

Product Review

RigExpert AA-2000 ZOOM 0.1 – 2000 MHz Antenna and Cable Analyzer

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The AA-2000 ZOOM is RigExpert’s latest and most capable antenna analyzer. Like all of the RigExpert antenna analyzers, the AA-2000 ZOOM is a single-port vector network analyzer (VNA). It provides signed, complex impedance measurements of RF loads from 100 kHz to 2 GHz with a frequency resolution of 1 kHz.

Overview

The AA-2000 ZOOM is a bit larger than other ZOOM models. The measurement port is a Type-N female connector, but a UHF-to-N adapter is included for the more common PL-259 interface used by hams in the HF and VHF ranges. Also included are the user manual, a USB cable for computer interfacing, three 2,700 mAh NiMH AA-size batteries, an external NiMH AA-size battery charger, a carrying case, and a carrying strap.

You can substitute 1.2 – 3.7 V lithium or alkaline AA batteries for the NiMH batteries. Depleted NiMH batteries take about 6 hours to charge with the included charger, and a battery indicator on the main menu shows the battery status. When a computer is connected, power is provided through the USB connection and the battery display is replaced by a USB icon.

Internal memory provides for the storage and recall of measured parameters in a variety of formats. All information is displayed on a 2 x 1.5 inch, 800 x 480 pixel Blanview color TFT-LCD screen, which provides high-contrast, crisp images even in bright sunlight. When the analyzer is connected to your computer, additional data recording and analysis capabilities, as well as firmware updates, are available. Table 1 summarizes the AA-2000 ZOOM specifications.

Initial Setup

Before using the AA-2000 ZOOM for the first time, visit the RigExpert website and download and install the *AntScope2* software (Windows, macOS, or Linux



Bottom Line

The AA-2000 ZOOM is a flexible, accurate and easy to use antenna analyzer for those who need analyzer capabilities up to 2 GHz.

versions are available) and the *Flash Tool* for Windows or macOS. Connect the AA-2000 ZOOM USB cable to your computer, which automatically powers on the AA-2000 ZOOM. Now open the downloaded *Flash Tool* file and the *Flash Tool* will determine if there is newer firmware available, and — if so — will update the firmware automatically. *AntScope2* permits importing and viewing data from the AA-2000 ZOOM’s memory and provides real-time control of the analyzer.

An *Antscope* app is available for Android and iOS devices. The AA-2000 ZOOM has a built-in Bluetooth feature for communicating with mobile devices.

Table 1
AA-2000 ZOOM Manufacturer’s Specifications

Frequency range: 0.1 to 2,000 MHz with 1 kHz resolution for 25, 50, 75, 100, 150, 200, 300, 450, and 600 Ω systems.
SWR measurement range: 1 to 100 in numerical modes, 1 to 10 in chart modes.
Memories: 250
RF output: Square wave, 0.1 to 2,000 MHz, at -10 dBm into 50 Ω.
Operating temperature: 32 – 104 °F.
Dimensions: 9 x 3.9 x 2 inches. Weight: 15.6 oz. with battery.

Measurement Capabilities

The AA-2000 ZOOM menus and keypad markings are self-explanatory, so you will rarely need to refer to the manual. The user interface is very similar to other RigExpert ZOOM series analyzers, so if you've used one of these before, the AA-2000 ZOOM will be very familiar. You can select a single-frequency display, a swept-frequency display, a Smith chart display, or a time domain reflectometer (TDR) display.

The single-frequency modes let you select displays of SWR, impedance (Z, R, and X), or the equivalent series and parallel representation of an impedance. The MultiSWR display shows the measured SWR on five different frequencies, making it ideal to look at resonances on a multiband antenna.

The swept-frequency modes display SWR, return loss, or impedance (R/X), and all the graphical displays can be expanded with the ZOOM feature for enhanced reading accuracy. The ZOOM capability permits you to scan a wide frequency range, after which you can use the left/right arrow keys to center the frequency of interest, and then use the up/down arrow keys to zoom in or out in order to see more or less detail from the scan.

With its constant, stable output, the AA-2000 ZOOM is suitable for receiver sensitivity testing when used with a good step attenuator, keeping in mind that the output waveform is a square wave with multiple harmonics. The AA-2000 ZOOM can zero-out a transmission line for making accurate remote antenna feed point impedance measurements if open/source/load calibration standards are available.

