Cover Info: Top to bottom: The impedance transformer designed by Phil Salas, AD5X, for matching vertical antennas on 160 and 80 meters. (see Chapter 24) Joe Garcia, NJ1Q designed and built the automatic antenna relay control and display unit. (Also in Chapter 24) Amateurs with stacked HF Yagis can use this remote-switched matching transformer designed by George Cutsogeorge, W2VJN. (See Chapter 20)
A more detailed Table of Contents is included at the beginning of each chapter.

INTRODUCTION
1 What is Amateur (Ham) Radio?
1.1 Do-It-Yourself Wireless
1.2 Joining the Ham Radio Community
1.3 Assembling Your Station
1.4 Hello, World! — Getting on the Air
1.5 Your Ham Radio “Lifestyle”
1.6 Public Service
1.7 Ham Radio in the Classroom
1.8 Resources
1.9 Glossary

FUNDAMENTAL THEORY
2 Electrical Fundamentals
2.1 Introduction to Electricity
2.2 Resistance and Conductance
2.3 Basic Circuit Principles
2.4 Power and Energy
2.5 Circuit Control Components
2.6 AC Theory and Waveforms
2.7 Capacitance and Capacitors
2.8 Inductance and Inductors
2.9 Working with Reactance
2.10 Impedance
2.11 Quality Factor (Q) of Components
2.12 Practical Inductors
2.13 Resonant Circuits
2.14 Transformers
2.15 Heat Management
2.16 Radio Mathematics
2.17 References and Bibliography

Digital Basics
4.1 Digital vs Analog
4.2 Number Systems
4.3 Physical Representation of Binary States
4.4 Combinational Logic
4.5 Sequential Logic
4.6 Digital Integrated Circuits
4.7 Microcontrollers
4.8 Personal Computer Interfacing
4.9 Glossary of Digital Electronics Terms
4.10 References and Bibliography

PRACTICAL DESIGN AND PRINCIPLES
5 RF Techniques
5.1 Introduction
5.2 Lumped-Element versus Distributed Characteristics
5.3 Effects of Parasitic Characteristics
5.4 Ferrite Materials
5.5 Semiconductor Circuits at RF
5.6 Impedance Matching Networks
5.7 RF Transformers
5.8 Noise
5.9 Two-Port Networks
5.10 RF Techniques Glossary
5.11 References and Bibliography

6 Computer-Aided Circuit Design
6.1 Circuit Simulation Overview
6.2 Computer-Aided Design Examples
6.3 Limitations of Simulation at RF
6.4 CAD for PCB Design
6.5 References and Bibliography
7 Power Supplies
7.1 The Need for Power Processing
7.2 AC-AC Power Conversion
7.3 Power Transformers
7.4 AC-DC Power Conversion
7.5 Voltage Multipliers
7.6 Current Multipliers
7.7 Rectifier Types
7.8 Power Filtering
7.9 Power Supply Regulation
7.10 “Crowbar” Protective Circuits
7.11 DC-DC Switchmode Power Conversion
7.12 High-Voltage Techniques
7.13 Batteries
7.14 Glossary of Power Supply Terms
7.15 Reference and Bibliography
7.16 Power Supply Projects

8 Modulation
8.1 Introduction
8.2 Analog Modulation
8.3 Digital Modulation
8.4 Image Modulation
8.5 Modulation Impairments
8.6 Modulation Glossary
8.7 References and Bibliography

9 Oscillators and Synthesizers
9.1 How Oscillators Work
9.2 Phase Noise
9.3 Oscillator Circuits and Construction
9.4 Designing an Oscillator
9.5 Quartz Crystals in Oscillators
9.6 Oscillators at UHF and Above
9.7 Frequency Synthesizers
9.8 Present and Future Trends in Oscillator Application
9.9 Glossary of Oscillator and Synthesizer Terms
9.10 References and Bibliography

