

QEX

QEX (ISSN: 0886-8093) is published bimonthly in January, March, May, July, September, and November by the American Radio Relay League, 225 Main St., Newington, CT 06111-1400. Periodicals postage paid at Hartford, CT and at additional mailing offices.

POSTMASTER: Send address changes to: QEX, 225 Main St., Newington, CT 06111-1400 Issue No. 339

Publisher
American Radio Relay League

Kazimierz "Kai" Siwiak, KE4PT
Editor

Lori Weinberg, KB1EIB
Assistant Editor

Ray Mack, W5IFS
Contributing Editors

Production Department
Becky R. Schoenfeld, W1BXJ
Director of Publications and Editorial

Jodi Morin, KA1JPA
Assistant Production Supervisor

David Pingree, N1NAS
Senior Technical Illustrator

Brian Washing
Technical Illustrator

Advertising Information
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 06111-1400 USA
Telephone: 860-594-0200
Fax: 860-594-0259 (24-hour direct line)
Email: qex@arrl.org

Subscription rate for 6 print issues:
In the US: \$29
US by First Class Mail: \$40
International and Canada by Airmail: \$35
ARRL members receive the digital edition of QEX as a member benefit.

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 © 2023 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 title, page numbers, and a description of where and how you intend to use the reprinted material. Send the request to permission@arrl.org.

July/August 2023

About the Cover

Barry Chambers, G8AGN, bases an antenna pointing system on the u-Blox C94-M8P-3 evaluation kit. Accurate alignment of microwave antennas is particularly important when using electrically large dishes or when operating QRP, especially on mm-wave bands such as 122 GHz. Real-time kinematic, differential global navigation satellite system, (RTK DGNSS) can provide extremely high-quality information about the separation and compass bearing between two global navigation satellite system (GNSS) modules, normally referred to as the Base and the Rover. This information can then be used to calibrate a rotatable protractor mounted on the operator's dish antenna tripod. It is then a simple matter to point the dish accurately in the direction of a distant station whose beam heading has been determined previously or by calculation from known latitude and longitude coordinates, or Maidenhead locators.



In This Issue:

- 2 Perspectives**
Kazimierz "Kai" Siwiak, KE4PT
- 3 Transformer Balun Circuit Characteristics Revealed**
Alan Victor, W4AMV
- 12 APRS with LoRa TTGO Module**
Anthony Le Cren, F4GOH/KF4GOH
- 16 Errata**
- 16 Upcoming Conferences**
- 17 An Antenna Pointing System Based on the U-Blox C94-M8P-3 Evaluation Kit**
Barry Chambers, G8AGN
- 23 30 THz Experiment Over 100 m Distance**
Hieronim Lecybyl, M7HBL and Remigiusz Lecybyl, MØLRH
- 29 Opulent Voice**
Michelle Thompson, W5NYV
- 35 Self-Paced Essays — #18 Vector Network Analyzer**
Eric P. Nichols, KL7AJ

Index of Advertisers

DX Engineering:	Cover III	Kenwood Communications:	Cover II
ICOM America:	Cover IV	Tucson Amateur Packet Radio:	28