Other useful features available in the AA-2000 ZOOM include the ability to measure cable length, cable loss, velocity factor, and characteristic impedance. The TDR function is useful for finding discontinuities in your antenna system. One use for this is to determine the physical length of coax to any of your antennas, just by leaving the antenna end of the coaxial feed line disconnected.

Using the AA-2000 ZOOM

I used the **ALL PARAMS** (All Parameters) mode for some basic measurements. I first checked the 10 MHz output frequency against the 10 MHz WWV signal, and I could not discern any difference in frequency between the two. Next, I checked the output level over the full frequency range using my Mini-Circuits PWR-6GHS+ power sensor. It measured -9 dBm ± 0.5 dB from 1.8 – 450 MHz, dropping to -11.1 dBm at 1 GHz and -14.6 dBm at 2 GHz.

Table 2 displays the measured open-circuit impedance of the AA-2000 ZOOM. This gives an indication of the impedance magnitude you can accurately measure as a function of frequency. I found these measurements interesting, as all other antenna analyzers I've reviewed measure a high open-circuit impedance (several thousand ohms) at low frequencies, but the measured impedance drops off to low values (hundreds of ohms) at the high end of the instrument's range. The AA-2000 ZOOM measures virtually the same high open-circuit impedance across its entire range.

Next I compared return loss (RL) measurements of various loads using the AA-2000 ZOOM and my Array Solutions VNAuhf vector network analyzer. I have found the VNAuhf to be similar in accuracy to an HP/Agilent 8722D VNA over the frequency range covered by the VNAuhf. However, I cannot measure frequencies above 1200 MHz with the VNAuhf.

For these measurements, I used return loss instead of SWR because return loss is the preferred measurement method on the higher frequencies. You can easily convert return loss to SWR using online calculators.

First I measured return loss using a precision 50Ω load (see Table 3) and then I measured several open and shorted microwave attenuators of 6 dB (12 dB return loss) and 3 dB (6 dB return loss). Return loss measurements were also made using a 2 dB attenuator (4 dB return loss), although the attenuator is only specified to 500 MHz. These measurements are shown in Table 4. As you can see in the tables, the measurement discrepancies between the AA-2000 ZOOM and

Table 2
AA-2000 ZOOM Measured Open Circuit Impedance

Frequency (MHz)	Output (Z) (Ω)	Frequency (MHz)	Output (Z) (Ω)
1.8	2,400	222	2,300
14	2,400	450	2,000
28	2,400	915	1,800
50	2,300	1,250	1,600
146	2,300	2,000	1,900

Table 3
Return Loss Measurements with a Precision 50Ω Load

Measurements with the AA-2000 ZOOM compared to Array Solutions VNAuhf

Freq. (MHz)	Return Loss (dB)		Freq. (MHz)	Return Loss (dB)	
	AA-2000	VNAuhf		AA-2000	VNAuhf
146	52	58	915	31	42
222	45	51	1,200	29	36
440	38	48	2,000	28	n/a

VNAuhf are not significant, especially when considering these very high frequencies. Also, you can see that the 2 dB attenuator is definitely not a microwave attenuator!

For my final test I used a 222 MHz series resistive/capacitive (R/C) complex load with an SWR of approximately 2:1. The AA-2000 ZOOM and VNAuhf measurement provided almost identical measurements.

VHF/UHF Capabilities

I normally like to show SWR curves of my home station antennas. However, the AA-2000 ZOOM gave exactly the same HF antenna displays as shown in my reviews of the AA-55 ZOOM and AA-230 ZOOM. Rather than duplicating this information, I decided to highlight some of the higher-frequency capabilities of the AA-2000 ZOOM.

Figure 1 shows the SWR of a 2-meter band-pass filter on the AA-2000 ZOOM screen, and Figure 2 shows the *AntScope2* display of the return loss of that same filter.

Figure 3 shows the SWR of a 440-MHz mobile antenna on the AA-2000 ZOOM screen. Figure 4 is an *AntScope2* display of the 440 MHz antenna's return loss.

Finally, amateurs share the 902 – 905 MHz band with ISM (industrial, scientific, and medical) users. I looked at an ISM filter with the AA-2000 ZOOM. Figures 5 and 6 show *Antscope2* filter scans of the filter's SWR and return loss.