10 Mixers, Modulators and Demodulators
10.1 The Mechanism of Mixers and Mixing
10.2 Mixers and Amplitude Modulation
10.3 Mixers and Angle Modulation
10.4 Puting Mixers, Modulators and Demodulators to Work
10.5 A Survey of Common Mixer Types
10.6 References and Bibliography

11 RF and AF Filters
11.1 Introduction
11.2 Filter Basics
11.3 Lumped-Element Filters
11.4 Filter Design Examples
11.5 Active Audio Filters
11.6 Quartz Crystal Filters
11.7 SAW Filters
11.8 Transmission Line Filters
11.9 Helical Resonators
11.10 Use of Filters at VHF and UHF
11.11 Filter Projects
11.12 Filter Glossary
11.13 References and Bibliography

12 Receivers
12.1 Introduction
12.2 Basics of Heterodyne Receivers
12.3 The Superheterodyne Receiver
12.4 Superhet Receiver Design Details
12.5 Control and Processing Outside the Primary Signal Path
12.6 Pulse Noise Reduction
12.7 VHF and UHF Receivers
12.8 UHF Techniques
12.9 References and Bibliography

13 Transmitters
13.1 Introduction
13.2 Early Transmitter Architectures
13.3 Modulation Types and Methods Applied to Transmitter Design
13.4 Modern Baseband Processing
13.5 Increasing Transmitter Power
13.6 Transmitter Performance and Measurement
13.7 References and Bibliography

14 Transceivers
14.1 The Transceiver Appears
14.2 Early SSB Transceiver Architectures
14.3 Modern Transceiver Architecture and Capabilities
14.4 Transceiver Control and Interconnection
14.5 Transceiver Projects
14.6 References

15 DSP and Software Radio Design
15.1 Introduction
15.2 Typical DSP System Block Diagram
15.3 Digital Signals
15.4 Digital Filters
15.5 Miscellaneous DSP Algorithms
15.6 Analytic Signals and Modulation
15.7 Software-Defined Radios (SDR)
15.8 Glossary
15.9 References and Bibliography

16 Digital Modes
16.1 Digital “Modes”
16.2 Unstructured Digital Modes
16.3 Fuzzy Modes
16.4 Structured Digital Modes
16.5 Networking Modes
16.6 Glossary
16.7 References and Bibliography
17 RF Power Amplifiers
17.1 High Power, Who Needs It?
17.2 Types of Power Amplifiers
17.3 Vacuum Tube Basics
17.4 Tank Circuits
17.5 Transmitting Device Ratings
17.6 Sources of Operating Voltages
17.7 Tube Amplifier Cooling
17.8 Amplifier Stabilization
17.9 Design Example: A High Power Vacuum Tube HF Amplifier
17.10 Solid-State Amplifiers
17.11 A New 250-W Broadband Linear Amplifier
17.12 Tube Amplifier Projects
17.13 References and Bibliography

18 Repeater Overview
18.1 A Brief History
18.2 Repeater Overview
18.3 FM Voice Repeaters
18.4 D-STAR Repeater Systems
18.5 Glossary of FM and Repeater Terminology
18.6 References and Bibliography

ANTENNA SYSTEMS AND RADIO PROPAGATION

19 Propagation of Radio Signals
19.1 Fundamentals of Radio Waves
19.2 Sky-Wave Propagation and the Sun
19.3 MUF Predictions
19.4 Propagation in the Troposphere
19.5 VHF/UHF Mobile Propagation
19.6 Propagation for Space Communications
19.7 Noise and Propagation
19.8 Glossary of Radio Propagation Terms
19.9 References and Bibliography

20 Transmission Lines
20.1 Transmission Line Basics
20.2 Choosing a Transmission Line
20.3 The Transmission Line as Impedance Transformer
20.4 Matching Impedances in the Antenna System
20.5 Baluns and Transmission-Line Transformers
20.6 Using Transmission Lines in Digital Circuits
20.7 Waveguides
20.8 Glossary of Transmission Line Terms
20.9 References and Bibliography

