Declassified CIA Documents Shed New Light on Amateur Radio During the Cold War Page 64

QST
DIGITAL EDITION
ARRL The national association for AMATEUR RADIO®
February 2018 www.arrl.org

The Truth About Trees and Antenna Gain

QST Reviews

TYT MD-2017
Dual-Band Analog and DMR Handheld Transceiver

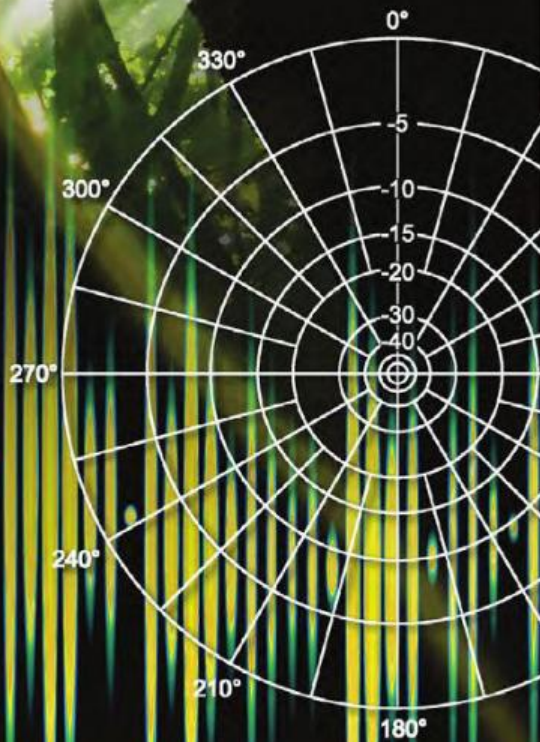
Heil PR 10 Home-Station Microphone Package

Elenco DT-100 Diode/Transistor Tester Kit

HamGadgets Universal Keying Adapter 3+ Kit

AlexMic Speaker/Microphone for the Elecraft KX2 and KX3

SOTABEAMS Click2Tune
Accessory for Icom Transceivers



DIGITAL FEATURE

49 | See our Video Review of the **TYT MD-2017** Dual-Band Analog and DMR Handheld Transceiver

The radio... YAESU

Superior RF Performance

HF/50 MHz Transceiver

FT DX 5000MP Limited

200 W / Class-A 75 W

Best Performance for the Serious DX'er

- Narrow IF Down-Conversion Receiver
- Equipped with Extra Sharp Crystal Roofing Filters (300 Hz, 600 Hz and 3 kHz)
- Astounding 112 dB IDR & +40dBm IP3
- Provides ultra-high-Q RF preselection selectivity

HF/50 MHz Transceiver

FT DX 3000D

100 W

Achieving the Highest Ideal of HF Transceivers

- Narrow IF Down-Conversion Receiver
- Equipped with Extra Sharp Crystal Roofing Filters (600 Hz and 3 kHz)
- Yaesu IF DSP provides powerful and effective QRM rejection
- High dynamic range and IP3 performance

HF/50 MHz Transceiver

FT DX 1200

100 W

Best in Class Performance and Supreme Operability

- 3 kHz, 6 kHz and 15 kHz Roofing Filters included
- Yaesu IF DSP provides powerful and effective QRM rejection
- 40MHz 1st IF produces excellent shape factor

YAESU
The radio

YAESU USA
6125 Phyllis Drive, Cypress,
CA 90630 (714) 827-7600

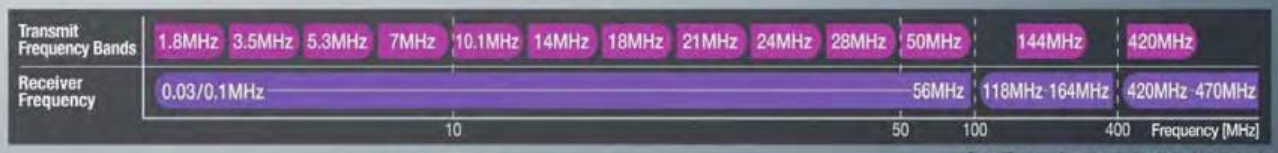
For the latest Yaesu news, visit us on the Internet: **http://www.yaesu.com**

Specifications subject to change without notice. Some accessories and/or options may be standard in certain areas. Frequency coverage may differ in some countries. Check with your local Yaesu Dealer for specific details.

The radio... YAESU

Wide-Coverage Transceivers

HF through VHF/UHF in One Radio



* Specified performance: Amateur bands only

A Superb All-around Transceiver with a built-in real-time spectrum scope and superior basic operation

HF/50/144/430MHz 100W All Mode Transceiver

FT-991A

Operating Modes: CW/SSB/AM/FM/C4FM

- Covers all-modes SSB/CW/AM/FM and C4FM digital
- Built in Real-Time Spectrum Scope with Multi-Color Waterfall Display
- 100 Watts (2 Meter & 70 Centimeter: 50 Watts) of Solid Performance
- IF DSP for Superb Interference Rejection
- 3.5-inch TFT Full-Color Touch Panel Display
- Advanced Support for C4FM Digital

* Desktop Microphone & External Speaker (Optional)

The Smallest HF/VHF/UHF Mobile Transceiver
Provides base station performance from a compact package

HF/50/144/430MHz 100W All Mode Transceiver

FT-857D

Operating Modes: CW/SSB/AM/FM * C4FM digital mode is not supported

- Ultra-Compact Package (6.1" x 2.0" x 9.2")
- The 4 Pole Roofing Filter (MCF) and 11 Band Pass Filter RF stages
- Large Radio Tuning Dial and Outstanding Ergonomics

The Ultimate Backpack
Multi-Mode Portable Transceiver

HF/50/144/430MHz 5W All Mode Transceiver

FT-817ND

Operating Modes: CW/SSB/AM/FM * C4FM digital mode is not supported

- Incredibly Small Size (5.3" x 1.5" x 6.5") and Light Weight (under 2 pounds)
- Ni-MH Battery Pack and Battery Charger Included
- AA Alkaline Battery Operation

YAESU
The radio

YAESU USA
6125 Phyllis Drive, Cypress,
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Cushcraft...Keeping You in Touch Around the Globe

MA-6B 6-Band Beam

Small Footprint – Big Signal

2-Elements on 20/17/15/12/10/6 Meters!!!

Cushcraft's latest MA-6B gives you *2-elements on six bands!* You get solid *signal-boosting directivity* in a bantam-size and weight.

It mounts on your roof or mast using standard TV hardware. It's perfect for exploring exciting DX without the high cost and heavy lifting of installing a large tower and a full-sized array. Its 7 foot 3-inch boom has less than 9 feet of turning radius. Contest tough – handles 1500 Watts.

The unique MA-6B is a *two-element Yagi* on 20/17/15/12/10/6 Meters. It delivers solid power-multiplying gain over a dipole on *all* bands. You get automatic band switching and a super easy installation in a compact 26-pound package.

When working DX, what really matters are the interfering signals and noise you *don't hear*. That's where the MA-6B's impressive side rejection and front-to-back ratio really shines.

MA-5B, $499.95. Like MA-6B but five bands: 20/17/15/12/10 Meters. 12 and 17 Meters is a single element trapped dipole.

***See cushcraftamateur.com** for gain figures.*

Cushcraft 10, 15 & 20 Meter Tribander Beams

Only the best tri-band antennas become DX classics, which is why the Cushcraft World-Ranger A4S, A3S, and A3WS go to the head of the class. For more than 30 years, these pace-setting performers have taken on the world's most demanding operating conditions and proven themselves every time. The key to success comes from attention to basics. For example, element length and spacing has been carefully refined over time, and high-power traps are still hand-made and individually tuned using laboratory-grade instruments. All this attention to detail means low SWR, wide bandwidth, optimum directivity, and high efficiency – important performance characteristics you rely on to maintain regular schedules, rack up impressive contest scores, and grow your collection of rare QSLs!

It goes without saying that the World-Ranger lineup is also famous for its rugged construction. In fact, the majority of these antennas sold years ago are still in service today! Conservative mechanical design, rugged over-sized components, stainless-steel hardware, and aircraft-grade 6063 make all the difference.

The 3-element A3S/A3WS and 4-element A4S are world-famous for powerhouse gain and super performance. **A-3WS, $499.95,** 12/17 M. **30/40 Meter** *add-on kits* available.

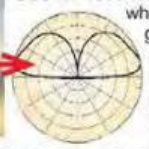
Cushcraft R9...80-6 Meters 80 Meters...No Radials...1500W

Cushcraft's world famous R8 now has a big brother!

Big Brother R9 now includes 75/80 Meters for local ragchewing and worldwide low band DX *without radials!*

Its omni-directional low angle radiation gives you exciting and easy DX on all 9 bands: 75/80, 40, 30, 20, 17, 15, 12, 10 and 6 Meters with low SWR. QSY instantly – no antenna tuner needed.

Use full 1500 Watts SSB/CW when the going gets tough to break through pileups/ poor band conditions.



The R9 is super easy to assemble, installs just about anywhere, and its low profile blends inconspicuously into the background in urban and country settings alike.

Compact Footprint: Installs in an area about the size of a child's sandbox -- no ground radials to bury with all RF-energized surfaces safely out of reach.

Rugged Construction: Thick fiberglass insulators, all stainless steel hardware and 6063 aircraft-aluminum tubing is double or triple walled at key stress points to handle anything Mother Nature can dish out.

31.5 feet tall, 25 lbs. Mounting mast 1.25 to 2 inches. Wind surface area is 4 square feet.

R8, $539.95. Like R9 antenna but less 75/80 Meters.

R-8TB, $79.95. Tilt-base lets you tilt your antenna up/down easily by yourself to work on.

R-8GK, $59.95. Three-point guy kit for high winds.

Cushcraft Dual-Band Yagis

One Yagi for Dual-Band FM Radios

Dual-bander VHF rigs are the norm these days, so why not complement your FM base station with a dual-band Yagi? Not only will you eliminate a costly feed line, you'll realize extra gain for digital modes like high-speed packet and D-Star! Cushcraft's A270-6S provides three elements per band and the A270-10S provides five for solid point-to-point performance. They're both pre-tuned and assembly is a snap using the fully illustrated manual.

Cushcraft Famous Ringos Compact FM Verticals

W1BX's famous Ringo antenna has been around for a long time and remains unbeaten for solid reliability. The Ringo is broadbanded, lightning protected, extremely rugged, economical, electrically bullet-proof, low-angle, and more -- but mainly, it just plain works! To discover why hams and commercial two-way installers around the world still love this antenna, order yours now!

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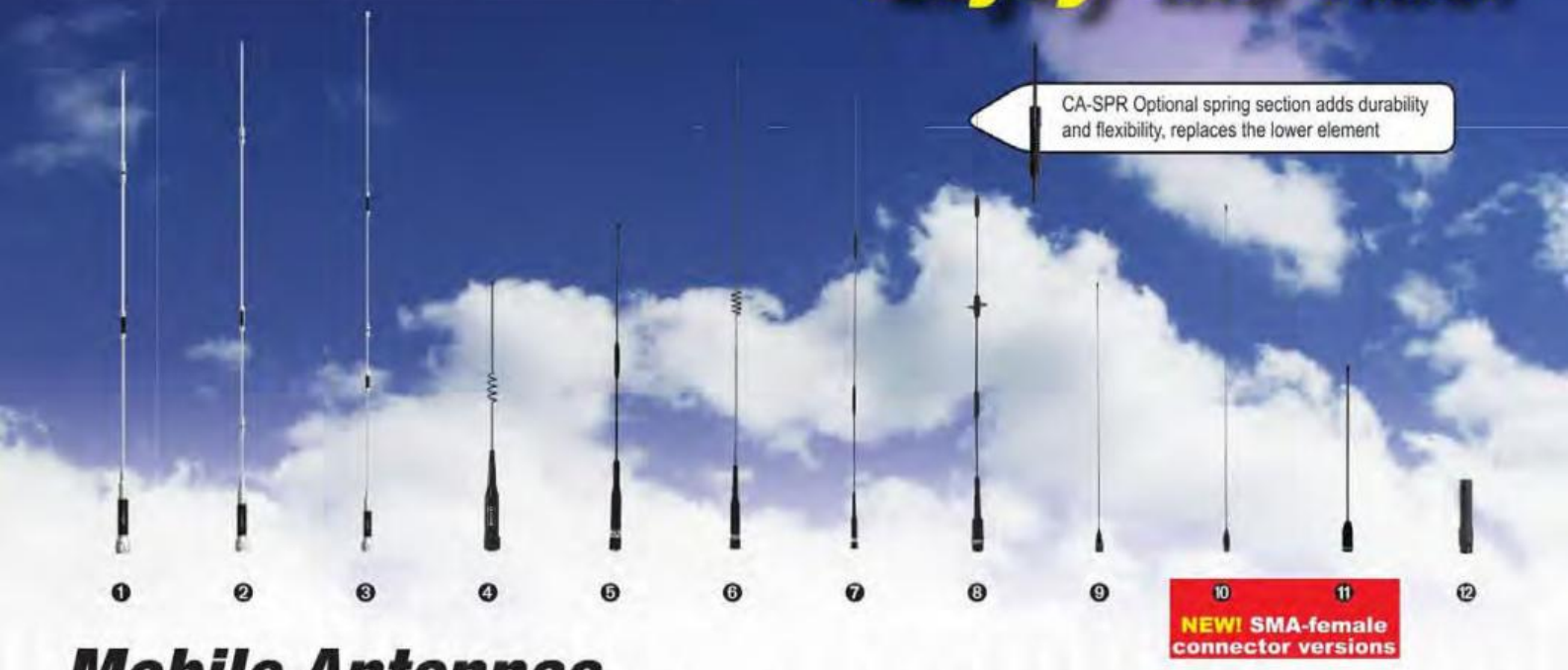

