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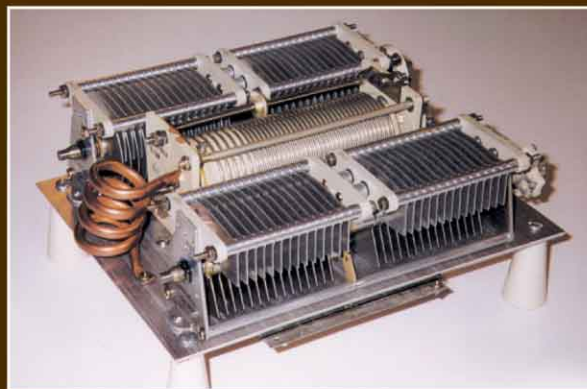
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# HANDBOOK

**FOR RADIO AMATEURS**

*The Standard in Applied  
Electronics and Communications*

# 2001



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AMATEUR RADIO*

# 2001

# The ARRL Handbook

For Radio Amateurs

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**The Cover**

*Top:* The antenna relay box for NJ1Q's Automatic Antenna Switch is perched on a W1AW tower leg. The inset photo shows the control unit. Read all about it in [Chapter 22](#).  
*Photos courtesy of Joe Bottiglieri, AA1GW.*

*Bottom left:* If you're looking for power-handling capacity, you've found the right tuner. N6BV's design works with both balanced and unbalanced antenna systems. See [Chapter 22](#).

*Bottom right:* WA2EBY's all-band linear amplifier uses low-cost MOSFETs. Details are in [Chapter 17](#).



Seventy-Eighth Edition

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# Foreword

This 2001 edition of *The ARRL Handbook* continues the tradition begun by ARRL staff in 1926 of publishing essential and useful technical information for radio amateurs. This volume represents the work of many people, some of whom are listed on the [title page](#). The authors and editors have put together informative theory discussions as well as practical projects. Further, they have updated the [References](#) chapter to make the book even more valuable to all hams (regardless of their areas of interest), technicians and engineers.

This year's *Handbook* includes a new chapter on [DSP](#) by *QEX* editor Doug Smith, KF6DX. Doug explains how this technology works, what it will do and where you might find it used in Amateur Radio equipment.

Bob Wolbert, K6XX, wrote a new section on [computer hardware](#) for [Chapter 7](#). With computers being used increasingly in our installations, most of us should find this material very helpful. In addition, you'll find pin connections for most common computer connectors in the References chapter.

W1AW Manager Joe Carcia, NJ1Q, presents an [automatic remote antenna switch](#) in [Chapter 22](#). The automatic function works for Yaesu or ICOM radios, and manual control will work with any equipment you might have.

In addition, there have been many updates throughout this book. In fact, most chapters have been changed to provide you with the most up-to-date reference material available.

This is the 78th edition of *The ARRL Handbook*, and we'd like to think it's the best ever. You can help us make future editions even more useful by providing your comments and suggestions on the [Feedback Form](#) elsewhere in this section.

David Sumner, K1ZZ  
Executive Vice President  
Newington, Connecticut  
September 2000

# The Amateur's Code

## **The Radio Amateur is:**

**CONSIDERATE**...never knowingly operates in such a way as to lessen the pleasure of others.

**LOYAL**...offers loyalty, encouragement and support to other amateurs, local clubs, and the American Radio Relay League, through which Amateur Radio in the United States is represented nationally and internationally.