21 Antennas
21.1 Antenna Basics
21.2 Dipoles and the Half-Wave Antenna
21.3 Vertical (Ground-Plane) Antennas
21.4 T and Inverted-L Antennas
21.5 Slopers and Vertical Dipoles
21.6 Yagi Antennas
21.7 Quad and Loop Antennas
21.8 HF Mobile Antennas
21.9 VHF/UHF Mobile Antennas
21.10 VHF/UHF Antennas
21.11 VHF/UHF Yagis
21.12 Radio Direction Finding Antennas
21.13 Glossary
21.14 References and Bibliography

EQUIPMENT CONSTRUCTION AND MAINTENANCE

Component Data and References
22.1 Component Data
22.2 Resistors
22.3 Capacitors
22.4 Inductors
22.5 Transformers
22.6 Semiconductors
22.7 Tubes, Wire, Materials, Attenuators, Miscellaneous
22.8 Computer Connectors
22.9 RF Connectors and Transmission Lines
22.10 Reference Tables

Construction Techniques
23.1 Electronic Shop Safety
23.2 Tools and Their Use
23.3 Soldering Tools and Techniques
23.4 Surface Mount Technology (SMT)
23.5 Electronic Circuits
23.6 Mechanical Fabrication

Station Accessories
24.1 A 100-W Compact Z-Match Antenna Tuner
24.2 A Microprocessor Controlled SWR Monitor
24.3 A 160- and 80-M Matching Network for Your 43-Foot Vertical
24.4 Switching the Matching Network for Your 43-Foot Vertical
24.5 An External Automatic Antenna Switch for Use With Yaesu or ICOM Radios
24.6 A Low-Cost Remote Antenna Switch
24.7 Audible Antenna Bridge
24.8 A Trio of Transceiver/Computer Interfaces
24.9 A Simple Serial Interface
24.10 USB Interfaces For Your Ham Gear
24.11 The Universal Keying Adapter
24.12 The TiCK-4 — A Tiny CMOS Keyer
24.13 The ID-O-Matic Station Identification Time
24.14 An Audio Intelligibility Enhancer
24.15 An Audio Interface Unit for Field Day and Contesting
Technology is at the core of Amateur Radio whether applied to emergency communications, experimentation and development, competitive events and awards, or casual operating. The pace of technological change accelerates every year and the number of topics involved continues to expand. The challenge of providing a comprehensive technical reference for the amateur in a single book is growing, too.

The 2012 ARRL Handbook is addressing that challenge by continuing to provide updated material and supplements to previous material. Simultaneously, it is necessary to apply editorial discretion lest the physical size of the book become excessive. To that end, you will find an increased amount of material on the book’s accompanying CD-ROM, including a new Operating Supplement that contains the Space Communications, Digital Communications, and Image Communications chapters of previous editions. The editors anticipate the expansion of operating information in this electronic format in future editions. The annual HF transceiver survey has also been updated and reworked to become a feature of the CD-ROM.

This edition’s largest change is a brand new chapter on Test Equipment and Measurement by Alan Bloom, N1AL who previously updated the Modulation and DSP and Software Radio Design chapters. The basics receive a fresh new treatment and several new topics are included for the first time. A whole new set of test equipment construction projects is included, as well.

In addition, a new integrated treatment of Noise by Paul Wade, W1GHZ replaces the previous edition’s treatment of noise that was distributed across several different chapters. The material on Background Noise by Joe Taylor, K1JT is included in this comprehensive treatment of the subject and is also retained in the Operating Supplement’s material on Earth-Moon-Earth communications.

The software provided with the book continues to be updated — this edition includes the very latest version of Jim Tonne, W4ENE’s professional-quality ELSIE filter-design software and his brand-new PDF manual for MeterBasic, a graphics program for designing just the right face and scale for analog meters.