Mobile Antennas

❶ COMET **CSB-750A** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 1/2 wave • 440MHz: 5/8 wave x 2 • VSWR: 1.5:1 or less • Length: 42" • Conn: PL-259 • Max. Pwr: 150W

❷ COMET **CSB-770A** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 5/8 wave center load • 440MHz: 5/8 wave x 2 center load • VSWR: 1.5:1 or less • Length: 51" • Conn: PL-259 • Max Pwr: 150W

❸ COMET **CSB-790A** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 7/8 wave center load • 440MHz: 5/8 wave x 3 center load • VSWR: 1.5:1 or less • Length: 62" • Conn: PL-259 • Max Pwr: 150W

❹ COMET **B-10/B-10NMO** DUAL-BAND 2M/440MHz
2M: 1/4 wave • 440MHz: 1/2 wave • Length: 12" • Conn: B-10 PL-259, B-10NMO - NMO style • Max Pwr: 50W

❺ COMET **SBB-2/SBB-2NMO** DUAL-BAND 2M/440MHz
2M: 1/4 wave • 440MHz: 5/8 wave center load • VSWR: 1.5:1 or less • Length: 18" • Conn: SBB-2 PL-259, SBB-2NMO - MNO style • Max Pwr: 60W

❻ COMET **SBB-5/SBB-5NMO** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 1/2 wave • 440MHz: 5/8 wave x 2 • Length: 39" • Conn: SBB-5 PL-259, SBB-5NMO - NMO style • Max Pwr: 120W

❼ COMET **SBB-7/SBB-7NMO** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 6/8 wave • 440MHz: 5/8 wave x 3 • Length: 58" • Conn: SBB-7 PL-259, SBB-7NMO - NMO style • Max Pwr: 70W

❽ COMET **CA-2X4SR/CA-2X4SRNMO** WIDE-BAND 140-160MHz 435-465MHz w/FOLD-OVER
2M: 5/8 wave • 440MHz: 5/8 wave x 3 • Length: 40" • Conn: CA-2x4S PL-259, CA-2x4SRNMO NMO style • Max Power: 150W

❾ COMET **BNC-24** DUAL BAND 2M/440MHz HT ANTENNA
RX range: 100-1200MHz • Length: 17" • SuperFlex featherweight whip • Conn: BNC

❿ COMET **SMA-24** NEW! **SMA-24J** DUAL BAND 2M/440MHz HT ANTENNA
RX range: 100-1200MHz • Length: 17" • SuperFlex featherweight whip • Conn: SMA-24: SMA-male / SMA-24J: SMA-female

⓫ COMET **SMA-503** NEW! **SMA-503J** DUAL BAND 2M/440MHz HT ANTENNA
RX range: 100-1200MHz • Length: 8.75" • Conn SMA-503: SMA-male, SMA-503J: SMA-female

⓬ *Maldol* **MH-209, MH-209SMA** DUAL BAND 2M/440MHz HT ANTENNA
Length: 3" • Conn: MH-209 BNC, MH-209SMA: SMA-male • Soft rubber cover, good performance in a small package!

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QST

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February 2018 ♦ Volume 102 ♦ Number 2

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Includes audio
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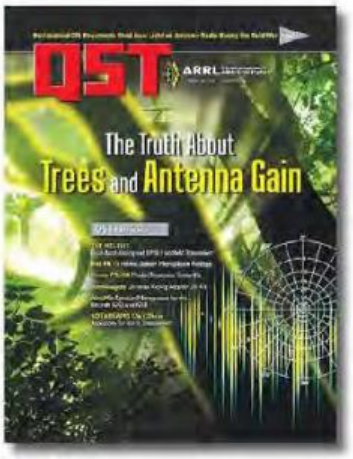

Our Cover
Hams' love/hate relationship with trees is as old as Amateur Radio itself. We love the trees that are there for us when we need a means of raising an antenna, and we hate the ones that are in the way of our signal getting out effectively. Kai Siwiak, KE4PT, and Richard Quick, W4RQ, explore the relationship more deeply in this month's article, "Live Trees Affect Antenna Performance," on page 33.

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When you're ready to get on HF,
or to upgrade your HF station,

DO IT RIGHT - GET A

In 1865 physicist James Clerk Maxwell mathematically predicted electromagnetic waves, and in 1888 experimenter Heinrich Hertz confirmed their existence. From that moment on it was a race to see who could build a practical wireless telegraph and telephone system based on this new science. Pioneers like Tesla, Fleming, de Forest, Armstrong, Marconi and Fessenden all made critical contributions to the development of radio as a practical communications medium, and by the 1920s radio spanned the world.

Hams were there from the beginning, building their own spark gap transmitters and coherer receivers, adding to radio science and engineering. Skywave propagation, which makes direct long distance communications possible, was entirely an amateur discovery made after the government relegated hams to wavelengths below 200 meters. These were thought to be useless but hams proved them wrong, ushering in the shortwave era.

In my humble opinion HF is the heart and soul of ham radio; it's where it all started. Sure I'm on two meters and 440, but for me the magic happens when I talk to another ham on the other side of the world, direct from my station to his. Even though most new hams get their start on VHF these days, there are millions of hams in nearly every country of the world just waiting to talk on HF.

Back in the day HF equipment was expensive, and not very capable. Today it's a bargain, and modern radios offer a fantastic array of functions. Most even include a built-in antenna tuner, although they're quite limited in capacity and can handle SWRs of only 3:1 at most, insufficient for many real-world antennas.

LDG makes a full line of tuners for every amateur purpose, from QRP to QRO. Many are fully automatic, tuning as you operate to maintain a match between the transmitter and antenna. They handle SWRs of up to 10:1, and have 2,000 memories for nearly instant retuning on previously used frequencies.

LDG tuners are designed to work with coax-fed antennas, but they can also be used with antennas fed with ladder line, or with long-wire antennas. LDG makes a full line of Baluns and Ununs for these purposes, and best of all for a short time they're free with purchase!

All LDG tuners come with a two-year warranty, and it's fully transferable. If you sell or give away your tuner just give the new owner the receipt and it's covered for the remainder of the two-year period. And of course all of our tuners come with our legendary customer support, the best in the industry.

When you're ready to get on HF, or to upgrade your HF station, do it right and get an LDG tuner.

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Brand Specific Tuners

These brand-specific LDG tuners integrate seamlessly with your rig for streamlined operation.

NEW YT-1200

Designed for Yaesu's FT-450, FT-450D, FT-950, FT-991, FTDX-1200, FTDX-3000 and FT-2000 (non-D). Seamless integration. The tuner is powered by the transceiver (except the FT-2000). It has a CAT port pass-through - use computer control of the transceiver when using this tuner. Power and control through the provided interface cable.

Suggested Price $259.99

KT-100

For AT-300 compatible Kenwood transceivers (except TS-480HX). The KT-100 allows you to use the Tune button on the radio. 2,000 memories for instant recall of tuning parameters for favorite bands and frequencies.

Suggested Price $199.99

IT-100

Matched in size to the Icom IC-7000 and IC-706. Control the IT-100 and its 2000 memories from either its own button or the Tune button on your IC-7000 or other Icom rigs. For your Icom radio that is AH3 or AH-4 compatible.

Suggested Price $179.99

radio not included

Z-817

The ultimate autotuner for QRP radios including the Yaesu FT-817(D). Tuning is simple, one button push on the tuner is all that is needed - the Z-817 takes care of the rest. 2000 memories cover 160 through 6 meters.

Suggested Price $129.99

Your Favorite Dealer has these tuners in stock NOW! Don't Miss Out - Call or visit them TODAY!

TUNER FROM LDG ELECTRONICS

Generic Tuners

AT-1000ProII shown with optional M-1000 external analog meter $129.99

AT-1000ProII

Our flagship 1KW tuner: 5 to 1,000Watts PEP; RF Sensing; Auto and Semi Tuning Modes; 1.8 to 54 MHz range; 6 to 800 ohm range (15 to 150 on 6M); simplified operation; and an optional external 4.5" analog meter. With the two position antenna switch, there are 2,000 memories that store tuning parameters for almost instantaneous memory recall whenever you transmit on or near a frequency you've used before.

Suggested Price $539.99

Optional M-600 external analog meter $129.99

AT-600ProII

Simplified operation with two-position antenna switch, there are 2,000 memories that store tuning parameters for almost instantaneous memory recall whenever you transmit on or near a frequency you've used before.

Suggested Price $369.99

Z-100Plus

Runs on any voltage source from 7 to 18 volts; six AA batteries will run it for a year of normal use. Includes an internal frequency counter so the operating frequency is stored with tuning parameters.

Suggested Price $159.99

AT-100ProII

Covers all frequencies from 1.8 – 54 MHz (including 6 meters), and will automatically match your antenna in no time. It features a two-position antenna switch with LEDs, allowing you to switch instantly between two antennas. The AT-100ProII requires just 1 watt for operation, but will handle up to 125 watts.

Suggested Price $229.99

AT-200ProII

The AT-200ProII now includes LEDs to show antenna position and if the tuner is in bypass. A two position antenna switch stores 2000 memories per switch. Handles up to 250 watts SSB or CW on 1.8 to 30 MHz and 100 watts on 54 MHz. Rugged and easy to read LED bar graphs simultaneously show RF power and SWR.

Suggested Price $259.99

Z-11ProII

Designed for battery operation. Handles 0.1 to 125 watts, great for both QRP and standard 100 watt transceivers from 160 - 6 meters. It will match dipoles, verticals, inverted-Vs or virtually any coax-fed antenna.

Suggested Price $179.99

Don't know which tuner is right for you?

Many of LDG's tuners are fully generic and can be used with any transceiver or transmitter in its power range. You can use them with modern microprocessor-controlled rigs, vacuum tube boat anchors or anything in between.

Call your favorite dealer or visit www.ldgelectronics.com to see our Tuner Comparison chart!

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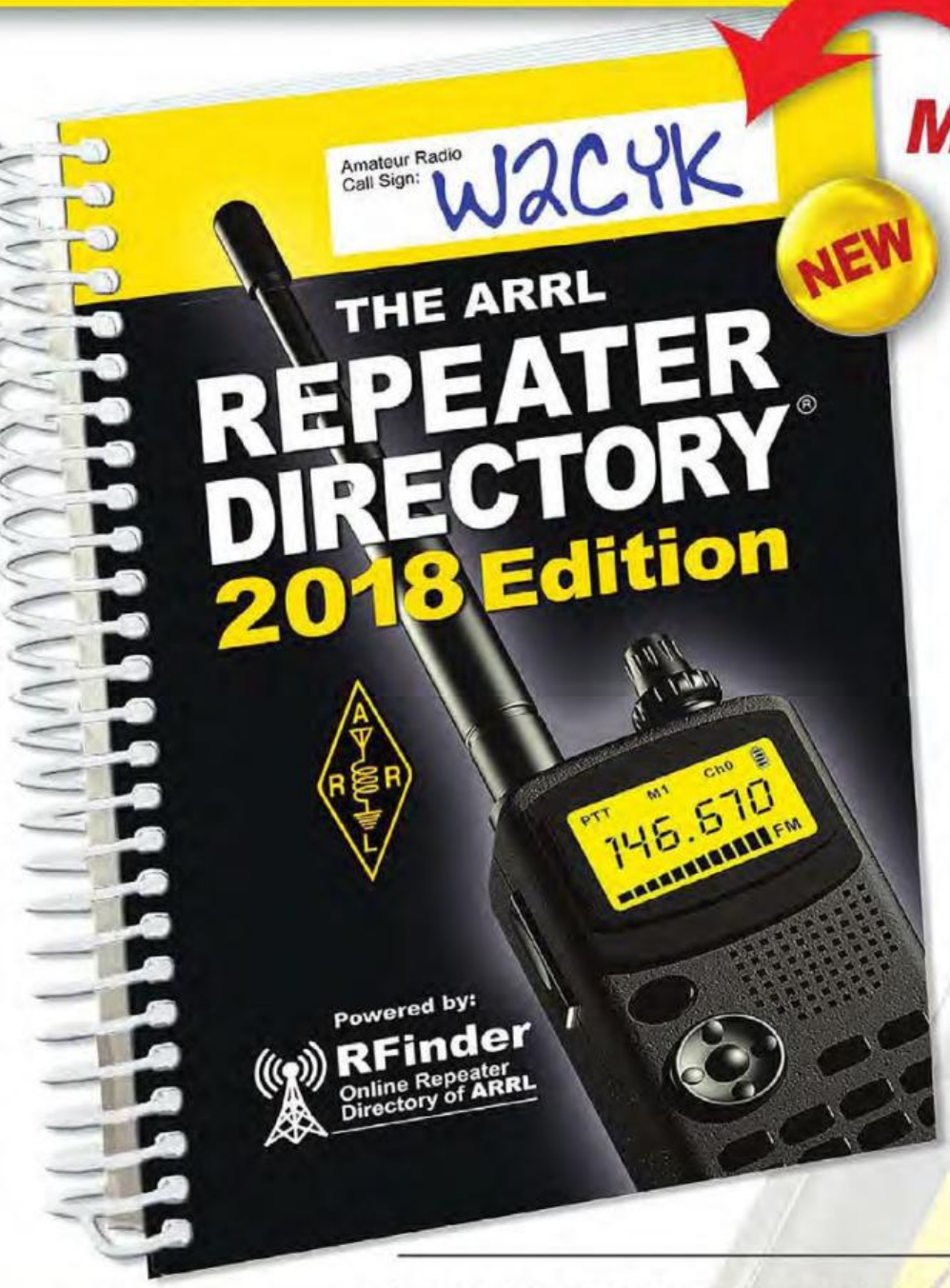

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2018 Edition

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QST 2/2018

Tom Gallagher, NY2RF, ARRL Chief Executive Officer, tgallagher@arrl.org

Second Century

The New Protection Game: What it Could Mean for You

"ARRL has a reputation for protecting every kilohertz of amateur spectrum from reallocation and from harmful interference. We mean to keep doing that. These days, the issue isn't so much the threat of loss of our spectrum, but rather the addition of incompatible, forced-sharing partners. Kind of like arranged marriages."

