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QST

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July 2017 WWW.ARRL.ORG

DIGITAL EDITION

IARU HF World Championship

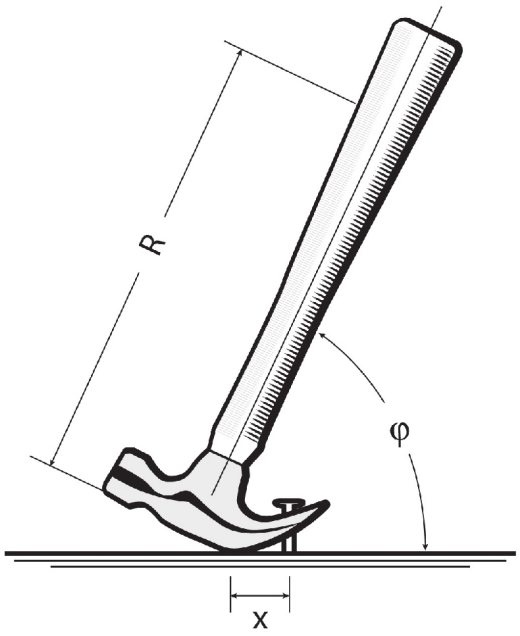
July 8-9

QST Reviews

- **Rigol Technologies DSA705** Spectrum Analyzer
- **RigExpert AA-30 0.1 to 30 MHz** Antenna Analyzer
- **Elenco XK-150** Digital/Analog Trainer
- **TKEY-1** CW Touch Key Paddle Kit
- **Wolf River Coils** Silver Bullet 1000 and Silver Bullet Mini Antennas
- **Rainbow Kits TT-16 DTMF** Decoder and RELAY-5 Kits

DIGITAL FEATURE

44 | See the Video Overview of the **Rigol Technologies DSA705** Spectrum Analyzer.



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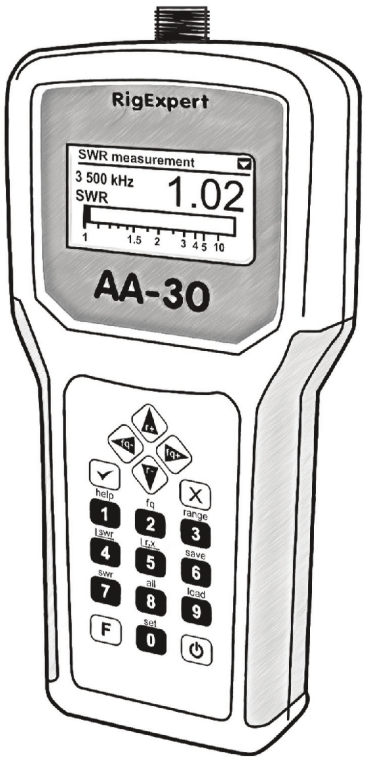
HF/VHF Family of the RigExpert® Antenna Analyzers

for those who measure

AA-170 (for up to 170 MHz)
AA-54 (for up to 54 MHz)
AA-30 the Legendary
to examine
your antennas and cables



*see AA-30 review at page 45

RigExpert
www.rigexpert.com

RigExpert AA-30 0.1 to 30 MHz Antenna Analyzer

Reviewed by Phil Salas, AD5X
ad5x@arrl.net

RigExpert offers a number of antenna analyzers, several of which have been reviewed in *QST*.[5, 6, 7] The AA-30 reviewed here is the lowest-priced of the RigExpert antenna analyzers, and for many hams, it just might be the analyzer of choice.

Like other RigExpert analyzers, the AA-30 can look at single-frequency standing-wave ratio (SWR) and signed complex impedance, and it can produce swept SWR and impedance plots (up to 100 points). You can also use it to measure unknown capacitors and inductors.

The AA-30's frequency range is 0.1 to 30 MHz. Unlike some of the higher-priced models, it's not supplied with carrying case, power supply/charger, internal rechargeable batteries, or a USB interface cable. You can't look at simultaneous multiband SWR plots or save plots for later review, although you can download the current scan with the included *AntScope* program. Even with these limitations, the price-to-feature ratio of the AA-30 is hard to beat.

Overview

The AA-30 is a single-port vector network analyzer (VNA) that provides signed, complex impedance measurements of RF loads from 100 kHz to 30 MHz. Power is provided by two easily changed alkaline AA batteries. Rechargeable AA batteries can be used, but they must be charged externally. An indicator on the Main Menu screen shows the battery status. The RF connector is an SO-239.

All information is displayed on a 128 × 64 pixel backlit LCD screen. You can select a single-frequency or a swept-frequency display. The single-frequency mode displays SWR, impedance (Z, R, and ±X), or the equivalent series and parallel representation of an impedance. The swept-frequency mode displays SWR or signed impedance (R and ±X) with graphs of up to 100 points. Finally, the AA-30 may be connected to your computer to provide additional data recording and analysis capabilities. Table 3 lists the AA-30 specifications.

AA-30 Testing

When checked against the 10 MHz WWV signal, the AA-30's frequency was off by about 70 Hz, well within the

Bottom Line

The AA-30 antenna analyzer covers 100 kHz to 30 MHz. It is an accurate, easy-to-use instrument for hams primarily interested in HF antenna and component analysis.