In the third year of the current cycle of renewal and updates, the 2012 ARRL Handbook rises to the challenge of technological change by continuing to draw on the expertise of the amateur community. These authors and reviewers represent and continue Amateur Radio’s best traditions of self-help and tutoring. The editors are expanding the use of electronic media, supplementing the printed material and developing new means of providing information to the reader. While the FCC’s Basis and Purpose for the Amateur Service has not changed, The ARRL Handbook — now in its eighty-ninth edition — continues to evolve along with technology and Amateur Radio.

David Sumner, K1ZZ
Chief Executive Officer
Newington, Connecticut
September 2011
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.
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 communication 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," the 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: ARRL, 225 Main Street, Newington, Connecticut 06111-1494.
The seed for Amateur Radio was planted in the 1890s, when Guglielmo Marconi began his experiments in wireless telegraphy. Soon he was joined by dozens, then hundreds, of others who were enthusiastic about sending and receiving messages through the air—some with a commercial interest, but others solely out of a love for this new communications medium. The United States government began licensing Amateur Radio operators in 1912.

By 1914, there were thousands of Amateur Radio operators—hams—in the United States. Hiram Percy Maxim, a leading Hartford, Connecticut inventor and industrialist, saw the need for an organization to band together this fledgling group of radio experimenters. In May 1914 he founded the American Radio Relay League (ARRL) to meet that need.

Today ARRL, with approximately 155,000 members, is the largest organization of radio amateurs in the United States. The ARRL is a not-for-profit organization that:

• promotes interest in Amateur Radio communications and experimentation
• represents US radio amateurs in legislative matters, and
• maintains fraternalism and a high standard of conduct among Amateur Radio operators.

At ARRL headquarters in the Hartford suburb of Newington, the staff helps serve the needs of members. ARRL is also International Secretariat for the International Amateur Radio Union, which is made up of similar societies in 150 countries around the world.

ARRL publishes the monthly journal QST, as well as newsletters and many publications covering all aspects of Amateur Radio. Its headquarters station, W1AW, transmits bulletins of interest to radio amateurs and Morse code practice sessions. The ARRL also coordinates an extensive field organization, which includes volunteers who provide technical information and other support services for radio amateurs as well as communications for public-service activities. In addition, ARRL represents US amateurs with the Federal Communications Commission and other government agencies in the US and abroad.

Membership in ARRL means much more than receiving QST each month. In addition to the services already described, ARRL offers membership services on a personal level, such as the Technical Information Service—where members can get answers by phone, email or the ARRL website, to all their technical and operating questions.

Full ARRL membership (available only to licensed radio amateurs) gives you a voice in how the affairs of the organization are governed. ARRL policy is set by a Board of Directors (one from each of 15 Divisions). Each year, one-third of the ARRL Board of Directors stands for election by the full members they represent. The day-to-day operation of ARRL HQ is managed by an Executive Vice President and his staff.

No matter what aspect of Amateur Radio attracts you, ARRL membership is relevant and important. There would be no Amateur Radio as we know it today were it not for the ARRL. We would be happy to welcome you as a member! (An Amateur Radio license is not required for Associate Membership.) For more information about ARRL and answers to any questions you may have about Amateur Radio, write or call:

ARRL—The national association for Amateur Radio
225 Main Street
Newington CT 06111-1494
Voice: 860-594-0200
Fax: 860-594-0259
E-mail: hq@arrl.org
Internet: www.arrl.org/

Prospective new amateurs call (toll-free):
800-32-NEW HAM (800-326-3942)
You can also contact us via e-mail at newham@arrl.org
or check out ARRLWeb at www.arrl.org/
### US Amateur Radio Bands

#### US AMATEUR POWER LIMITS

FCC 97.113 An amateur station must use the minimum transmitter power necessary to carry out the desired communications. (b) No station may transmit with a transmitter power exceeding 1.5 kW PEP.