**PROGRESSIVE**...with knowledge abreast of science, a well-built and efficient station and operation above reproach.

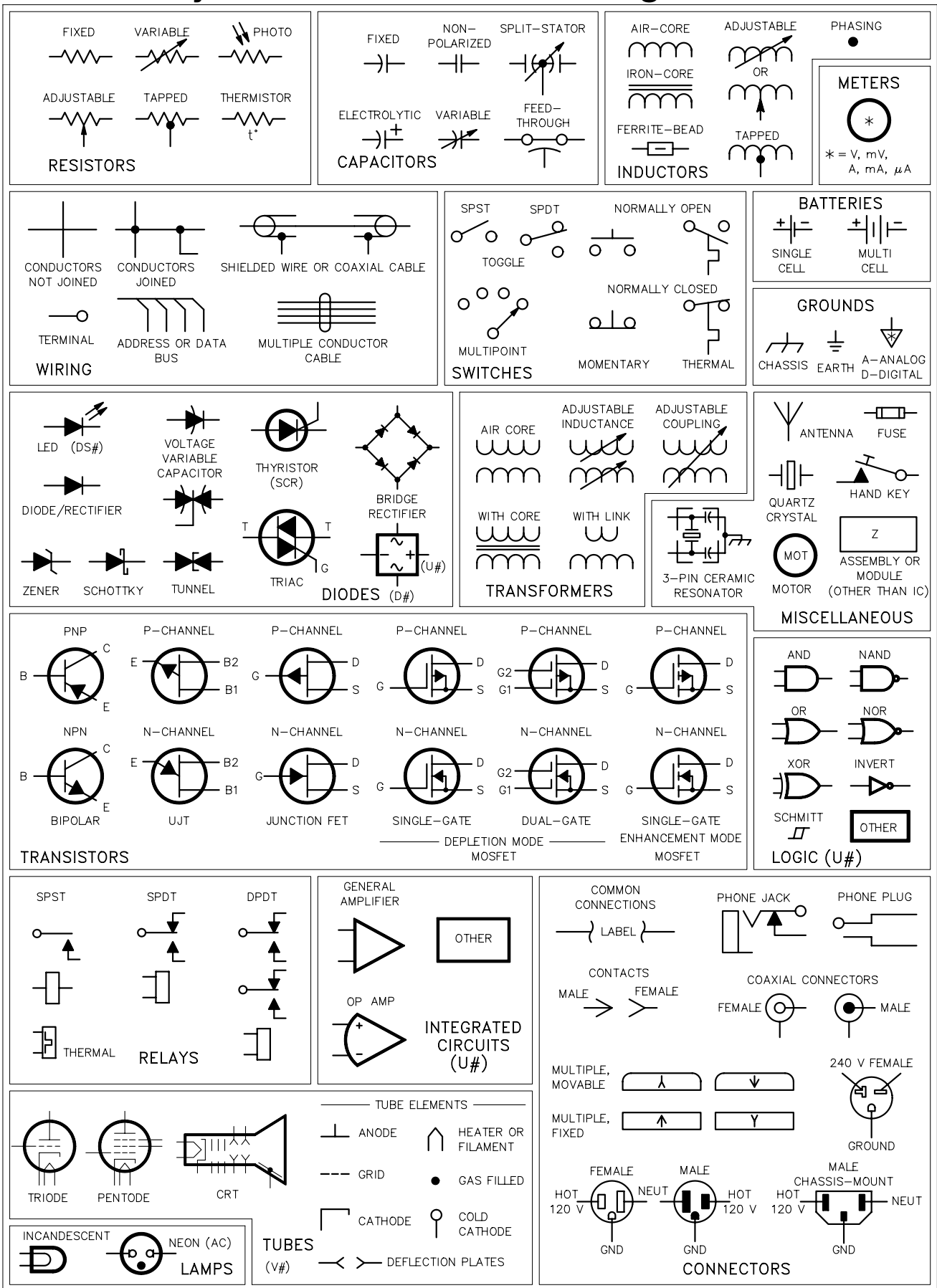
**FRIENDLY**...slow and patient operating when requested; friendly advice and counsel to the beginner; kindly assistance, cooperation and consideration for the interests of others. These are the hallmarks of the amateur spirit.

**BALANCED**...radio is an avocation, never interfering with duties owed to family, job, school or community.

**PATRIOTIC**...station and skill always ready for service to country and community.

—The original Amateur's Code was written by Paul M. Segal, W9EEA, in 1928.

# Schematic Symbols Used in Circuit Diagrams



## Handbook Software

The 1996 Edition was the first to include bundled software. The software proved to be a valuable addition for many readers. On the other hand, bundling the disk with the printed book increased its cost. A readership survey indicated clearly that keeping the cost of the book as low as possible was more important than the bundled disk.

For this reason, we will again be making the software for the 2001 Edition available separately.

### DOWNLOADING HANDBOOK SOFTWARE

You can download *Handbook* software from the Product Notes section of *ARRLWeb*: <http://www.arrl.org/notes/1867/>. Simply click on **Download hbk2001.exe**. The Handbook software can also be found on this CD, in the `\software` directory.