Table 3
RigExpert AA-30, serial number n/a

Manufacturer's Specifications	Measured Performance
Frequency range: 0.1 – 30 MHz.	As specified.
Frequency resolution: 1 kHz.	As specified.
Output power: About +13 dBm into 50 Ω.	See Table 4.
Open circuit output impedance: Not specified.	See Table 5.
Output signal shape: Square wave, 0.1 – 10 MHz; 3rd harmonic for 10 – 30 MHz.	Harmonics: 1.8 MHz: 2nd –17 dBc, 3rd –10 dBc. 3.5 MHz: 2nd –24 dBc, 3rd –10 dBc. 7 MHz: 2nd –37 dBc, 3rd –10 dBc. 14 MHz and 28 MHz: Fundamental, +10 dBc, 2nd –5 dBc, 3rd –8 dBc.
Measurement systems: 50 and 75 Ω.	As specified.
SWR range: Up to 10:1.	SWR of ∞ is indicated into open circuit.
R, X range (numerical): ±1 kΩ.	As specified except ±950 Ω at 28 MHz.
R, X range (graph): ±200 Ω.	As specified.
Power: USB interface or two AA 1.5 V alkaline or 1.2 V NiMH batteries.	
Battery operating time: 3 hours continuous, 2 days standby.	
Dimensions (height, width, depth): 9 × 4 × 1.5 inches; weight, 14 oz.	
Operating temperature: 32 – 104° F (0 – 40° C).	
Price: $250.	

Table 4
Output Power Versus Frequency

Power measured with a NIST-traceable Mini-Circuits PWR-6GHS+ power sensor and Siglent SSA3021X spectrum analyzer.

Spec Power (dBm)	Measured Power (dBm) at Frequency (MHz) 1.8	3.5	7	14	28
+13 typical	+9.9	+10.3	+10.6	0*	0*

*Above 10 MHz, the third harmonic of the AA-30's internally generated square wave signal is used. The ⅓ frequency fundamental signal is +10 dBm at 14 and 28 MHz.

Table 5
Open Circuit Output Measurements

Frequency (MHz)	SWR (digital)	Impedance (digital)
1.8	∞	8,500
3.5	∞	7,000
7	∞	3,500
14	∞	1,900
28	∞	950

analyzer's 1 kHz frequency readout. No noticeable frequency drift occurred over a 5-minute test period. The output level and frequency stability are sufficient for receiver sensitivity testing when used with a good step attenuator.

The output is a square wave, however, and this must be considered. Further, above 10 MHz, the third harmonic of the AA-30's internally generated square wave signal is used. So, above 10 MHz, the ⅓ frequency fundamental signal is 10 dB stronger than the desired on-frequency measurement signal. This is highlighted in Table 4.

Table 5 shows the unterminated SWR and impedance measured by the AA-30. This gives an indication of the impedance magnitude that can be measured accurately as a function of frequency.

I tested the AA-30 SWR accuracy against a precision 50 Ω load, followed by tests with shorted microwave attenuators of 5 dB (1.92:1 SWR), 3 dB (3.01:1 SWR), and 2 dB (4.42:1 SWR). Additional testing was done with loads made from Caddock thick-film resistors: 7.5 Ω (theoretically 6.67:1 SWR), 200 Ω (theoretically 4:1 SWR), and 400 Ω (theoretically 8:1 SWR). Table 6 compares the AA-30 SWR measurements with an Array Solutions AIM UHF. As you can see, the AA-30 SWR readings are quite accurate.

Finally, Table 7 shows a complex load measured by the AA-30 at 24.9 MHz. The load was constructed from a 49.9 Ω resistor in series with a 180 pF capacitor — theoretically 50 – *j*36 and an SWR of 2:1. Of course, components are not perfect, so I measured this load with an AIM UHF and used this for the comparison. As you can see, the AA-30 measurement was quite close to the AIM UHF measurement. Note that the AA-30 displays the correct sign of the reactance.

Using the AA-30

The AA-30 comes with two AA alkaline batteries, a user manual for standalone operation, and a software manual for computer interfacing. The latest manuals are available on the RigExpert website, as well as the latest version of the AA-30 firmware — but you must provide your own USB A/B cable for software updates and computer interfacing. Because USB A/B cables are inexpensive and available at any electronics store, I recommend purchasing one, so you can at least check and update the AA-30 firmware when new versions are available. Firmware updates are easily performed by following the instructions in the AA-30 software manual.

After a quick reading of the manual, you'll find that the AA-30 menus and keypad markings are self-explanatory. My main antenna is a Hy-Gain TH-1 20/15/10 meter trap dipole. Figure 6 shows a 10 to 30 MHz scan of the antenna. You can clearly see the three ham bands covered by this scan. The < and > keys can be used to move the frequency readout cursor anywhere within the scan. Normally, of course, you'll want to look at one band at a time. Figure 7 shows a scan of just the 15-meter band.

In addition to SWR and impedance measurements, the AA-30 can also

Table 6
Resistive Load Measurements

Loads measured with the AA-30 compared to the AIMUHF.

