJ's option without charge to the original owner any defective product under warranty, provided the product is returned postage prepaid to MFJ Enterprises, Inc. with a personal check, cashiers check, or money order for \$12.00 covering postage and handling .
3. MFJ Enterprises, Inc. will supply replacement parts free of charge for any MFJ product under warranty upon request. A dated proof-of-purchase and a \$5.00 personal check, cashiers check, or money order must be provided to cover postage and handling.
4. This warranty is NOT void for owners who attempt to repair defective units. Technical consultation is available by calling (662) 323-5869.
5. This warranty does not apply to kits sold by or manufactured by MFJ Enterprises, Inc.
6. Wired and tested PC board products are covered by this warranty provided only the wired and tested PC board product is returned. Wired and tested PC boards installed in the owner's cabinet or connected to switches, jacks, or cables, etc. sent to MFJ Enterprises, Inc. will be returned at the owner's expense unrepai red.
7. Under no circumstances is MFJ Enterprises, Inc. liable for consequential damages to person or property by the use of any MFJ products.
8. Out-of-warranty Service: MFJ Enterprises, Inc. will repair any out-of-warranty product provided the unit is shipped prepaid. All repaired units will be shipped COD to the owner. Repair charges will be added to the COD fee unless other arrangements are made.
9. This warranty is given in lieu of any other warranty expressed or implied.

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10. MFJ Enterprises, Inc. reserves the right to make changes or improvements in design or manufacture without incurring any obligation to install such changes upon any of the products previously manufactured.
11. All MFJ products to be serviced in-warranty or out-of-warranty should be addressed to MFJ Enterprises, Inc., 300 Industrial Park Road, Starkville, Mississippi 39759, USA and must be accompanied by a letter describing the problem in detail along with a copy of your dated proof-of-purchase.
12. This warranty gives you specific rights, and you may also have other rights, which vary from state to state.

**MFJ Enterprises, Inc
300 Industrial Park Rd
Starkville, MS 39759 USA
Phone 662-323-5869
Fax 662 323 6551**



MFJ ENTERPRISES, INC.

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