On December 1, the FCC's Office of Engineering and Technology called for comment on some very far-reaching spectrum policy recommendations. For years, the Commission has been wrestling, sometimes unsuccessfully from our perspective, with interference issues arising from multiple sources.

The first is interference caused by Part 15 devices (unlicensed emitters), which do not comply with field strength limits and whose interference we are currently not required to accept. The best example is grow lights.

The second is co-channel and adjacent channel interference from licensed sources.

A third, and possibly most troublesome for amateurs, is "spectrum overlay," the resulting interference caused by allegedly compatible licensed services occupying the same spectrum. Closest to home: the PAVE PAWS program allows us to use certain 440 MHz spectrum where we don't interfere with that vital Air Force program.

To address and hopefully minimize these interference issues, the FCC is considering a sea change in emphasis. The policies under consideration shift the primary focus from transmitters and RF emitters to include the ability of receivers to reject interference. It also suggests the upgrade of legacy modes (pay special attention if you operate analog SSB) to avoid interference and permit greater sharing opportunities. In plain language: to allow more *sharing* of spectrum — including amateur spectrum — with other services.

From here on in, this gets complicated, so bear with me because it's important for all of us to understand fully, and respond appropriately to, this FCC interrogatory.

Behind all the broad spectrum policy actions now on the table is the work of the FCC's Technical Advisory Council (TAC), a private sector group. (ARRL's delegate to the TAC is Greg Lapin, N9GL.) The council recommendations are supported by three white papers developed over the past several years, and the TAC believes that a fair and efficient allocation of spectrum in congested RF environments requires striking a balance between the rights and responsibilities of transmitters and those of receivers. From a procedural standpoint, the comments called for in the December 1 notice, along with the TAC recommendations, will help the FCC formulate a policy statement informing spectrum management guidance and principles.

What principles? Well, to begin with, according to the TAC, (1) receivers must be designed properly to reject out-of-band signals in present *and future* use; (2) receiving systems must be designed to manage as much interference as possible; (3) interference regulations, which establish entitlements to protection, should be premised on "acceptable levels of risk" of interference, and (4) interference and interference protection thresholds should be established. Reading between the lines, I see some disquieting assumptions.

It's obvious both transmitter and receiver characteristics determine the impact of interference; but by introducing the notion that receiver performance as a co-factor when it hasn't been featured in the past, the burden of resolving interference begins to shift toward the victim. Moreover, the TAC suggests that the FCC may set interference thresholds below which no protection from interference is available. Or in other words, there is some acceptable level of interference to be tolerated, which modern receiver technology can overcome. What's an appropriate threshold? What's an acceptable level of interference or noise? This action could pose a significant threat to our service because it is possible that, for non-commercial, non-safety of life services, the FCC could set the threshold very high, allowing high levels of interference based on some perceived value metric. Amateurs could need to measure the field strength of noise to be able to prove harm, even if a reasonable interference threshold is established. And of course, there is no assumption that FCC enforcement resources would be available evenly among radio services to enforce whatever threshold is established.

The difficulty here is that Amateur Radio, essentially an experimental radio service, doesn't have standardized operating parameters, making interference limits difficult to determine. The Notice argues that operators and services seeking protection from interference must disclose to the Commission the operating characteristics of the system before expecting protection. This is difficult conceptually for Amateur Radio. Amateur Radio uses many operating modes, including experimental modes.

(continued on page 92)

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QST review: Feb. 2010

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Attenuation per 100ft	Power Rating	Efficiency%
0.6dB @ 10MHz	3.43kW	87%
1.0dB @ 30MHz	1.95kW	79%
1.4dB @ 50MHz	1.5kW	73%
2.4dB @ 150MHz	.83kW	57.1%
4.5dB @ 450MHz	.45kW	35.8%

Part #	Length/Ft
2213A-PL-3	3
2213A-PL-25	25
2213A-PL-50	50
2213A-PL-75	75
2213A-PL-100	100
2213A-PL-150	150

1" Tinned Copper Flat Ground Braid. 7ga 85/Amps
w/1/4" Stud Ring Terminals. Quick &
Easy Grounding Terminations.

Part #	Length/Ft
235-5X-20	20
235-5X-10	10
235-5X-5	5
235-5X-3	3

1/2" Tinned Copper Flat Ground Braid. 10ga 53/Amps
w/#10 Stud Ring Terminals. Quick &
Easy Grounding Terminations.

Part #	Length/Ft
233/2-4X-12	12
233/2-4X-10	10
233/2-4X-5	5
233/2-4X-3	3
233/2-4X-1	1

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Good option as a buss-bar in the shack
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Part#	Length/Ft
233/2-G4-10	10
233/2-G4-5	5
233/2-G4-3	3
233/2-G4-1.5	1.5

218XA RG8X (240F) Foil+TC Braid
Non-contaminating Direct-Burial Ultra-Violet Resistant Jacket.
W/SILVER-TEFLON PL259 & WEATHERPROOF HST each end.

Attenuation per 100ft	Power Rating	Efficiency%
0.9dB @ 10MHz	2.16kW	80%
1.6dB @ 30MHz	1.24kW	69%
2.1dB @ 50MHz	0.96kW	62%
3.6dB @ 150MHz	0.55kW	43.5%
6.3dB @ 450MHz	0.31kW	23.2%

Part #	Length/Ft
218XA-PL-1.5	1.5
218XA-PL-3	3
218XA-PL-6	6
218XA-PL-9	9
218XA-PL-12	12
218XA-PL-18	18
218XA-PL-30	30
218XA-PL-40	40
218XA-PL-50	50
218XA-PL-75	75
218XA-PL-100	100
218XA-PL-125	125
218XA-PL-150	150
218XA-PL-200	200

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Part#	Description	Length/Ft
23316-NM-3	N Male Both ends	3
23316-NM-6	N Male Both Ends	6
23316-SM-SF-3	SMA Male-SMA Female	3
23316-SM-SF-6	SMA Male-SMA Female	6
23316-SM-SF-9	SMA Male-SMA Female	9
23316-SM-SF-12	SMA Male-SMA Female	12
23316-SM-SF-15	SMA Male-SMA Female	15
23316-SM-3	SMA Male Both Ends	3
23316-SM-6	SMA Male Both Ends	6
23316-SM-PL-3	SMA Male-PL259	3
23316-SM-PL-6	SMA Male-PL259	6
23316-SM-SO-3	SMA Male-SO239	3
23316-SM-SO-6	SMA Male-SO239	6

25400F 400-FLEX (RG8/U TYPE) FLEXIBLE LOW LOSS
Non-contaminating Direct-Burial Ultra-Violet Resistant Jacket.
W/SILVER-TEFLON PL259 & WEATHERPROOF HST each end.

Attenuation per 100ft	Power Rating	Efficiency%
0.8dB @ 30MHz	2.77kW	83.0%
1.1dB @ 50MHz	2.14kW	78.5%
1.8dB @ 150MHz	1.22kW	65.4%
3.3dB @ 450MHz	0.69kW	47.3%

Part #	Length/Ft
25400F-PL-1.5	1.5
25400F-PL-3	3
25400F-PL-6	6
25400F-PL-12	12
25400F-PL-18	18
25400F-PL-35	35
25400F-PL-50	50
25400F-PL-75	75
25400F-PL-100	100
25400F-PL-150	150

25400F 400-FLEX (RG8/U TYPE) FLEXIBLE LOW LOSS
w/N Male plugs each end. Complete
w/Weatherproof Heat Shrink Tubing (WP-HST)

Attenuation per 100ft	Power Rating	Efficiency%
0.8dB @ 30MHz	2.77kW	83.0%
1.1dB @ 50MHz	2.14kW	78.5%
1.8dB @ 150MHz	1.22kW	65.4%
3.3dB @ 450MHz	0.69kW	47.3%

Part #	Length/Ft
25400F-NM-3	3
25400F-NM-6	6
25400F-NM-12	12
25400F-NM-18	18
25400F-NM-25	25
25400F-NM-35	35
25400F-NM-50	50
25400F-NM-75	75
25400F-NM-100	100
25400F-NM-150	150

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Member Spotlight

Ken Brown, N6KB

When one thinks of Hawaii, they might associate it with beaches, palm trees, and volcanoes — not outer space. However, there are about a dozen observatories located on the Big Island. The dark, dry, and stable conditions on dormant volcano Mauna Kea, the highest point in Hawaii, make it one of the greatest places in the world for astronomical study, and ARRL Life Member Ken Brown, N6KB, works at the James Clerk Maxwell Telescope right near the summit.

Laser-Focused

Ken grew up in California. His father was a photography enthusiast, introducing Ken to all kinds of audio-visual equipment from a young age, while his uncle was a radio amateur stationed at Kaneohe, Oahu, for the Air Force. After serving, he worked in aerospace electronics and opened his own two-way radio service company. Ken remembers spending hours working with his "Uncle Chuck" on VHF and UHF FM two-way radios for multiple industries in San Diego County. With encouragement from his father, Ken got licensed in 1970.

Following this captivation with electronics, Ken took on various technician jobs, including working as an Electro-Optical Systems Engineer at Air Force Maui Optical Station Observatory in Haleakala, Maui. There, he designed and built the computer/laser control interface and safety interlock system for a LIDAR system, the light version of RADAR, in which a laser is used instead of a radio transmitter.

Currently, he operates as the RF/Microwave Field Engineer for the James Clerk Maxwell Telescope, maintaining and improving radio-astronomical heterodyne receiver systems.

"Essentially, they are very specialized radio receivers," Ken explained. "Some of them operate up to as high as 700 GHz. One of them, called HARP (Heterodyne Array Receiver Package) is a 16-pixel radio camera operating at around 360 GHz, or just under 1-millimeter wavelength. Aside from the radio and electronics, these systems also require cryogenic and vacuum systems. Their first mixers are operated at about 4 K."

> *"Another hobby — riding historic and scenic trains — has led Ken to travel all over Europe."*

Although he has years of experience with observatories, ones with advanced equipment that take in distant data for sometimes days before a visible image is processed, Ken said that the most awe-inspiring thing he has seen is the planet Saturn through a basic 6-inch reflector telescope. "There is something magical about seeing it yourself with simple equipment," he said, "live and direct to your own eye."

To Infinity and Beyond

While his career focuses on objects out of this world, Ken continues a similar exploration in his free time. He enjoys travelling to view total solar eclipses, a hobby that has brought him to Baja California in Mexico,

Ken Brown, N6KB, underneath the James Clerk Maxwell Telescope dish backing structure. [Ken Brown, N6KB, photo]

Venezuela, and Turkey so far. He went to Nebraska for the 2017 eclipse, and is planning a trip to Argentina for 2020.

During his visit to South America, Ken hopes to combine eclipse viewing with yet another hobby — riding historic and scenic trains. This interest has led him to travel all around Europe, starting in 1990 while following a Grateful Dead tour. On one train trip across northern Europe in 1998, he visited the historic long-wave station SAQ in Grimeton, Sweden, a tour he said he'll "never forget."

This look at traditional radio is more suited to what he likes to do. His jobs have always involved VHF, UHF, and microwave spectrum, so outside of work, Ken favors the lower frequencies and simpler technology. Nonetheless, whether it's with vacuum-tube equipment or cryogenic vacuum systems, Ken's pursuits in radio provide some astronomical experiences.

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The American Radio Relay League, Inc.

ARRL, the national association for Amateur Radio® in the United States: supports the awareness and growth of Amateur Radio worldwide; advocates for meaningful access to radio spectrum; strives for every member to get involved, get active, and get on the air; encourages radio experimentation and, through its members, advances radio technology and education; and organizes and trains volunteers to serve their communities by providing public service and emergency communications *(ARRL's Vision Statement, adopted in January 2016)*.

ARRL is an incorporated, noncommercial 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 3 years by the general membership. The officers are elected or appointed by the directors. The League is noncommercial, and no one with a pervasive and continuing conflict of interest 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: ARRL, 225 Main St., Newington, Connecticut 06111-1494 USA.

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As an ARRL member, you elect the Director and Vice Director who represent your Division on ARRL policy matters. If you have a question or comment about ARRL policies, contact your representatives listed below.

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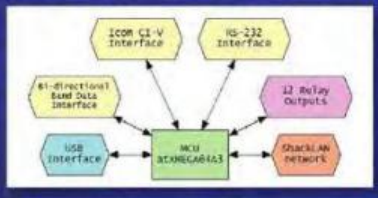

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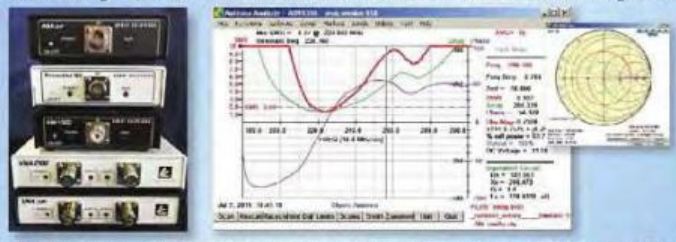

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Up Front

Scouting 500 Event at Kansas City Speedway

Dave Hinkley, KA0SOG
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Last September 22 – 24, 11,000 children and another 2,000 parents, scout leaders, and staff showed up at the Kansas City Speedway in Kansas City, Kansas, for Scouting 500 — the single biggest scouting event in the United States, except for the National Jamboree. I organized the Amateur Radio aspect of the gathering, and I received an enormous amount of assistance from local hams. Without them, the event would not have been possible.

The "antenna farm" outside the exhibit area.

Setting up for the event, with Amateur Radio on the International Space Station taking center stage.