Frequency (MHz)	1:1 SWR AA-30/AIM	1.9:1 SWR AA-30/AIM	3:1 SWR AA-30/AIM	4.4 SWR AA-30/AIM	7.5 Ω Load AA-30/AIM	200 Ω Load AA-30/AIM	400 Ω Load AA-30/AIM
1.8	1.00/1.00	2.0/2.01	3.1/3.17	4.5/4.62	6.6/6.76	4.0/3.97	7.9/7.93
3.5	1.01/1.00	2.0/2.01	3.1/3.16	4.5/4.61	6.6/6.72	4.0/3.96	7.9/7.93
7	1.01/1.00	2.0/2.01	3.1/3.17	4.5/4.61	6.6/6.73	4.0/3.96	8.0/7.93
14	1.02/1.00	2.0/2.00	3.1/3.15	4.5/4.59	6.5/6.70	4.0/3.97	8.0/7.95
28	1.04/1.00	1.9/2.00	3.1/3.15	4.4/4.59	6.5/6.71	4.1/3.97	8.3/7.93

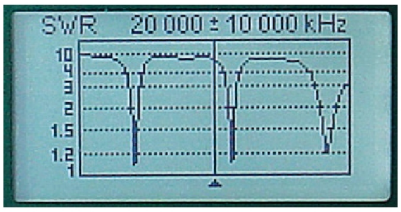


Figure 6 — 10 to 30 MHz scan of the reviewer's TH-1 20/15/10 meter trap dipole.

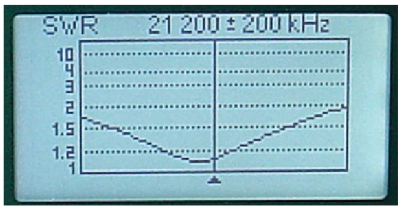


Figure 7 —Scan of the reviewer's TH-1 trap dipole showing the response over the 15-meter band.

Table 7
Complex Load Measurements

Loads measured with the AA-30 compared to the AIMUHF.

Frequency (MHz)	SWR		Impedance	
	AA-30	AIMUHF	AA-30	AIMUHF
24.9	2.0	1.92	46 –*j* 34	49 –*j* 33

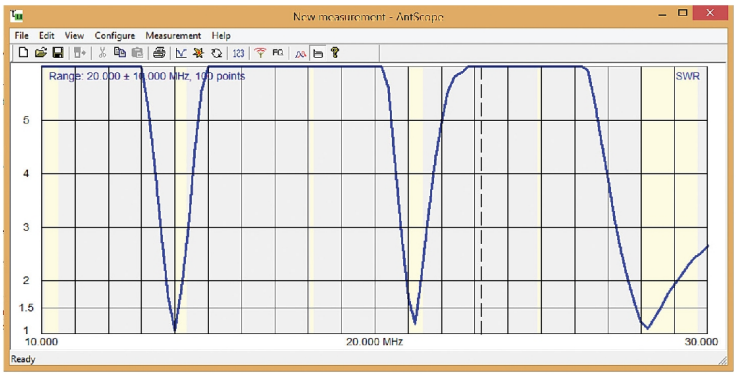


Figure 8 — The same measurement as in Figure 6, but displayed with the *AntScope* software.

measure cable length, cable loss, velocity factor, and characteristic impedance. Procedures for these tasks are detailed in the user manual.

Computer Interface

As discussed earlier, you can easily update the AA-30 firmware by interfacing it to a computer with internet access. Additionally, computer interfacing permits the AA-30 to use the included *AntScope* program. This powerful, easy-to-use program permits importing a current screenshot from the AA-30 as well as provides real-time control of the AA-30. Upon installation, *AntScope* does not create a desktop icon, so you must go to the appropriate folder to execute the program. (You can create a desktop icon by right-clicking on the AntScope.exe program, selecting Create Shortcut, and then dragging this shortcut to your desktop.) Figure 8 shows the *AntScope* output for the same 10 to 30 MHz antenna scan of my antenna, shown in Figure 6.

Conclusion

The AA-30 is a flexible, accurate, and inexpensive antenna and component analyzer that will satisfy those hams mostly interested in HF. If you want the addition of 6 meters, the ability to save/recall scans, and simultaneous multiband SWR displays, the RigExpert AA-54 is available for approximately an additional $70. You can investigate the AA-30 further by downloading the manual from the RigExpert website.

Manufacturer: Rig Expert Ukraine Ltd., Yakira St., 17A 04119 Kyiv, Ukraine; **www.rigexpert.com**. Available from many US dealers.

Notes

[5]J. Hallas, W1ZR, "RigExpert AA-200 Antenna Analyzer," Product Review, *QST*, Aug. 2008, pp. 45 – 47.
[6]J. Hallas, W1ZR, "RigExpert AA-54 Antenna Analyzer," Product Review, *QST*, Mar. 2012, pp. 49 – 51.
[7]P. Salas, AD5X, "RigExpert AA-230 ZOOM 0.1 – 230 MHz Antenna and Cable Analyzer," Product Review, *QST*, Mar. 2016, pp. 54 – 56.