

The American Radio Relay League



The American Radio Relay League, Inc. is a noncommercial association of radio amateurs, organized for the promotion of interest in Amateur Radio communication and experimentation, for the establishment of networks to provide communications in the event of disasters or other emergencies, for the advancement of the radio art and of the public welfare, for the representation of the radio amateur in legislative matters, and for the maintenance of fraternalism and a high standard of conduct.

ARRL is an incorporated association without capital stock chartered under the laws of the state of Connecticut, and is an exempt organization under Section 501(c)(3) of the Internal Revenue Code of 1986. Its affairs are governed by a Board of Directors, whose voting members are elected every three years by the general membership. The officers are elected or appointed by the Directors. The League is noncommercial, and no one who could gain financially from the shaping of its affairs is eligible for membership on its Board.

"Of, by, and for the radio amateur," ARRL numbers within its ranks the vast majority of active amateurs in the nation and has a proud history of achievement as the standard-bearer in amateur affairs.

A *bona fide* interest in Amateur Radio is the only essential qualification of membership; an Amateur Radio license is not a prerequisite, although full voting membership is granted only to licensed amateurs in the US.

Membership inquiries and general correspondence should be addressed to the administrative headquarters:

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The purpose of QEX is to:

- 1) provide a medium for the exchange of ideas and information among Amateur Radio experimenters,
- 2) document advanced technical work in the Amateur Radio field, and
- 3) support efforts to advance the state of the Amateur Radio art.

All correspondence concerning *QEX* should be addressed to the American Radio Relay League, 225 Main St., Newington, CT 06111 USA. Envelopes containing manuscripts and letters for publication in *QEX* should be marked Editor, *QEX*.

Both theoretical and practical technical articles are welcomed. Manuscripts should be submitted in word-processor format, if possible. We can redraw any figures as long as their content is clear. Photos should be glossy, color or black-and-white prints of at least the size they are to appear in *QEX* or high-resolution digital images (300 dots per inch or higher at the printed size). Further information for authors can be found on the Web at www.arrl.org/qex/ or by e-mail to qex@arrl.org.

Any opinions expressed in *QEX* are those of the authors, not necessarily those of the Editor or the League. While we strive to ensure all material is technically correct, authors are expected to defend their own assertions. Products mentioned are included for your information only; no endorsement is implied. Readers are cautioned to verify the availability of products before sending money to vendors.

Kazimierz "Kai" Siwiak, KE4PT

Perspectives

The March to Modules

Radio began with purely mechanical devices, at first with spark-gap transmitters and spark-gap receiving loops of Heinrich Hertz. Then as we marched through technical innovations, receiving of radio waves improved by the introduction of electrical detectors and coherers. Spark could by then provide actual wireless transmission and reception of messages over usable distances. We then entered the era of vacuum tubes and electronics; the excess bandwidths of spark-gap transmissions — Class B (damped wave) emissions — could no longer be tolerated, and were prohibited internationally by 1934 (but recently permitted once again under the *Ultra-wide Band Operation* provisions of FCC Part 15 subpart F). Radio became carrier-wave based, and the spectrum was carved up and allocated in relatively narrowband slivers of *frequencies*. We radio amateurs got our fair share of these band segments.

Vacuum tube electronics led to semiconductors and then to ICs (integrated circuits). By 1930 Julius Lilienfeld had already patented (US 1,745,175) the forerunner of the field effect transistor. At each stage of technical innovation transmitters and receivers became less costly, more capable and more compact. Today sophisticated application-specific ICs are driving the development of highly compact versatile modules, such as frequency synthesizers, tiny single-board computers, display modules, mixer modules, and real-time clock modules.

You can now easily build a very capable radio transceiver from readily available modules. Welcome to the world of modular electronics!

In This Issue

Harry Bloomberg, W3YJ, describes an inexpensive configuration that lets you operate an all-mode station remotely.

Eric Nichols, KL7AJ, in his Essay Series discusses setting up a home electrical engineering lab.

Bob Fontana, AK3Y, uses a NanoVNA to design an SSB ceramic resonator filter for digital modes.

Joe Purden, W6AYC, describes limitations of the transmission line resonator approach to broad banding dipoles.

Steve Stearns, K6OIK, describes *HOBBIES*, a series of computational electromagnetic analysis programs that use the method-of-moments with higher-order basis functions.

Al Yerger, K2ATY, exploits the quadrature coupling of power amplifiers to provide redundancy in a UHF power amplifier design.

Writing for QEX

Please keep the full-length *QEX* articles flowing in, or share a **Technical Note** of several hundred words in length plus a figure or two. *QEX* is edited by Kazimierz "Kai" Siwiak, KE4PT, (ksiwiak@arrl.org) and is published bimonthly. *QEX* is a forum for the free exchange of ideas among communications experimenters. All members can access digital editions of all four ARRL magazines: *QST*, *On the Air*, *QEX*, and *NCJ* as a member benefit. The *QEX printed edition* annual subscription rate (6 issues per year) for members and non-members is \$29 in the United States. First Class mail delivery in the US is available at an annual rate of \$40. For international subscribers, including those in Canada and Mexico, *QEX* printed edition can be delivered by airmail for \$35 annually, see www.arrl.org/qex.

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Very kindest regards,
Kazimierz "Kai" Siwiak, KE4PT
QEX Editor