One of the biggest attractions was our contact with the International Space Station. Astronaut Paolo Nespoli, IZ0JPA, patiently answered the Scouts' questions during the brief flyby. The Amateur Radio on the International Space Station (ARISS) contact took place in the press box high above the speedway and was broadcast to everyone over the public-address system. The contact was also livestreamed on the Heart of America Council — BSA Facebook page, and broadcast live on the local Fox 4 TV morning news show. Thanks to the ARISS volunteers, Dr. John Kludt, K4SQC, and Tim Bosma, W6MU, as well as the assistance of the Santa Rosa Community College Amateur Radio Club, W6SRJ, everything went smoothly.

The International Space Station flyby has begun! Attendees spoke with Astronaut Paolo Nespoli, IZ0JPA.

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Letters from Our Members

Puerto Rico is Rising

On behalf of the Puerto Rico Section, I want to give thanks for the help sent to our Section team. Kudos to our Section Manager, Oscar Resto, KP4RF, for the outstanding work with the Red Cross and other agencies in coordinating with the Amateur Radio operators who deployed to Puerto Rico, our Section Emergency Coordinator Juan Sepulveda, KP3CR, who helped in a hospital near his hometown in Lares, and those fellow hams who helped in their areas and sent traffic via HF and VHF. They did a great job, and everyone learned more about traffic handling during disastrous events.

Amateur Radio was basically the only means of wireless communications, as it was the only way to stay in touch with other hams. I'm amazed that ham radio was covered in the American media as well as on worldwide news organizations.

Despite the devastation, Amateur Radio has again proven its resiliency. If every government agency had at least one licensed ham, I think communications would be much easier.

As of this past week, nets are again getting on the air — a sign that things are getting back on track. #PuertoRicoisRising ¡Gracias!

Angel Santana, WP3GW
Trujillo Alto, Puerto Rico

Paying it Forward

I drive a lot of miles round trip to my closest Veterans Hospital and I usually bring my thoroughly read monthly military magazines and issues of *QST* (having blacked out my address), hoping these fine men and women read and take them home. If there's one thing I could ask nationwide, it's that members drop off your unwanted magazines to your club for redistribution to a local VA hospital, nursing home, or civilian hospital. Maybe one of your members is going that way and would be happy to drop them off. Think of how great it would be if the recipients' kids or grandkids got interested in our fascinating hobby.

Bobby McKahan, K4VE
Vonore, Tennessee

Praise for the 2018 *Handbook*

While there is a core of *ARRL Handbook* material that has remained basically unchanged for decades, there has always been enough new material to justify getting a new *Handbook* every year. In the 2018 edition, the supplemental information is too expansive to fit onto a CD, so ARRL has provided a download site. Do *not* neglect to obtain all the supplemental material; this is an integral part of the *Handbook*, and is really what sets the later editions apart from earlier revisions.

A large number of program data files are included, which have extensions that may be unfamiliar. However, it is worthwhile learning how to do this, even if you've never done any scientific programming before. There are several filter design and matching programs, and numerous *LTSpice* datafiles for other design tasks. I believe every modern ham should know how to use *LTSpice*. It is free for download, and a lot of programs (such as *ELSIE* filter design) are based on it.

For the homebrewer, there is a neat little program for designing meter faces; this is probably my favorite in the whole batch. There's also a new program called *Pizza*, which is a Great Circle calculating program. It has a useful beacon-locating feature too. The reverse beacon network is rapidly becoming mainstream in Amateur Radio, especially now that propagation is becoming more challenging. There are programs for designing Class E power amplifiers, Pi-El tube output networks, a tube design program, and, most importantly, a very user-friendly Smith Chart program. The chapter-based supplemental files have hundreds of *QST* archives, as well as artwork for printed circuit board fabrication and blueprints for mechanical construction of antennas, chassis layouts, and the like. The breadth and depth of information in here is truly encyclopedic in scope.

The 2018 ARRL Handbook has struck an excellent balance between the theoretical and the practical — a tough balancing act to achieve. This works so well because of the large number of contributors; it is really a community project. If you have never owned a copy of *The ARRL Handbook*, this is a great year to start the tradition.

Eric P. Nichols, KL7AJ
North Pole, Alaska

Iodine Protocol

In his "Public Service" column in the November 2017 issue of *QST*, Rick, K1CE, should have included the one sure way to kill or inactivate potentially harmful microorganisms in waters — that of boiling for at least 1 minute. The use of iodine tablets will not kill the oocysts of Cryptosporidium, and may not kill the cysts of Giardia — the two most common pathogenic parasites in surface waters, and the two most frequently reported causes of parasitic enteric disease in North America. Also, the addition of iodine to drinking water may be contraindicated in some people and in some medical conditions — check with your physician before using this.

Brian J. Harrington, WD8MXR, PhD, MPH
Toledo, Ohio

Send your letters to "Correspondence," ARRL, 225 Main St., Newington, CT 06111. You can also submit letters by fax at 860-594-0259, or via e-mail to **letters@arrl.org**. We read every letter received, but we can only publish a few each month. We reserve the right to edit your letter for clarity, and to fit the available page space. Letters published in "Correspondence" may also appear in other ARRL media. The publishers of *QST* assume no responsibility for statements made by correspondents.

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Hummelmasten Mini XL Tower

Hummelmasten started as a family business in Minden, Germany in 1978. Today, the company continues to excel, producing mast systems that reflect its creativity, craftsmanship and focus on finding solutions to unique customer needs. DX Engineering now offers its 29 foot Mini XL, one of the company's signature towers and an ideal choice for Hams. Made from high-strength aluminum, the Mini XL is built to handle tough weather conditions and is a good choice for small- to medium-sized beams and VHF antenna use. Learn more at DXEngineering.com.

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Founded in Verona, Italy, Ciro Mazzoni Radiocomunicazioni has been a trusted global supplier of professional-quality radio communications equipment for more than 40 years. DX Engineering is pleased to announce that it is now offering Ciro Mazzoni's popular magnetic Baby Loop and Midi Loop antennas. Compact, quiet and easy to install, the sturdy Baby Loop (6.6-29.8 MHz) and Midi Loop (3.5-14.5 MHz) are designed and manufactured to meet the highest standards for performance and reliability. Look for them at DXEngineering.com.

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Answering the call from Hams who want a state-of-the-art, solid state RF amplifier with full HF and 6 meter coverage, ACOM introduces its 1200S. It's very compact and sturdy, making it a smart choice for DXpeditions. The final PA stage uses a rugged LDMOS transistor. Its impressive five-inch high-resolution color display features intuitive menus and on-board monitoring of 10 parameters. The 1200S is compatible with virtually all modern radios, requiring less than 50 watts of drive power. For complete details, search "1200S" at DXEngineering.com.

RigExpert Analyzer and NANUK Case Combos

In the field, an antenna analyzer is especially at risk for weather and shock damage. We've paired select RigExpert Antenna Analyzers with perfectly sized NANUK equipment cases. Each case is filled with cubed, sectioned foam for custom configuration. Find detailed information on each analyzer and case at DXEngineering.com.

Coaxial Prep Tool Kit for Crimp Connectors

Stop bothering with knives and box cutters. DX Engineering now offers an easy way to precisely prepare coaxial cable ends for RF crimp connectors. Its Coaxial Prep Tool Kit for Crimp Connectors (DXE-UT-KIT-CC1) includes 4 coaxial cable strippers, grippers for 8X and 213-size coaxial cables, 10 replacement blades, side cutter braid trimmers, Channellock cable cutters and a custom carrying case. The strippers will prepare 400MAX, 8U, 213U, LMR-400, 8X and LMR-240-size cables for installation of crimp-style PL-259, N type and BNC connectors. Tools are also available separately.

DXE-UT-KIT-CC1 $249.95

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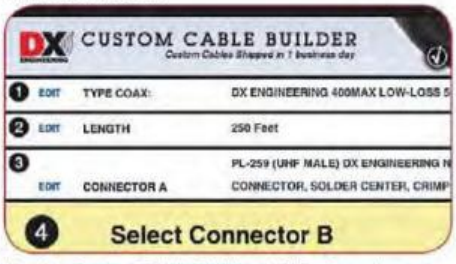

Use the Custom Cable Builder at DXEngineering.com to build assemblies made to your exact specs. DX Engineering's coaxial cable is also available by the foot or in bulk spools.

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DX ENGINEERING

Advanced Design Thrust Bearing

The Advanced Design Thrust Bearing from DX Engineering features ball bearings that ride on an all-metal surface to promote a longer service life. It can also handle much greater static loads, which reduces stress on the rotator, and makes rotator service possible without removing your antenna—saving you tons of hassle, time and money!

DXE-TB-300 $169.95

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Contesters have been clamoring for rugged, high performance antennas that won't break the bank. EAntenna's Yagi and dipole antenna designs deliver on all three fronts. These HF and VHF antennas can be found in some of Europe's most competitive stations, and now you can get them for your installation from DX Engineering.

ACOM
Outstanding HF Power Products

ACOM 04AT Automatic Antenna Tuner

Powered and controlled by ACOM's solid state HF+6M amplifiers, this antenna tuner delivers automatic and manual tuning to ensure the proper impedance match between radio and amplifier. Full tuning is completely automatic, and tuning patterns can be stored in its nonvolatile memory (or transferred to a PC for future use). Tuner information is displayed on the amplifier's screen for easy use. It has built-in voltage, power, and hot-switching protection, and the unit can be mounted indoors or outdoors.

AOM-04AT $1,199.95

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New from DX Engineering Tower Accessory Shelves

Ever try to pound in a one-piece accessory shelf to get it to fit in the midpoint of your tower? DX Engineering's new Tower Accessory Shelves are simpler to install and feature a thicker, stainless steel plate for greater stability. The DXE-AS-455G works with both 45G and 55G towers. It lets you easily mount rotators and thrust bearings thanks to its innovative multi-piece design. The shelf is bolstered by three adjustable, stainless steel corner attachments bolted to the plate. Each corner is secured flush to the tower with two V-bolt clamps for reduced flex. The DXE-AS-25G makes an ideal choice for worry-free mounting of a rotator to your 25G tower. Both shelves come with a complete set of stainless steel mounting hardware.

ICOM

New from ICOM —IC-7610 HF/50MHz Transceiver

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Fan Controller for Your Classic Radio

Draw heat away from your radios with this easy-to-build circuit.

Mike Bryce, WB8VGE

This project started as not being about cooling a radio, but on the availability of tubes used in the older "boatanchor" radios that many of us collect. Inexpensive at the time the radios were made, these tubes could be bought at any drugstore that had a tube tester. Today, they're becoming quite expensive. A set of four 6DQ6 tubes used in the Dentron GLA-1000 amplifier can set you back almost $400. Keeping those tubes cool to extend their lifetimes is what this project is all about, and simple ventilation is often not enough.

The Trouble with Fans

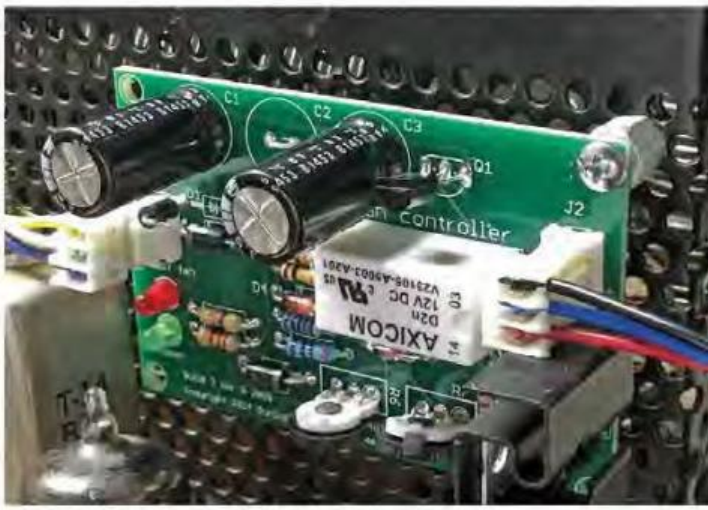
The old standby for cooling continues to be the muffin or pancake fan. These compact fans operate from supply voltages ranging from 220 V ac to under 5 V dc. A fan needs full supply voltage so it will start, and moving a lot of air generates noise. To combat that noise, you slow the fan down. The slower it moves the air, the quieter the fan.

You can insert a low-value resistor in series with the fan power source, and thus reduce the operating voltage so that the fan runs at a much lower speed. But if you drop the operating voltage too low, the next time you turn on the radio, the fan might not start. As the fan ages, it will be clogged with pet hair, dust, and assorted debris, so sometimes there won't be enough voltage to start the fan when using a series resistor in the supply feed. This project solves that starting problem.

Circuit Overview

When you turn on your radio, the fan is sent full operating voltage, and then after 10 to 15 seconds the voltage is reduced, slowing the fan down and reducing ambient noise. A pair of small trimmer potentiometers sets both the high and low speeds.

A small muffin fan is mounted on the rear of the power amplifier (PA) compartment, pulling hot air from the tubes and exhausting it into the room. The control board, a 1 by 2 inch printed circuit board, is mounted along one side of the PA compartment.



The circuit, wired up and ready to cool.

Power and ground wires snake through the chassis via any convenient access hole. There are no switches or controls needed — operation is totally automatic. There are no holes to drill, and the entire circuit can be removed without cosmetic damage to the radio. This circuit works on any vacuum tube-based radio. It will even work with a solid-state radio, cooling the power supply or the heatsink fins on the back of a transceiver.

The Circuit in Detail

It's easy to control a muffin fan that operates on dc. There are two ways you can configure the circuit (see Figure 1). By tapping the filament string, you can pick off the 6.3 V ac filament voltage in nearly all radios, but some still use a 12.6 V ac filament supply. This circuit allows for either a voltage doubler or half-wave rectifier by moving a few components on the circuit board.

The doubler for 6.3 V ac source consists of C1 and C2 along with D2 and D1. For a 12.6 V ac source, I used the half-wave rectifier. In that case, C2 and D1 are removed from the circuit, and a jumper is used in place of C2.