A description of the software appears [elsewhere](#) in this section.

## The ARRL—At Your Service

ARRL Headquarters is open from 8 AM to 5 PM Eastern Time, Monday through Friday, except holidays. Call **toll free** to join the ARRL or order ARRL products: **1-888-277-5289** (US), M-F only, 8 AM to 8 PM Eastern Time.

**If you have a question, try one of these Headquarters departments . . .**

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You can send e-mail to any ARRL Headquarters employee if you know his or her name or call sign. The second half of every Headquarters e-mail address is [@arrl.org](#). To create the first half, simply use the person's call sign. If you don't know their call sign, use the first letter of their first name, followed by their complete last name. For example, to send a message to John Hennessee, N1KB, Regulatory Information Specialist, you could address it to [jhennessee@arrl.org](mailto:jhennessee@arrl.org) or [N1KB@arrl.org](mailto:N1KB@arrl.org).

If all else fails, send e-mail to [hq@arrl.org](mailto:hq@arrl.org) and it will be routed to the right people or departments.



## Technical Information Server

If you have Internet e-mail capability, you can tap into the ARRL Technical Information Server, otherwise known as the *Info Server*. To have user instructions and a handy index sent to you automatically, simply address an e-mail message to: [info@arrl.org](mailto:info@arrl.org)

Subject: **Info Request**

In the body of your message enter:

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## ARRL on the World Wide Web

You'll also find *ARRLWeb* at: <http://www.arrl.org/>

At the ARRL Web page you'll find the latest W1AW bulletins, a hamfest calendar, exam schedules, an on-line ARRL Publications Catalog and much more. We're always adding new features to *ARRLWeb*, so check it often!

## Members-Only Web Site

As an ARRL member you enjoy exclusive access to our Members-Only Web site. Just point your browser to <http://www.arrl.org/members/> and you'll open the door to benefits that you won't find anywhere else.

- Our on-line Web magazine, the *ARRLWeb Extra* with colorful news and features you *won't* see in *QST*.
- *QST* Product Review Archive. Get copies of *QST* product reviews from 1980 to the present.
- *QST/QEX* searchable index (find that article you were looking for!)
- Previews of contest results and product reviews. See them here before they appear in *QST*!
- Access to your information in the ARRL membership database. Enter corrections or updates on line!

## Stopping by for a visit?

We offer tours of Headquarters and W1AW at 9, 10 and 11 AM, and at 1, 2 and 3 PM, Monday to Friday (except holidays). Special tour times may be arranged in advance. Bring your license and you can operate W1AW anytime between 10 AM and noon, and 1 to 3:45 PM!

## Would you like to write for *QST*?

We're always looking for new material of interest to hams. Send a self-addressed, stamped envelope (2 units of postage) and ask for a copy of the *Author's Guide*. (It's also available via the ARRL Info Server, and via *ARRLWeb* at <http://www.arrl.org/qst/aguide/>)

## Press Releases and New Products/Books

Send your press releases and new book announcements to the attention of the *QST* Editor (e-mail [qst@arrl.org](mailto:qst@arrl.org)). New product announcements should be sent to the Product Review Editor (e-mail [reviews@arrl.org](mailto:reviews@arrl.org)).

## Strays and Up Front

Send your Strays and Up Front materials to the *QST* Features Editor (e-mail [upfront@arrl.org](mailto:upfront@arrl.org)). Be sure to include your name, address and daytime telephone number.

## **ARRL Audio News**

The best way to keep up with fast-moving events in the ham community is to listen to the ARRL Audio News. It's as close as your telephone at 860-594-0384, or on the Web at <http://www.arrl.org/arrletter/audio/>

## **Interested in Becoming a Ham?**

Just pick up the telephone and call toll free 1-800-326-3942, or send e-mail to [newham@arrl.org](mailto:newham@arrl.org). We'll provide helpful advice on obtaining your Amateur Radio license, and we'll be happy to send you our informative Prospective Ham Package.

# ARRL Handbook CD Companion Software

Included on this CD-ROM is companion utility software that pertains to information and projects in the *Handbook* or is generally useful to hams. To use the companion software, you need an IBM PC-compatible computer with approximately 3 MB of free hard-disk space if you want to install all of the programs. The *TISFIND* and *SVCFILT* applications run only under Microsoft *Windows* or an equivalent operating system. The others require DOS.