It is nice to be able to look at the input impedance, SWR, and return loss of a filter. But wouldn't it be nice to be able to look at a filter's transmission characteristic? To do this, connect the filter's output to a spectrum analyzer set for **MAX HOLD**. Set the AA-2000 ZOOM for **SWR CHART**, set the desired sweep range, and press **OK**. You will now see the filter's passband response. Figure 7 shows the ISM band-pass filter's response using this method with my Siglent SSA3021X spectrum analyzer. The markers show the 902 and 928 MHz frequency limits of this amateur band. If you don't already have a spectrum analyzer, consider the



Figure 1 — SWR sweep of a 2-meter band-pass filter observed on the AA-2000 ZOOM screen.

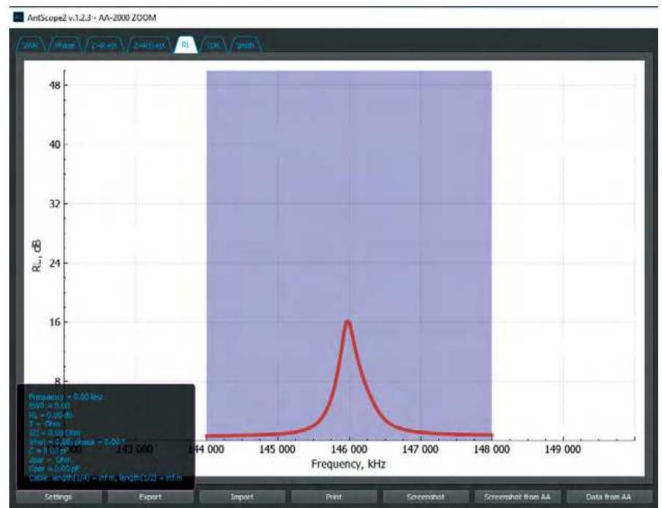


Figure 2 — Antscope2 display of the return loss of the 2-meter band-pass filter.

Table 4
Return Loss Measurements with Low and High Impedance (Z) Loads

Measurements with the AA-2000 ZOOM compared to Array Solutions VNAuhf

Freq. (MHz)	12 dB Return Loss		6 dB Return Loss		4 dB Return Loss	
	Low Z AA-2000/ VNAuhf	High Z AA-2000/ VNAuhf	Low Z AA-2000/ VNAuhf	High Z AA-2000/ VNAuhf	Low Z AA-2000/ VNAuhf	High Z AA-2000/ VNAuhf
1.8	12.3/12.3	11.9/12.1	7.0/7.0	5.6/5.3	3.8/3.8	3.6/3.3
14	12.3/12.3	12.0/12.1	7.0/7.0	5.6/5.3	3.9/3.8	3.6/3.4
50	12.4/12.3	11.5/12.1	7.0/6.9	5.6/5.3	3.9/3.9	3.7/3.4
146	12.4/12.3	11.7/12.1	6.9/6.8	5.7/5.4	3.8/3.7	3.8/3.5
222	12.4/12.2	12.1/12.2	6.8/6.7	5.7/5.4	3.7/3.5	4.0/3.8
440	12.3/11.8	12.4/12.9	6.4/6.2	6.2/5.4	3.8/3.3	3.8/3.8
915	12.5/11.3	12.2/14.1	5.9/5.4	7.3/7.3	4.2/4.0	4.5/3.3
1200	12.8/12.0	12.7/13.0	6.5/6.0	7.5/8.8	3.8/4.3	6.0/6.2
2000	15.2/—	12.6/—	9.8/NA	5.6/—	2.0/—	8.4/—

— VNAuhf does not cover this frequency range

inexpensive tinySA handheld spectrum analyzer that I reviewed in the March 2021 issue of *QST*. The latest firmware includes the **MAX HOLD** function.

Conclusion

The AA-2000 ZOOM is an accurate antenna, transmission line, and component analyzer tool with capabilities up to 2 GHz. You can investigate the AA-2000 ZOOM further by downloading the manual from RigExpert's website. See www.arri.org/qst-in-depth for additional illustrations and information about the AA-2000 ZOOM.

Manufacturer: RigExpert Ukraine. For a list of US distributors, see www.rigexpert.com. Price: \$1100.