The fan connects to the output of U1, an LM317 adjustable regulator. A small signal relay has one set of contacts that connect the adjust line of the LM317 to either R7 or R6. When power is first applied, the relay is off and trimmer R7 controls the high-speed mode of the fan. This is the turn-on voltage. A second pair of contacts illuminates DS2 to signal the high-speed mode.

Capacitor C3 begins charging via R2 and D3. When the voltage matches the conduction point of D4, a 3.9 V Zener diode, transistor Q1 saturates and turns on K1. The relay contacts switch, so now the speed of the fan is set by R6, and the fan runs at a lower speed. DS2 extinguishes.

I avoided using a microprocessor to pulse-width modulate the fan source because I did not want to generate RFI. I also did not want to deal with the temperature sensor for that approach.

Building the Fan Controller

Construction is straightforward. A perf board will work, as will point-to-point or dead-bug-style wiring. A small 1 by 2 inch printed circuit board is available from the author.

There is a wide tolerance on parts values. The time required to go from high speed to low speed depends on the supply voltage and component values. Because there is no regulation from the rectifiers, the charging voltage for C3 is subject to change depending on such things as the line voltage, and the filament warm-up current draw down. This drop in voltage will produce a delay of 1 or 2 seconds more than if the circuit were to be installed in a solid-state rig. Reducing the value of R2 will reduce the time required to charge C3, while a higher resistance will increase the charging time.

The voltage rating of D4 will also determine the amount of charging time required before its junction is reached. Increasing the value of Zener diode D4 will lengthen the high-speed run time. However, if you select a Zener diode that has too high of a voltage, capacitor C3 may never charge high enough for the diode to conduct.

Diode D3 prevents C3 from discharging into the supply. Resistor R5 discharges C3 so it will be ready to recharge when power is reapplied to the circuit. DS1 lights when power is applied to the circuit and, at the same time, bleeds down capacitor C1.

Regulator U1 is rated for 1 A, but you shouldn't come close to its maximum. Most 12 V dc fans require no more than a few hundred milliamps. Sometimes, the current requirements are marked on the fan. I chose to add a small heatsink to U1 to be on the safe side.

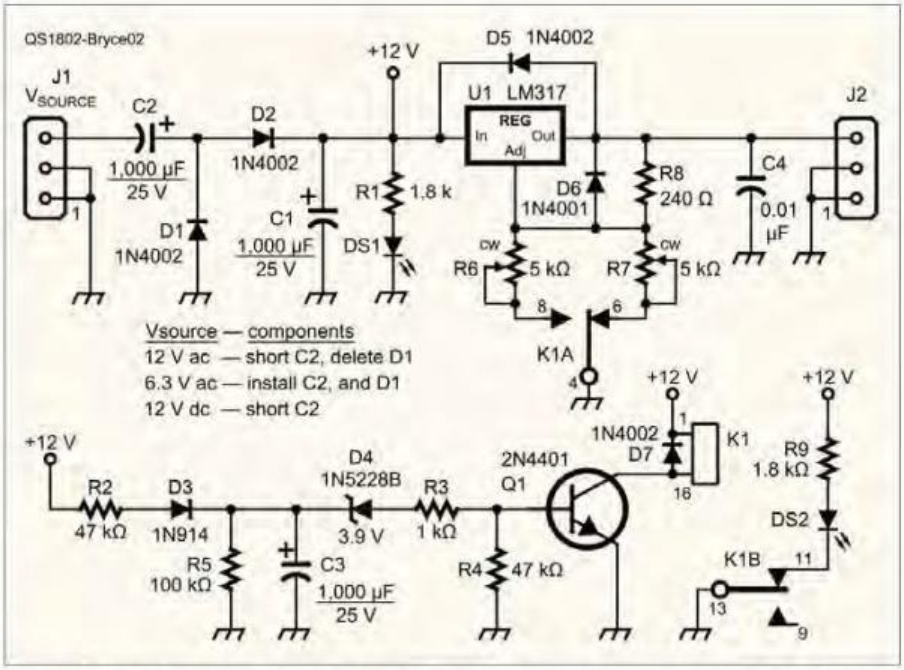


Figure 1 — A schematic diagram of the fan controller, which has three options for the source voltage. (Mouser parts, **mouser.com**).

C1, C2 — 1,000 µF, 25 V
C3 — 1,000 µF, 16 V
C4 — 0.01 µF ceramic disc
D1, D2, D5 – D7 — 1N4002 (821-1N4002)
D3 — 1N914
D4 — 3.9 V Zener (78-1N5228B)
J1, J2 — three-position header
K1 — 12 V relay (655-v23105a5003a201)
DS1 — green, 3-millimeter LED
DS2 — red, 3-millimeter LED
Q1 — 2N4401 (610-2N4401)
R1 — 1.8 kΩ resistor
R2, R4 — 47 kΩ resistor
R3 — 1 kΩ resistor
R5 — 100 kΩ resistor
R6, R7 — 5 kΩ trimmer resistor
R8 — 240 Ω
R9 — 1.8 kΩ
U1 — regulator, LM317K (595-LM317KCT)

The Voltage Source

If you're going to use the voltage doubler and a 12 V dc fan, you shouldn't connect the input to an ac source higher than 6 V. Using 12 V ac will result in over 25 V dc to the fan. That would require a 24 V dc fan, which is sometimes available on the surplus market. If you want to use this circuit with a higher output voltage than 12 V, then increase the voltage ratings of C1, C2, and C3 to at least 50 V, and experiment with the voltage of Zener diode D4 as well. The circuit will operate just fine on 12 V dc.

Checking Operation

Use a bench supply set to 12 V dc. That's the same configuration as with the half-wave rectifier, *Vsource*, set to 12 V dc in Figure 2. If you're testing the voltage doubler (*Vsource* set to 6.3 V ac), you can use a small transformer that supplies no more than 6.3 V ac to the *Vsource* input. Connect the fan at this time, observing the fan polarity. Preset both R7 and R6 to mid position. There is no exact setting.

DS1 and DS2 will illuminate when power is applied, and the fan should start. After C3 charges — about 10 to 15 seconds — you should hear a click, and DS2 should extinguish. Now, adjust the slow-speed trimmer R6 for a good balance between airflow and noise. Again, the exact setting is not critical and may be adjusted later.

Pulling hot air out of the radio helps keep tubes and circuits cool.

In setting the high-speed trimmer R7, you have to work quickly before the relay closes. If you'd like more time to set this trimmer, simply lift one end of either R2 or D3 from the circuit board. Also, remember that the maximum fan voltage is the supply voltage. If all you have at C1 is 14 V dc, that's the highest voltage that can be applied to the fan. You could set the trimmers to your liking and then measure their resistance, and replace both with fixed value resistors if you want. Power down and allow C3 to discharge. It will take several minutes. Then reapply power to the circuit. The fan should start instantly in high speed and run until the delay times out, at which time the fan will drop to its lower speed.

That's it. The best place to tap into ac is at the transformer where the filament string begins. You can also tap in at a tube socket, but avoid tapping this voltage from the final tubes, as there could be RF floating nearby. However you do it, keep the wires away from critical circuits and down along the chassis to minimize RF pickup. Also, keep in mind that there are high voltages lurking under the chassis. Be sure you pull the plug on the radio, and discharge any filter capacitors. Double-check for high voltages before doing any wiring.

Mounting the Fan

Mount the fan so it pulls air out of the radio; the exact placement is up to you. The idea is to get rid of the hot air and not blow it around inside the radio, where it could affect critical circuits. On my Drake radios, I mounted the fan on the rear of the PA compartment with a pair of 6-32 nylon screws. I salvaged a fan from a discarded computer power supply. That fan fit on the back of the Drake TR4 perfectly. The PA cage is holed screen. Using a stainless-steel screw as a tap, I made threads into the required holes. No new holes were drilled and, unless you look carefully, you won't see the holes I modified. I also didn't need to remove the PA cage, which was a great time-saver.

I used a 6-32 nut as a spacer between the body of the fan and the sheet metal of the PA compartment. This way, the fan can generate airflow without the blades hitting the sheet metal. I centered a rubber foot on the bottom of the fan housing instead of drilling more holes into the PA screen cover. Then, I used a few strips of black electrical tape to seal the ends where they meet the perforated sheet metal of the PA compartment. You might also consider a finger guard on the fan to keep fingers from getting struck by the blades.

Some Odds and Ends

Even if you don't have a classic rig, there's nothing wrong with mounting the circuit board inside a power supply or a solid-state radio. I have a PC board installed in a TEN-TEC Omni D that I use for RTTY. The fan mounts on the heatsink for the PA transistors. The circuit won't supply enough current to run a squirrel cage fan or blower, so stick to the pancake-style fans. I had no problem starting and running an 8-inch muffin fan.

Mount the PC board in a location away from critical parts of the radio, but allow for easy and safe adjusting of the two trimmers. *Be aware of unseen high voltages lurking inside these classic radios* — watch where you put your fingers. Once the board is installed, you may want to tinker with the slow speed setting for just the right amount of cooling with the least amount of noise.

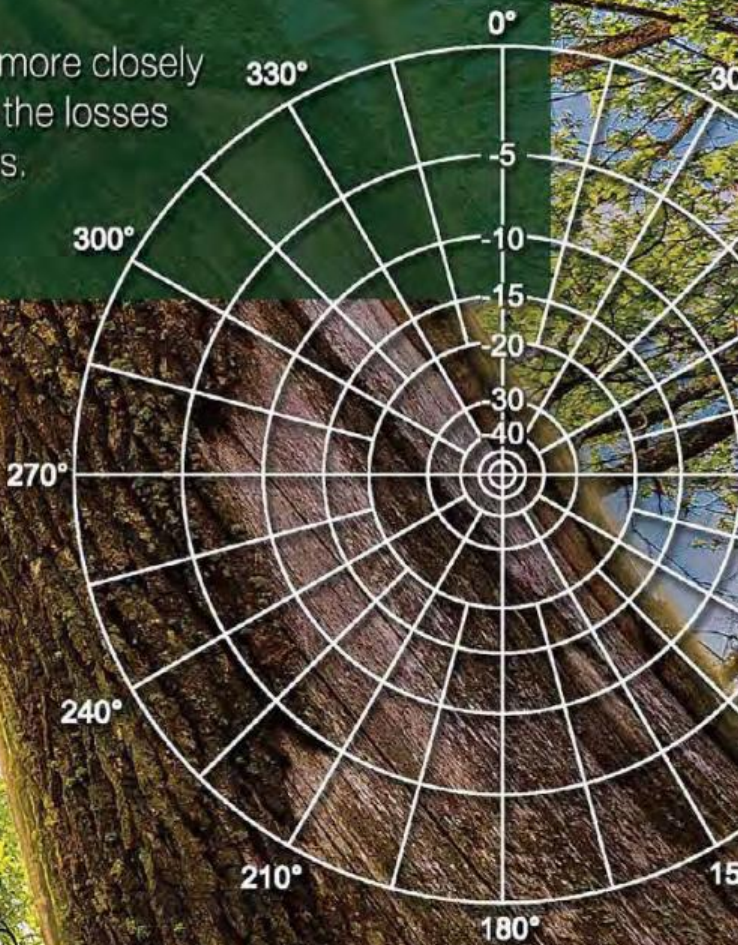
I have one of these small circuits installed in most of my older tube gear. I know it will extend the operating life of not only the tubes, but other critical components. This is a simple rainy afternoon construction project that will help keep your vintage radios running for decades to come.

Mike Bryce, WB8VGE, was licensed in 1975 and currently holds an Amateur Extra-class license. When not working QRP on the low end of 40 meters, he can be found up to his elbows working on a broken radio. His spare time is divided by keeping the water levels topped up in the batteries for his solar-powered station and working in the greenhouse. Mike is the author of the ARRL book, *Emergency Power for Radio Communications*.

For updates to this article, see the QST Feedback page at www.arrl.org/feedback.

Live Trees Affect Antenna Performance

Living wood resembles human tissue more closely than it does lumber, and can increase the losses of nearby antennas by several decibels.



Kai Siwiak, KE4PT,
and Richard Quick, W4RQ

Placing HF antennas amid towering trees[1] raises questions about their impact on antenna effectiveness, and how far away the antenna should be from trees. We simulated the effects of a vertical antenna near lossy cylinder models of live tree trunks to help answer such questions. The electrical parameters of live trees are dramatically different than those for dead wood or lumber and vary with tree type, so we carried out our simulations over a range of dielectric parameters. We'll also comment on the effect of a forest of trees.

Live Trees

Dielectric properties of live trees for frequencies below 1 GHz span the range of values[2] shown in Table 1. We chose an average value of 52 for relative permittivity and 0.17 S/m for conductivity for polarization aligned with the tree axis, then varied those nominal values over a range. The tree parameters include summer and winter variations, and tree trunk thickness.[3]

The Models and Simulations

We used two independent methods to find the effect of a vertical antenna next to a live tree trunk. In one method, we used *NEC* to simulate a tree trunk next to a half-wave dipole in free space. In the second method, we applied a purely analytical solution to wave scattering of a line source near an infinitely long two-layered lossy dielectric cylinder.

