



QEX (ISSN: 0886-8093) is published bimonthly in January, March, May, July, September, and November by the American Radio Relay League, 225 Main Street, Newington, CT 06111-1494. Periodicals postage paid at Hartford, CT and at additional mailing offices.

POSTMASTER: Send address changes to: QEX, 225 Main St, Newington, CT 06111-1494 Issue No 273

Harold Kramer, WJ1B  
*Publisher*

Larry Wolfgang, WR1B  
*Editor*

Lori Weinberg, KB1EIB  
*Assistant Editor*

Zack Lau, W1VT  
Ray Mack, W5IFS  
*Contributing Editors*

**Production Department**

Steve Ford, WB8IMY  
*Publications Manager*

Michelle Bloom, WB1ENT  
*Production Supervisor*

Sue Fagan, KB1OKW  
*Graphic Design Supervisor*

David Pingree, N1NAS  
*Senior Technical Illustrator*

Carol Michaud, KB1QAW  
*Technical Illustrator*

**Advertising Information Contact:**

Janet L. Rocco, W1JLR  
*Business Services*  
860-594-0203 – Direct  
800-243-7768 – ARRL  
860-594-4285 – Fax

**Circulation Department**

Cathy Stepina, QEX Circulation

**Offices**

225 Main St, Newington, CT 06111-1494 USA  
Telephone: 860-594-0200  
Fax: 860-594-0259 (24 hour direct line)  
e-mail: [qex@arrl.org](mailto:qex@arrl.org)

**Subscription rate for 6 issues:**

In the US: ARRL Member \$24, nonmember \$36;

US by First Class Mail: ARRL member \$37, nonmember \$49;

International and Canada by Airmail: ARRL member \$31, nonmember \$43;

Members are asked to include their membership control number or a label from their QST when applying.

In order to ensure prompt delivery, we ask that you periodically check the address information on your mailing label. If you find any inaccuracies, please contact the Circulation Department immediately. Thank you for your assistance.



Copyright © 2012 by the American Radio Relay League Inc. For permission to quote or reprint material from QEX or any ARRL publication, send a written request including the issue date (or book title), article, page numbers and a description of where you intend to use the reprinted material. Send the request to the office of the Publications Manager ([permission@arrl.org](mailto:permission@arrl.org)).

July/August 2012

**About the Cover**

Steve Whiteside, N2PON, describes the design and construction of A Linear Scale Milliohm Meter. This meter is temperature stabilized over normal operating temperatures, and includes compensation for battery voltage variations with age. Steve describes a number of practical applications for a milliohm meter when troubleshooting various electrical and electronics equipment.



**In This Issue**

**Features**

**3 Confirmation Measurements of Vector Potential Waves**  
George Works, KJ6VW; Shelley Works, KG4SRS

**8 A New Antenna Model**  
Glen Elmore, N6GN

**19 A High-Performance Sound-Card AX.25 Modem**  
Sivan Toledo, 4X6IZ

**26 New Results on Shortening Beverage Antennas**  
Dr. Christopher Kunze, DK6ED

**33 A Linear Scale Milliohm Meter**  
Steve Whiteside, N2PON

**39 Upcoming Conferences**

**Index of Advertisers**

American Radio Relay League:..... Cover IV  
Array Solutions: ..... 40  
Down East Microwave Inc:..... 18  
Jim George, N3BB..... Cover III  
Kenwood Communications:..... Cover II  
National RF, Inc: ..... 18  
Nemal Electronics International, Inc:..... 25  
RF Parts:..... 37, 39  
Tucson Amateur Packet Radio: ..... 40