To install the companion software:

- 1) Close any open applications and insert the CD-ROM into your CD-ROM drive.
- 2) From the *Windows* Program Manager, select the **File** menu and choose **Run**. (For *Windows 95* users, click the **Start** button and choose **Run**.)
- 3) Type **d:\software\setup.exe** (where d: is the drive letter of your CD-ROM drive; if the CD-ROM is a different drive on your system, type the appropriate letter) and press **Enter**.
- 4) Follow the instructions that appear on your screen.

The companion utility software *Windows* programs are located in the **ARRL Handbook Programs** program group. The DOS programs can be found in the HBKSW directory on your hard drive (they may be in a different directory if you specified one during installation). The programs are described in the following section. See the Help file in the **ARRL Handbook Programs** program group for more information.

## SOFTWARE DESCRIPTIONS

*ACTFILT.EXE* designs some simple active filters. See “[Active Filters](#)” in the **Filters** chapter for details of the filters.

*CONV.BAS* runs the “[PC Voltmeter and SWR Bridge](#)” in the **Station Accessories** chapter. It accepts analog input and sends the digital value to your computer printer port. *FINDLPT.BAS* helps you find the addresses of the printer ports for use with the “[PC Voltmeter and SWR Bridge](#)” project.

*CTL3DV2.DLL* is a *Windows* DLL that may be needed with *TISFIND*. See **TISFIND** below.

*DSP.EXE* contains *NWTNSQRT.BAS*, a program that uses Newton’s method for determining square roots; *FSQRT.TXT*, a machine-language routine for doing fast square roots and *DSP.DOC*, a file that gives more information about the first two.

*ELLER.EXE* consists of program and support files to calculate placement and length for a coil-loaded shortened dipole using an existing pair of inductors. See “[Computer-Aided Design of Loaded Short-Doublet Antennas](#),” in the **Antennas** chapter.

*INSTALL.EXE* reads this file and installs the software on a hard disk. *TISFIND* requires a separate installation under *Windows*. See instructions under **TISFIND**.

*GRIDLOC.BAS* converts latitude/longitude coordinates to four-character (such as FN42) grid square locations. *GRIDLOC.EXE* is a compiled version of the *.BAS* program.

*MORSE.EXE* sends and receives CW. See “[Quick and Easy CW with your PC](#)” in the **Station Accessories** chapter for details.

*SHADOW.EXE* locates local true north in order to orient directional antennas. See “[North Shadow](#)” in the **Antennas and Projects** chapter for details.

*PWRSPPLY.BAS* calculates the characteristics of various power supplies and regulators. *PWRSPPLY.EXE* is a compiled version of the *.BAS* program.

*PINET.EXE* consists of several programs to aid design of Pi and Pi-L matching networks, as described under “[Tank Output Circuits](#)” in the **Amplifiers** chapter.

*PRODREV.ADB* is the *QST* Product Review database, a comprehensive listing of reviews from 1970 to the present. *TISFIND.EXE* (see [below](#)) is used to search this data.

*README.TXT* is the README file for the disk.

*SAFETY.TXT* consists of the complete list of RF Safety references.

*SVCFILT.EXE* is a program that designs passive element filters using standard value capacitors. A complete help file is included.

*TIS.EXE* contains *TISFIND.EXE* (and related files), a Windows database look-up program used to view databases distributed by ARRL. Included with *TISFIND* is the ARRL TIS Address Database, which contains address and contact information for over 2000 companies and organizations of interest to amateurs.

*TLI.EXE* contains the files *TL.EXE* and *TL.DOC*. *TL.EXE* computes many parameters for transmission lines, as well as for antenna-tuners—including losses and stresses. See the [Transmission Lines](#) chapter.

*TUNER.TXT* contains tables that show losses measured under various load conditions with the new high-power antenna tuner.

*UTCZONE.BAS* is a handy program that gives the UTC zone and time offset for each zone.

*UTCZONE.EXE* is a compiled version of the *.BAS* program.

*VESTER\_F.EXE* contains the many files that make up the slow-scan TV system described in the [Modulation Sources](#) chapter. Be sure to read the README files.

# F E E D B A C K

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