Title:	***Understanding Your Antenna Analyzer, A Radio Amateur's Guide to Measuring Antenna Systems***
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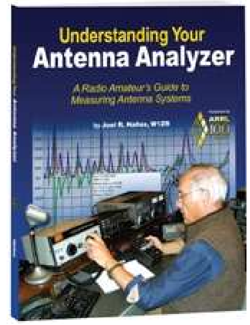
Reviewer:	Whitham D. Reeve



The foreword in ***Understanding Your Antenna Analyzer*** says "*This book is intended to introduce readers with a basic understanding of radio equipment and antennas to the ins and outs of antenna analyzers.*" The book succeeds as an introduction, but readers should not expect more. Overall, it is a nice and useful little book and it is not just for radio amateurs as indicated in the subtitle.

For better or worse, the book has almost no technical depth, so it can be followed by readers with limited technical background. However, to get the most from this book and from antenna measurements I recommend a basic understanding of complex impedance as a prerequisite. The author also uses the Smith Chart in some explanations, so brushing up on this graphical method would help too. The second chapter, *Making Antenna Measurements*, does provide some background information as well as a 3-page sidebar "*A Quick Discussion of Standing Wave Ratio*".

Understanding Your Antenna Analyzer first describes antenna analyzers in a general way. In its most basic form, an antenna analyzer provides a variable frequency signal source and the means to measure impedance magnitude and voltage standing wave ratio (VSWR, or just SWR). The goal of most basic antenna measurements is to tune an antenna to resonance and to determine and improve impedance matching. Later, the author reprints a dozen ARRL product reviews of specific analyzers including the MFJ-269 and YouKits FG-01. These reviews cover 44 pages, over 1/3 of the book, and having them in one place makes comparisons easy and convenient. Interestingly, the MFJ-259B, probably the most popular cheap antenna analyzer of all time, is not specifically mentioned; however, most MFJ analyzers works in a similar way, so if you own one you still could benefit from this book.

The book's value is enhanced by the description of a number of useful add-ons that readers can build themselves, including an audible VSWR indicator and a clever dip meter attachment. All of the add-ons were described in ARRL's QST magazine over the years but, again, it is nice to have them in one place. Missing from the book is a detailed checklist of useful features to aid a potential buyer in selecting an analyzer. Also, I think that, if there ever is an expanded second edition of this book, it should contain, in addition to the basic impedance and VSWR measurements, discussions of how to use some of the other features available in modern antenna analyzers.

This book makes it clear that when antenna measurements include the feedline (coaxial cable transmission line) those measurements are distorted by feedline effects, a fact often overlooked by many users. Depending on the feedline characteristics, the measured VSWR may be severely understated and the measured impedance far from representative of the antenna alone. This is due to the lossy nature of real feedlines. An example of this is a long feedline. If it is long enough, it does not matter what the far end is terminated by (short, open or a resistive or reactive load), the measured VSWR at the near end will be close to 1:1 and not representative of the actual VSWR at the other end where it matters. However, a short enough feedline at low enough frequency can be considered lossless and practically ideal. The author discusses ideal feedlines but provides no guidance as to when a real feedline can be considered lossless.

The author discusses what he describes as the key differences between the many available antenna analyzers – frequency range and display type (analog or digital). Digital displays are easier to read but invariably give the user a false sense of accuracy and precision (more on accuracy later). Some analyzers have both analog and digital displays. As for frequency range, most inexpensive antenna analyzers are designed for the radio amateur market and only cover the so-called ham bands and have gaps in their frequency coverage. This tends to keep their cost down but sometimes limits their usefulness for more general purposes such as amateur radio astronomy. Some analyzers have uninterrupted frequency ranges but few reach very far into the UHF range if at all. Most of the inexpensive antenna analyzers are for the MF and HF bands (from about 1.8 to 30 MHz).

The most basic antenna analyzer measures impedance, typically of an antenna alone, the antenna feedline alone or a combination. The VSWR is derived from the measurement. VSWR is a measure of how well an antenna or device matches the reference impedance, usually 50 ohms. A well-matched antenna allows more received or transmitted power to be transferred than a poorly-matched one. Most antenna analyzers will display impedance magnitude and some indicate the resistive and reactive components. Others indicate the sign of the reactance – negative for capacitive or positive for inductive reactance.

The antenna analyzers described in this book all are fairly accurate when the measured impedance is close to the reference impedance. However, the farther the measurements are from the reference impedance the more dubious the measurement becomes. The ARRL product reviews usually provide comparative measurements with a laboratory instrument and the loss in accuracy of the cheap antenna analyzer clearly stands out. Most inexpensive analyzers have a limited impedance measurement range, typically around 1/10x to 10x the reference impedance – or 5 to 500 ohms for a 50 ohms reference. This does not mean the measurements are accurate over that entire range, only that they display a reading over that range. All inexpensive antenna analyzers lose accuracy when the VSWR exceeds 5:1. In a system with 50 ohms reference, this is equivalent to a measured impedance of only 200 ohms (resistive).

The book contains a few errors but none of them are crippling. I notified the publisher of the ones I found (mostly in the chapter 6) and was told the corrections would be available at www.arrl.org/notes. There are a few annoyances. For example, in the 3-page sidebar on standing wave ratio the author uses the Greek letter α (lowercase alpha) for voltage reflection coefficient but a few pages later he uses Γ (uppercase gamma). Almost all antenna engineering books use ρ (lowercase rho) for voltage reflection coefficient. For someone not familiar with the terminology, this can be pretty confusing. One last comment: I purchased my copy of ***Understanding Your Antenna Analyzer*** from Amazon.com for $20 with free shipping – more than 15% cheaper than my discounted price as an ARRL member – so buyers should do some shopping around.

In summary, ***Understanding Your Antenna Analyzer*** will not break the bank; it covers almost all available inexpensive analyzers and very likely will help readers get more value from the one they already have or plan to purchase. Some readers may scoff at the book because much of the material is available to ARRL members for free on the ARRL website; however, not everyone on the planet who could benefit from this book is an ARRL member and having this information in one place is very convenient.