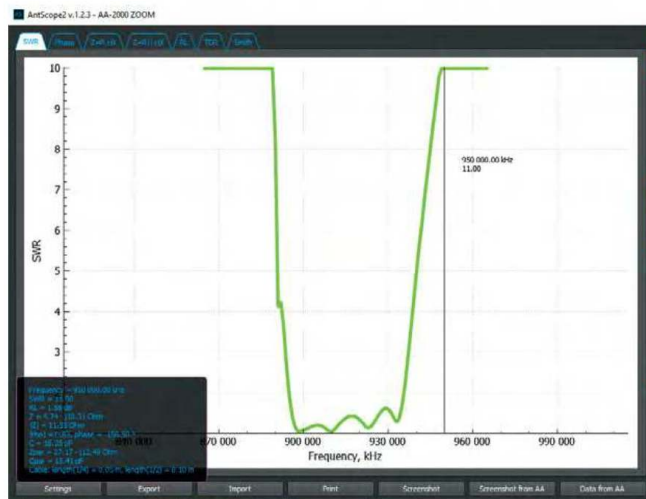


Figure 5 — SWR sweep of a 900 MHz ISM filter in *Antscope2*.



Figure 3 — SWR sweep of a 440 MHz mobile antenna observed on the AA-2000 ZOOM screen.

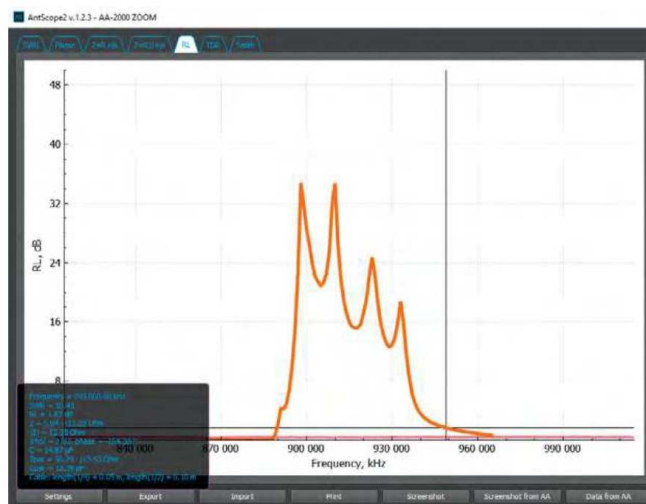


Figure 6 — Return loss sweep of a 900 MHz ISM filter in *Antscope2*.

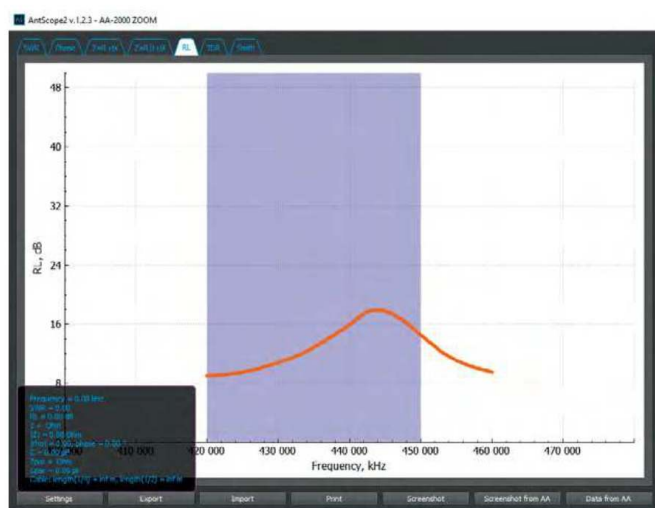


Figure 4 — *Antscope2* display of the return loss of the 440 MHz mobile antenna.

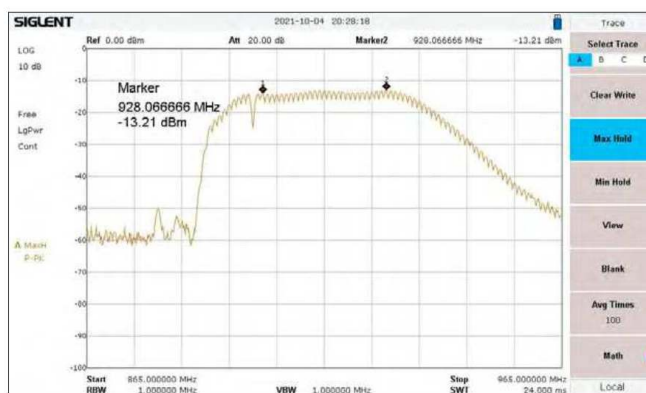


Figure 7 — Transmission response of the 900 MHz ISM filter using the AA-2000 ZOOM as a signal source and a spectrum analyzer to observe the test results.