The *NEC* Simulation

Figure 1 shows a lossy cylinder representing a live tree modeled by a single fat wire loaded by a parallel *RC* impedance. A dipole 10.3 meters in length, nominally resonant at 14.11 MHz, is near the lossy wire. To reduce computational artifacts, we maintained strict symmetry in the tree and dipole axis dimensions, with the dipole source centered. We also used identical segment lengths *s* for the dipole and the tree. Using the live tree permittivity ε_r and conductivity σ values, and noting that $\varepsilon_0 = 8.8542 \times 10^{12}$ F/m, the equivalent

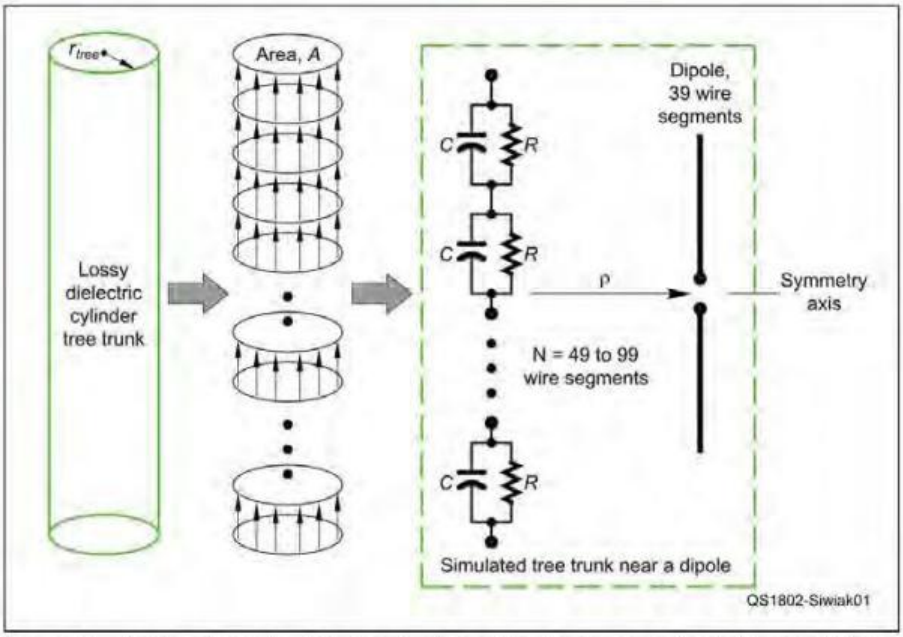


Figure 1 — An impedance-loaded wire simulates a tree trunk near a dipole. Tree and dipole segment lengths were identical, and symmetry was maintained on the vertical axis.

Table 1

Dielectric properties of live softwood and live hardwood trees for frequencies below 1 GHz. We used average values of 52 for relative permittivity and 0.17 S/m for conductivity in vertical polarization. The tree parameters include summer and winter variations. Dry, dead wood is dramatically different than living wood, while human muscle tissue and saline water are in the same order of magnitude as living wood.

Tree Type	Permittivity Range	Conductivity, S/m	Comments
Softwood, parallel to wood grain, or random polarization	46 – 72	0.17	below 1 GHz
Hardwood, parallel to wood grain, or random polarization	32 – 59	0.17	below 1 GHz
Softwood, perpendicular to wood grain	38 – 56	0.012	below 1 GHz
Hardwood, perpendicular to wood grain	12 – 31	0.012	below 1 GHz
Nonliving wood	2 – 9	<0.008	3 – 30 MHz, <65% moisture
Human muscle tissue	200 – 92	0.60 – 0.66	3 – 30 MHz
Saline water at 4 gm/L NaCl	79	0.63 – 0.69	below 500 MHz

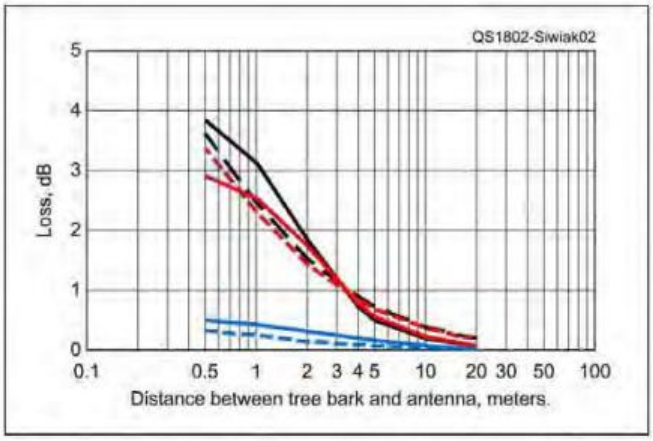


Figure 2 — The loss for different (permittivity, conductivity S/m) pairs at 14.1 MHz. Blue: (5, 0.017), red: (52, 0.17), and black: (32, 0.28). Solid lines show *NEC* simulations, and dashed lines are infinite cylinder analysis results.

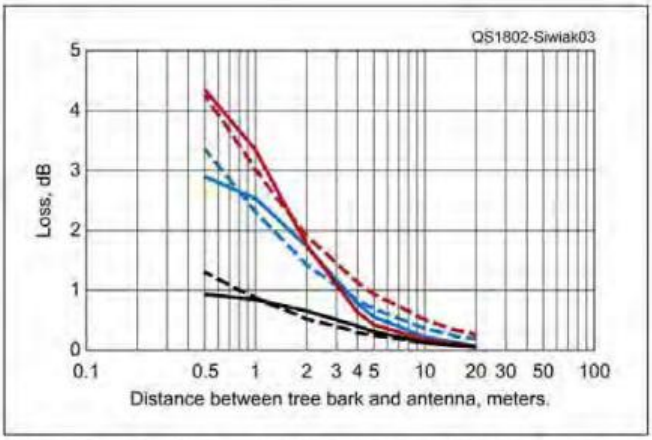


Figure 3 — Fatter tree trunks, r = 0.5 m (red), are more lossy than nominal, r = 0.33 m (blue) and thinner tree trunks r = 0.16 m (black). Solid lines are *NEC* simulations, and dashed lines are infinite cylinder analysis results.

parallel capacitance and resistance of each segment load is:

$$C = \frac{\varepsilon_r \varepsilon_0 A}{s} = \frac{\varepsilon_r \varepsilon_0 \pi r_{tree}^2}{s} \quad \text{[Eq. 1]}$$

$$R = \frac{s}{\sigma \pi r_{tree}^2} \quad \text{[Eq. 2]}$$

where r_{tree} is the tree trunk radius. A parallel *LCR* is handled by the LD card in *NEC*. We varied the tree trunk length from N = 49 segments, 10 more than the dipole length, to N = 99 in steps of 10 segments, representing tree trunks between about 13 meters to 26 meters in height. The capacitance and resistance values are computed automatically in 4*nec2* using the SY system card (see the *NEC* code[4] in Table 2). For our nominal tree, the segment length s = 0.264 meters, so C = 596 pF and R = 4.54 Ω.

Analytical Simulation

The far-zone source fields scattered by an infinite cylinder next to a line current source are summations of Bessel and Hankel functions and their derivatives. See Section 10.3.4-5 in Siwiak and Bahreini[5] for the details. The radiation efficiency of the system is the ratio of the scattered power *not* absorbed by the tree to the total power in the system, and is compared to the radiated efficiency reported by 4*nec2*.

Validation of the Models and Simulations

Our *NEC* model of a tree is rather unusual, and pushes *NEC* to the limits. The impedance-loaded wire model was suggested by a technique that Arthur Guy, W7PO, reported in 1990 to analyze electromagnetic pulse (EMP) induced currents in wire models of the human body. One of us (KE4PT, see Section 10.3.3 in Note 5) had applied that technique to simulate saline water-filled "human phantom" test devices in belt-mounted receiver sensitivity studies, and matched the results with measurements in 1992 (see Section 10.4.2 in Note 5). The close agreement between measurements and

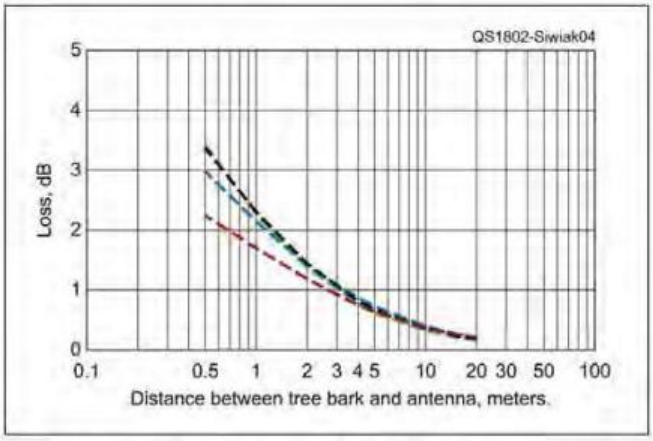


Figure 4 — Tree trunk losses at 3.5 MHz (red) increase at 7 MHz (blue) and 14 MHz (black), then stay constant (green) at and beyond 21 MHz.

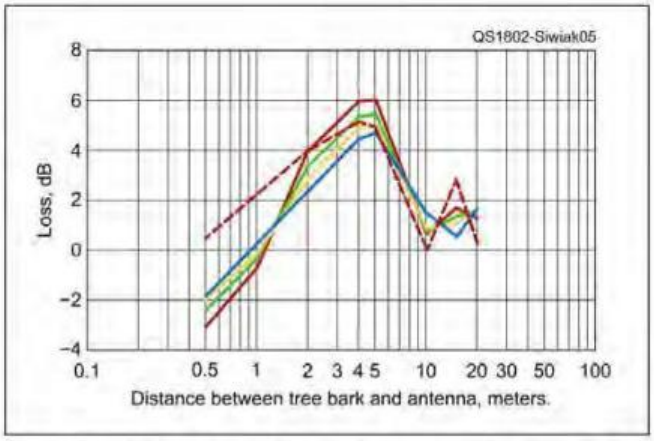


Figure 5 — Azimuth pattern front-to-back ratio peaks near 4 – 5 meters separation (0.2 wavelengths) between the tree and the dipole in this 14 MHz simulation. *NEC* tree length was varied from 49 (blue) to 99 segments (magenta) in 10-segment increments. The dashed line is the infinite cylinder analysis.

Table 2
***NEC* Code for *4nec2* Implementation of a Dipole Near a Tree**

CM					**Reference file for dipole parallel to a tree: KE4PT & W4RQ**				
CE	**User Input Values:**				',				
SY	Cond=5.8e14				'1e7 times copper times conductivity, S/m				
SY	len=5.15112				'dipole element length, meters				
SY	seg=39				'number of dipole segments (odd number)				
SY	addl=60				'additional segments for tree (even number)				
SY	Separation=0.5				'separation between tree and dipole axes, meters				
SY	treeR=0.33				'tree radius, meters				
SY	Diel=52				'tree dielectric relative permittivity				
SY	Sigma=0.17				'tree conductivity, S/m				
CE	**NEC Computed Values:**				',				
SY	sl=2*len/seg				'segment Length, meters				
SY	d=treeR+Separation				'distance, axis of tree to axis of dipole, meters				
SY	C1=Diel*(8.854e-12)*treeR*treeR*3.14159/sl				'capacitance, F				
SY	R1=sl/(Sigma*treeR*treeR*3.14159)				'resistance, ohms				
CE									
GW	1	seg	0	0	–len	0	0	len	.004
GW	2	seg+addl	d	0	–(len+(addl*0.5*sl))	d	0	len+(addl*0.5*sl)	treeR
GE	0								
LD	5	1	0	0	Cond				
LD	1	2	1	seg+addl	R1	0			C1
GN	–1								
EK									
EX	6	1	20	0	1	0	0		
FR	0	0	0	0	14.11	-	0		
EN									

calculations gives confidence that the same *NEC* and analysis methods could be applied to simulate trees. The conductivity of live trees, human muscle tissue, and saline water are in the same order of magnitude.

The Effect of One Tree

We considered several permittivity and conductivity pairs and calculated losses for tree-dipole separations between 0.5 and 20 meters using both *NEC* and analysis (see Figure 2). The low-conductivity pair (5, 0.017 S/m) exhibited little loss. Increasing the conductivities to the nominal case (52, 0.17 S/m), and then to (32, 0.28 S/m), increased the losses, especially for separations less than 3 meters. The *NEC* and analytical values track closely.

Next, we varied the tree trunk radius using the nominal (52, 0.17 S/m) parameters. Fatter tree trunks (r = 0.5 meters) are more lossy than the nominal (r = 0.33 m) and thinner tree trunks (r = 0.16 meters). In Figure 3, the solid lines (*NEC*) and dashed lines (analysis) tracked closely.

> *"The electrical parameters of live trees are dramatically different than those for dead wood or lumber and vary with tree type, so we carried out our simulations over a range of dielectric parameters."*

We then calculated the loss of our nominal (r = 0.33 meters), (52, 0.17 S/m) tree at different frequencies (see Figure 4). Tree trunk losses at 3.5 MHz were lowest, and increased up to 14 MHz, then stabilize at and above 21 MHz. When thickness is stated in wavelengths, tree losses follow the same trend as in Figure 3.

Finally, we calculated the front-to-back ratio of the azimuth pattern for different tree-dipole separations, and for the range of tree heights at 14.1 MHz (see Figure 5). Bear in mind that the *NEC* result was three-dimensional while the analysis was two-dimensional. The azimuth pattern had between 4 and 6 dB of front-to-back (F/B) ratio at a separation distance of 4 – 5 meters (0.2 wavelengths) on the dipole side of the tree, and acted like a two-element Yagi antenna. In a further analysis, at 7 MHz the F/B ratio

peaked at 3.7 dB at 9 meters (0.2 wavelengths) separation.

For separations less than 1 meter, there were indications that the *NEC* results were losing accuracy — not a surprise, since the segment length and tree radius were a large fraction of that separation distance. Analytical results, however, are valid at zero separation. Using nominal tree parameters at 1.8, 3.5, 7, 14, 21, and 28 MHz, and with zero separation, the F/B ratios are –0.1, –0.4, –1.1, –2.6, –2.2, and +0.1 dB; the losses are 1.9, 3.5, 5.4, 7.1, 7.8, and 8.2 dB, respectively. Losses top out at about 11 dB for VHF and UHF.

A Forest of Trees

A tree-dipole combination acts like the source to the next rank of trees in a cluster, and losses increase multiplicatively with distance. Thus, propagation losses through a forest increase exponentially, in decibels per unit distance.