#### Effective Date

May 6, 2008

---

### KEY

<table>
<thead>
<tr>
<th>Mode</th>
<th>E</th>
<th>A</th>
<th>G</th>
<th>N</th>
<th>T</th>
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<tr>
<td>RTTY and data</td>
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<td>Phone and image</td>
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<td>USB phone</td>
<td></td>
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<tr>
<td>Fixed digital message forwarding systems</td>
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</table>

- E = Amateur Extra
- A = Advanced
- G = General
- T = Technician
- N = Novice

---

### Note:

- CW operation is permitted throughout all amateur bands except 60 meters.
- MCW is authorized above 50.1 MHz, except for 219-220 MHz.
- Test transmissions are authorized above 51 MHz, except for 219-220 MHz.

---

### US Amateur Radio Bands

Effective Date: May 6, 2008

---

#### 160 Meters (1.8 MHz)

Avoid interference to radiolocation operations from 1.900 to 2.000 MHz.

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
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<tr>
<td>1.800</td>
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<tr>
<td>1.900</td>
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<tr>
<td>2.000</td>
<td></td>
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</tbody>
</table>

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#### 80 Meters (3.5 MHz)

USB only 2.8 kHz 5303.5, 5346.5, 5366.5, 5371.5, 5403.5 kHz

- General, Advanced, and Amateur Extra licensees may use the following five channels on a secondary basis with a maximum effective radiated power of 50 W PEP relative to a half wave dipole. Only upper sideband suppressed carrier voice transmissions may be used. The frequencies are 5330.5, 5346.5, 5366.5, 5371.5 and 5403.5 kHz. The occupied bandwidth is limited to 2.8 kHz centered on 5332, 5348, 5368, 5373, and 5405 kHz respectively.

---

#### 60 Meters (5.3 MHz)

<table>
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<th>Frequency (MHz)</th>
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<td>5300.5</td>
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<tr>
<td>5346.5</td>
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<td>5366.5</td>
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<td>5371.5</td>
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<tr>
<td>5403.5</td>
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</tbody>
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#### 40 Meters (7 MHz)

Phone and image modes are permitted between 7.075 and 7.100 MHz for FCC licensed stations in ITU Regions 1 and 3 and by FCC licensed stations in ITU Region 2 West of 130 degrees West longitude or South of 20 degrees North latitude. See Sections 97.305(c) and 97.305(f)(11).

---

#### 30 Meters (10.1 MHz)

Avoid interference to fixed services outside the US.

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<td>10.150</td>
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#### 20 Meters (14 MHz)

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<td>14.150</td>
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<td>14.350</td>
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#### 17 Meters (18 MHz)

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<td>17.200</td>
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<td>17.300</td>
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#### 15 Meters (21 MHz)

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<td>21.000</td>
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<td>21.200</td>
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#### 12 Meters (24 MHz)

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<td>24.930</td>
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<tr>
<td>24.990</td>
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#### 10 Meters (28 MHz)

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<td>28.300</td>
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<tr>
<td>28.990</td>
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</tbody>
</table>

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All licensees except Novices are authorized all modes on the following frequencies:

- 2300-2310 MHz 10.0-10.5 GHz
- 2390-2450 MHz 24.0-24.5 GHz
- 3300-3500 MHz 47.0-47.2 GHz
- 5650-5925 MHz 76.0-81.0 GHz

---

#### 6 Meters (50 MHz)

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#### 2 Meters (144 MHz)

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<td>148.0</td>
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#### 1.25 Meters (222 MHz)

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#### 70 cm (420 MHz)

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<td>450.0</td>
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#### 33 cm (902 MHz)

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<td>928.0</td>
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#### 23 cm (1240 MHz)

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<tr>
<td>1300</td>
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See ARRLWeb at www.arrl.org for detailed band plans.

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### ARRL We're At Your Service

- ARRL Headquarters: 860-594-0200 (Fax 860-594-0259) email: hq@arrl.org
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- Getting Started in Amateur Radio: Toll-Free 1-800-326-3942 (860-594-0355) email: newham@arrl.org
- Exams: 860-594-0300 email: vec@arrl.org

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