Theodor Tamir described[6] several propagation paths at HF through trees when antennas at both ends of the communication path are in the forest canopy. A direct path extends directly through the foliage, picking up losses exponentially with distance. Another path involves a *lateral wave* that skims along the tree tops, attenuating at 40 dB per decade of distance without additional foliage losses. The lateral wave leaks energy back into the forest below and into a sky wave. The sky-wave path from the canopy-air interface extends up to the ionosphere and back. In his *NCJ* paper,[7] Carl Luetzelschwab, K9LA, shows that the foliage adds about 9 dB of loss at 1.8 MHz down to 6 dB loss at 4 MHz and higher to this sky-wave path at an elevation angle of 20°.

"We used two independent methods to find the effect of a vertical antenna next to a live tree trunk."

Conclusions

Our 3D *NEC* and 2D analysis results tracked closely. For the single isolated tree, there is a strong Yagi-like directivity effect at about 0.2 wavelengths separation. There are two loss mechanisms for trees. First, a tree absorbs energy from a close-by, vertically polarized antenna. The effect is nearly the same in summer or winter, with small variation on tree type, but large variation with tree diameter. This loss diminishes quickly with distance from the tree. Horizontal polarization is not affected by this loss. Second, propagation attenuation through a forest for both horizontally and vertically polarized antennas has an exponential loss that depends on tree and foliage density, so there is summer to winter variation.

A likely HF propagation path is: (a) through the forest at a shallow angle up to the tree tops, then (b) by a lateral wave skimming the tree tops, which (c) bleeds energy into the sky-wave to the ionosphere and back. By starting with an antenna in the clear, you can avoid the close-by tree loss, and some of the exponential path loss through the forest.

Notes

[1]"The Doctor is In," *QST*, Jun. 2017, p. 69.
[2]Tree data; D. Tomasanis, "Effective Dielectric Constants of Foliage Media," *RADC-TR-90-157, Interim Report AD-A226 269*, Jul. 1990.
[3]Average Mature Tree Dimensions, **biorefinery.utk.edu/technical_reviews/Tree%20Size.pdf**.
[4]The *4nec2 NEC*-based antenna modeler and optimizer, by Arie Voors, is available from **www.qsl.net/4nec2**.
[5]Chapter 10 in: K. Siwiak and Y. Bahreini, *Radiowave Propagation and Antennas for Personal Communications, Third Edition*, Artech House, 2007.
[6]T. Tamir, "On Radio-Wave Propagation in Forest Environments," *IEEE Transactions on Antennas and Propagation*, Vol. AP-15, No. 6, Nov. 1967, pp. 806 – 817.
[7]C. Luetzelschwab, K9LA, "Low-Band Antennas and Trees, Propagation," *NCJ*, Mar./Apr. 2006, pp. 30 – 31. See **www.arrl.org/qst-in-depth**.

Kazimierz "Kai" Siwiak, KE4PT, enjoys DXing and carries a low-power "DX go-bag" station while travelling. You can reach Kai at **k.siwiak@ieee.org**.

Richard Quick, W4RQ, enjoys working at low-power levels and from portable locations. He is an avid CW operator. You can reach Rich at **w4rq@arrl.net**.

For updates to this article, see the QST Feedback page at www.arrl.org/feedback.

New Products

Mobile FM Transceivers from BridgeCom Systems

BridgeCom Systems offers three single-band FM mobile transceivers. The BCM-144 covers 144 – 148 MHz with 50 W RF output, an alphanumeric display, 4 W of audio with a front-panel speaker, and 250 memory channels. The BCM-220 covers 222 – 225 MHz with 30 W RF output and similar features, while the BCM-440 covers 430.0 – 450 MHz with 40 W RF output. Programming kits are available. Price: $240 each, or $290 each with the programming kit. For more information or to order, visit **www.bridgecomsystems.com**.

An Audio Switching Unit

Easily switch between speakers and headsets for control and guest operators.

Gene Hinkle, K5PA

For casual contacts and listening, my external speakers are fine, but when I work more demanding DX, a headset with its attached boom microphone is more convenient. However, unplugging and plugging cables to switch between the two modes of audio output is irksome. I needed a way to conveniently switch and also provide for an occasional guest operator to participate in a contact using their own headset. The audio switching unit described below fits the bill perfectly.

Circuit

The audio switching unit was designed to work with my Elecraft KX3 transceiver. However, the unit can easily be adapted to work with other transceivers by using adapter cables, which will be illustrated later. The schematic is shown in Figure 1.

Toggle switch S1 (**HP / SPKR**) connects the stereo audio from the radio (J6) to either the headphones (J3, J5) or the speakers (J7). The headphones are disabled when the speakers are selected. I am using stereo connections to support the KX3's independent audio (right/left ears) for dual-watch receiver functions used during split frequency operations.

Pushbutton S2 (**PTT**) is a momentary, normally open switch used for push-to-talk on the transceiver. The KX3 is wired so that the two rings on the microphone connector, R1 and R2, enable push-to-talk when connected. Although a PTT switch is included in this design, voice-operated transmit (VOX) can still be used for transmit control.

Also included is an audio input from a computer sound card to support digital modes such as PSK, JT65, and AFSK. The input signal level from the computer sound card passes through an internal 20 dB pad (resistors R1, R2, and R3) with stereo input support and dc isolation provided by capacitor C1. Direct current isolation is necessary due to the bias voltage present on the microphone input. Toggle switch S3 (**VOICE / DATA**) selects either the **DIGI** audio (J2) or **MIC-1** audio from the control operator (**MAIN**, J1) headset boom microphone.

External stereo isolators (e.g., PAC SNI-1/3.5) provide ground loop isolation in both the digital input (**DIGI**, J2) and speaker (**SPKR**, J7) audio paths. This keeps the low-level audio signals free of extraneous noise due to ground loops.

The guest operator audio jacks (**GUEST** J4 and **GUEST** J5) are in parallel with the control operator jacks (**MAIN** J1 and **MAIN** J3), with the exception that the microphone line from the guest operator (**MIC-2** J4) is selected through toggle switch S4. This allows the guest operator microphone input to be easily muted from the front panel — an important and highly recommended feature when working with young children during their first exposure to Amateur Radio.

Features of this Audio Switching Unit

- Small size for desktop use
- Bias voltage pass-through required for electret mic elements
- Pushbutton for push-to-talk transmit control while still supporting voice-operated transmit control
- Speaker/headset toggle switch for monitoring in the shack when not using a headset
- Control and guest operator boom microphone headset connections
- Ability to mute the guest operator microphone input
- Audio input that is switch-selectable for digital signals

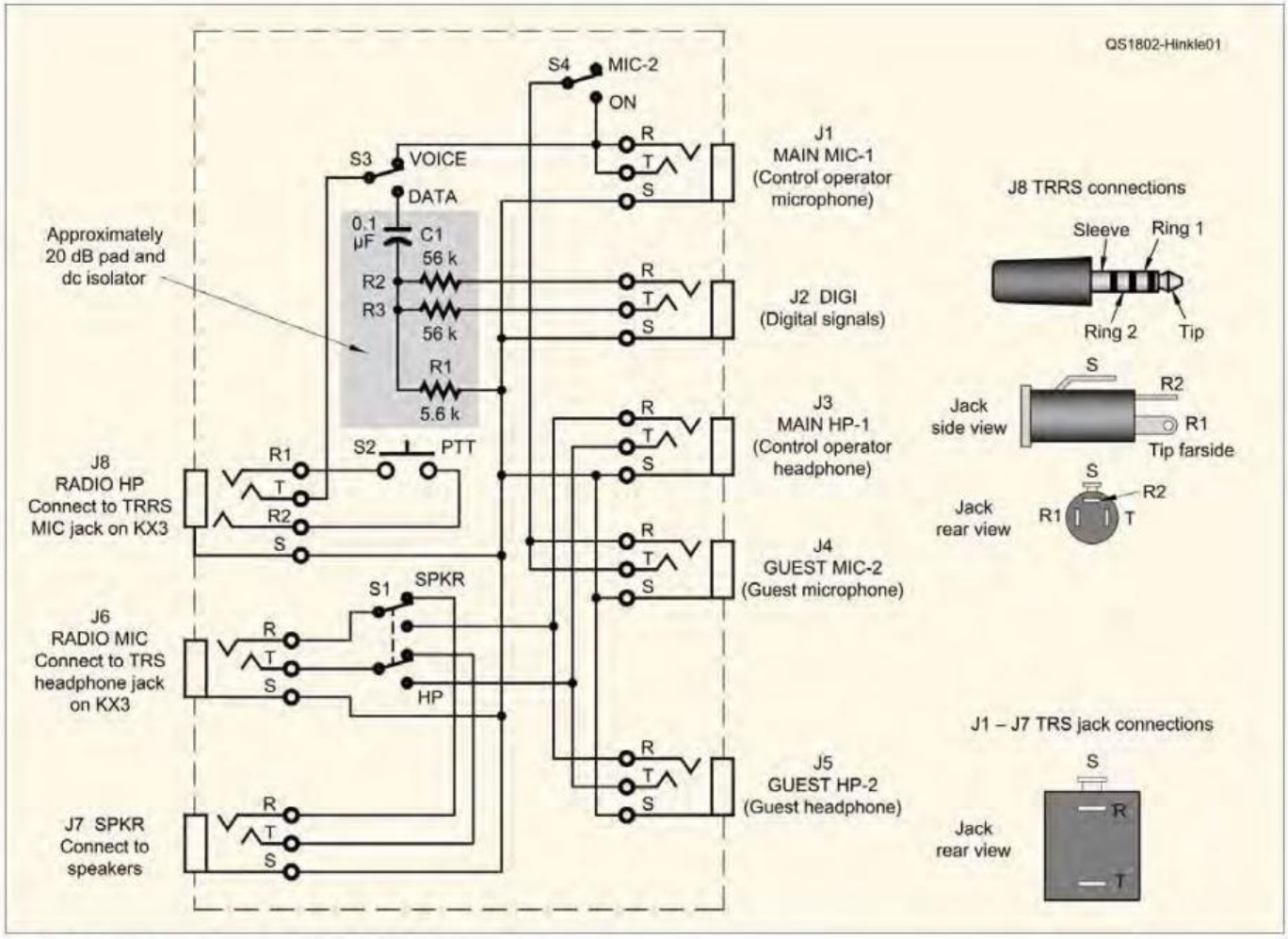


Figure 1 — Schematic diagram of the audio switching unit.

C1 — 0.1 µF capacitor
J1 – J7 — 3.5-millimeter panel-mount audio jack, three connector, TRS (Mouser STPX-3501-3C)
J8 — 3.5-millimeter panel-mount audio jack, four connector, TRRS (Mouser SJ5-43502PM)
R1 — 5.6 kΩ resistor, ¼ W
R2, R3 — 56 kΩ resistor, ¼ W
S1 — DPDT toggle switch (Mouser 7201SYZQE)
S2 — SPDT momentary contact push-button switch (Digi-Key CKN4031-ND); red pushbutton cap (Digi-Key CKN1105-ND); dress nut (Digi-Key CKN1184-ND)
S3, S4 — SPDT toggle switch (Mouser 7101SYZQE)
Box — ABS gray box 5.25 × 3 × 2 inches, Bud Industries CU-1874-G (Digi-Key 377-1166-ND)
Ground loop noise isolator — PAC SNI-1/3.5 (available from Amazon)
Labels — Brother TZe-121 9-millimeter black on clear tape for P-Touch labelers

Transceiver Audio Interface Cables

This unit was designed to use a four-wire connection with a TRRS 3.5-millimeter plug to connect the headset's boom microphone to an Elecraft KX3-style or similar transceiver (Figure 1, J8). The microphone cord requires TRRS 3.5-millimeter plugs on each end. For the headphone (**HP**) connection (Figure 1, J6), a three-wire cable with 3.5-millimeter TRS plugs at each end is needed. This is your standard miniature stereo headphone cord (plugs on both ends). See P2 and P3 in the

Plug and Jack Terminology

The terms *tip* and *ring* have been around since the early days of the Bell System and they refer to the extreme tip and the insulated metallic ring just behind it on the quarter-inch phone plugs, originally used by operators to complete telephone connections. Modern plugs take advantage of the area just behind the ring (termed the *sleeve*) to provide an additional connection. Tip, ring, and sleeve are typically abbreviated T, R, and S. To provide even more connections, additional rings are added and are identified by a numerical suffix, with R1 being the ring closest to the tip. For example, a plug capable of making four connections would be a TRRS plug, with the two rings identified as R1 and R2 on a schematic.

The original Bell System ¼-inch diameter plug is far too clunky for today's compact electronic devices, and a reduced diameter standard — confusingly multi-termed *mini*, *miniature*, *⅛ inch*, and *3.5 millimeter* (all the same size) — is used for making almost all audio and low-frequency control connections.

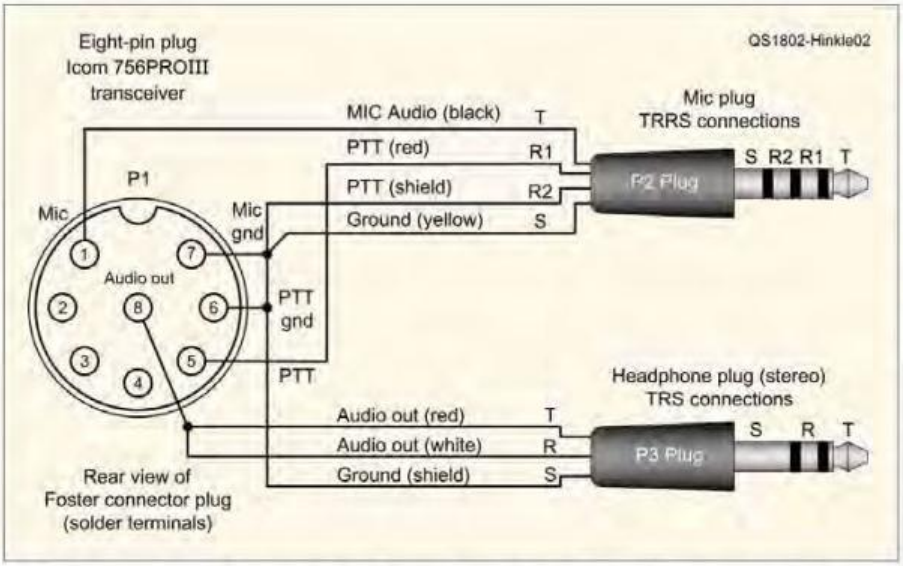


Figure 2 — Schematic diagram for an Icom eight-pin plug to TRRS/TRS microphone and headphone plugs.

P1 — Foster eight-pin plug connector for Icom (Universal Radio #2112)
P2 — Philmore #44-470, 3-foot, 3.5-millimeter shielded four-conductor audio cable with right angle male-to-male connectors (Universal Radio #3624)
P3 — Philmore #44-468, 6-foot, 3.5-millimeter three-conductor stereo cable with right angle male-to-male connectors (Universal Radio #4103)

parts list of Figure 2 for typical examples.

If the unit is to be used with an Icom transceiver, such as an IC-756PROIII, then an adapter cable to convert the TRRS and TRS jacks to the Foster-style (eight-pin) plug is necessary. Figure 2 shows the schematic to connect the TRRS and TRS plugs to an Icom eight-pin Foster-style microphone jack. Note that if your microphone jack does not include the radio audio output signal, a connection to the speaker or audio headphone output can be made directly without the need for this adapter for the headphone channel.

Construction

The unit is housed in an ABS lidded box made by Bud Industries (see parts list). All labels were created using a Brother P-Touch label maker and TZ tape with laminated black lettering on a clear background (see parts list). This provided a durable yet inexpensive method of labeling the unit. All wiring is point-to-point. I find that it is helpful to work out the placement of jacks and switches on a full-size drill template, which is then taped directly to the box for marking the hole positions.

Wrap-Up

The audio switching unit has proved to be an extremely useful shack accessory, enabling me to easily switch between external speakers and my headset with the flick of a switch and still have the convenience of push-to-talk, voice-actuated, and digital operational modes. Moreover, it has made it possible for my grandchildren to talk on the radio as third-party participants with their inexpensive boom microphone headsets, while still giving me the control to mute the occasional excited outburst.

Photo by the author.

Amateur Extra-class license holder and ARRL Life Member Gene Hinkle, K5PA, is also a Volunteer Examiner. He earned an MSEE from the University of Texas at Austin and is an IEEE Life Senior Member, as well as a retired professional engineer in Texas. Gene has been involved with Amateur Radio from a very early age and enjoys working CW and low-bandwidth digital, and making DX contacts. You can find out more about Gene from his website at **www.k5pa.com**, or reach him via e-mail at **k5pa@arrl.net**.

For updates to this article, see the QST Feedback page at www.arrl.org/feedback.

New Products

Volt Tattler 2 Kit from Progress Direct Systems

The Volt Tattler 2 kit is designed to help protect equipment by sounding an alert if the dc supply voltage wanders too high or too low. Volt Tattler works from 5 to 28 V and draws about 1 mA in normal "silent" operation, so it is appropriate for operating low power, portable, and field work. A simple kit using through-hole components, Volt Tattler 2 is suitable for beginners learning to solder. Price: $25 and available exclusively from **www.qrpkits.com**. For more information, visit **www.progressdirectsystemsllc.com**.

Strays

The 2018 AM Rally February 3 – 5

The AM Rally is designed to encourage the use of amplitude modulation on the 160-, 80-, 40-, 20-, 15-, 10-, and 6-meter bands, and to highlight various types of AM equipment in use today. The event is open to all radio amateurs who are running full-carrier amplitude modulation (standard AM), using any type of radio equipment. The AM Rally begins at 0000 UTC on Saturday, February 3, and runs through 0700 UTC on Monday, February 5. Visit **www.amrally.com** for more information.

5 and 10 MHz WWV TRF Receivers for Frequency Counter Calibration

Calibrate directly or indirectly with these easy-to-build tuned radio frequency receivers.

Don Kirk, WD8DSB

I designed these tuned radio frequency (TRF) receivers for viewing the WWV carrier frequency on an oscilloscope. That allows calibration of an adjustable temperature-compensated crystal oscillator (TCXO), or any other stable oscillator. The high level TCXO output is then used to calibrate my homebrew frequency counter, as in Figure 1. Set the oscilloscope to trigger on Channel 1, which is displaying the WWV 10 MHz waveform. Then adjust the 10 MHz TCXO frequency until its waveform, displayed on Channel 2, is stationary relative to the Channel 1 signal. Now, adjust the frequency counter until it displays exactly 10 MHz.

Direct calibration (see Figure 2) of the frequency counter using the WWV signal is also possible when the WWV signal is reasonably strong, and if a 20 dB gain preamp is placed between the TRF receiver output and the frequency counter.

Both methods allow calibration of frequency counters, regardless of their internal clock frequency.

TRF Receiver Design

My goal was to keep parts count to a minimum. The TRF receiver comprises a crystal filter at the antenna, followed by a tuned circuit that feeds an integrated circuit amplifier, followed by another crystal filter. Figure 3 (A) shows the combined schematic for both the 10 MHz and 5 MHz TRF receivers. Figure 3 (B) shows the schematic of the wide-band 20 dB gain preamp.

Some component values are common for both receivers, while other components have values specific to 10 MHz or 5 MHz. The MC1350 integrated circuit intermediate frequency (IF) amplifier with an input-tuned circuit and broadband output provides the required gain of approximately 42 dB. Simple crystal ladder filters before and after the amplifier stage establish the frequency and the selectivity.[1, 2] Back-to-back diodes D1

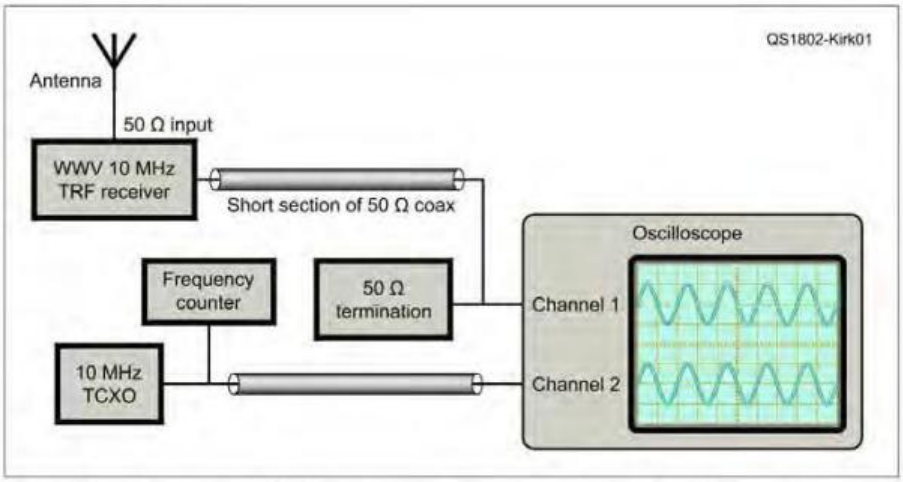
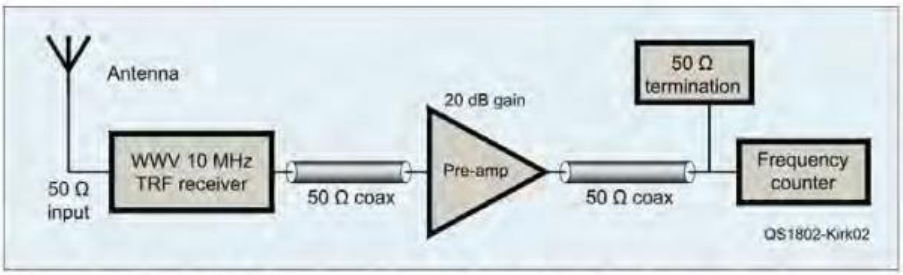


Figure 1 — Calibrate the TXCO by comparing the TRF receiver and TXCO waveforms on a two-channel oscilloscope. Then calibrate the frequency counter by adjusting its frequency until 10 MHz is displayed.



"A 20 dB broadband preamp connects to the output of the TRF receiver and provides a very large signal when WWV is reasonably strong."

Figure 2 — Calibrate the frequency counter directly by adjusting its frequency until 10 MHz is displayed.

and D2 prevent strong signals from damaging the MC1350. I placed these diodes directly across the MC1350 input rather than across the antenna connector based on previous experience with the MC1350.

Resistors R1 and R4 help with stability of U1. The input and output circuits are kept away from each other, and the input transformer T1 is rotated 90° relative to the output transformer T2, even though toroids are considered self-shielding. These precautions help prevent oscillation.

The 10 MHz receiver has an asymmetrical passband (see Figure 4). The values for tuning capacitors C1, C4, C11, and C15 were chosen to be 36 pF, so that the peak of the passband is close to 10 MHz. The more common value of 39 pF can be used in place of the 36 pF capacitors. That will cause the center of the passband to be closer to 10 MHz, resulting in slightly reduced gain.

The 5 MHz receiver has a symmetrical passband (see Figure 5) and the value for tuning capacitors C1, C4, C11, and C15 was chosen to be 33 pF so that the center of the passband is close to 5 MHz. The 5 MHz receiver uses an extra capacitor C17 as part of the tuned circuit, and it also uses the two additional transformers T3 and T4 for impedance matching.

My TRF receiver experienced oscillation under certain conditions when not mounted in the aluminum enclo-

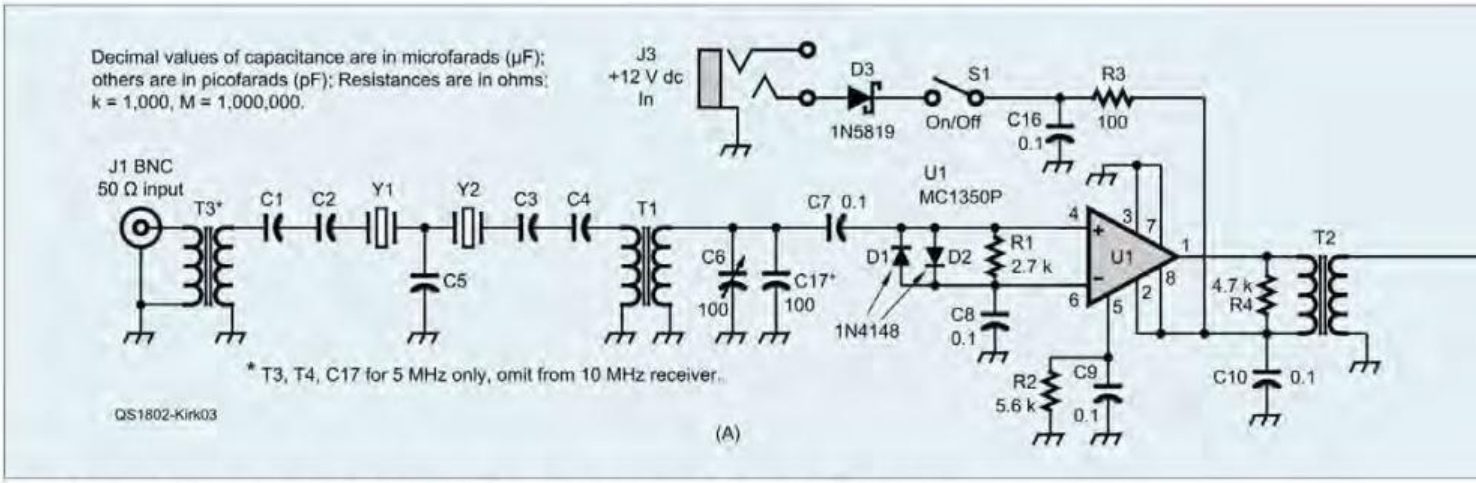


Figure 3 — (A) Schematic of the 10 MHz and 5 MHz TRF receivers, and (B) the 20 dB gain preamp.

10 and 5 MHz common components:

J1, J2 — BNC panel-mount jacks (Mouser 530-VB1094)
J3 — coaxial power jack, 2.1-millimeter ID, 5.5-millimeter OD (RadioShack 2741582 or Jameco 151555)
C6 — 100 pF ceramic trimmer capacitor (Jameco 94449)
C7, C8, C9, C10, C16 — 0.1 μF MLCC (Mouser 581-SR155C104KAR)
D1, D2 — Diode 1N4148 (Mouser 512-1N4148)
D3 — Schottky diode 1N5819 (Mouser 625-1N5819-E3)
R1 — 2.7 kΩ ¼ W
R2 — 5.6 kΩ ¼ W
R3 — 100 Ω ¼ W
R4 — 4.7 kΩ ¼ W
S1 — SPDT toggle switch (RadioShack 2750613 or Jameco 21910)
U1 — MC1350P IF amplifier (Jameco 24942)
U1 Socket — eight-pin IC socket (Jameco 112206)
Enclosure — Bud Industries model CU-3005-A (Mouser 563-CU-3005A)

10 MHz components:

C1, C4, C11, C15 — 36 pF MLCC type C0G NP0 (Mouser 581-SR151A360JAR) Optional: 39 pF (Mouser 594-K390J15C-0GF53L2)
C2, C3, C5, C12, C13, C14 — 220 pF MLCC type C0G NP0 (Mouser 594-K221J15C0GH5TL2)
T1 — primary eight turns, secondary 35 turns, #26 AWG enamel on T50-2
T2 — primary 30 turns, secondary four turns, #26 AWG enamel on FT50-43
Y1 – Y4 — CTS Electronics MP101 10 MHz parallel crystals (Mouser 774-MP101)

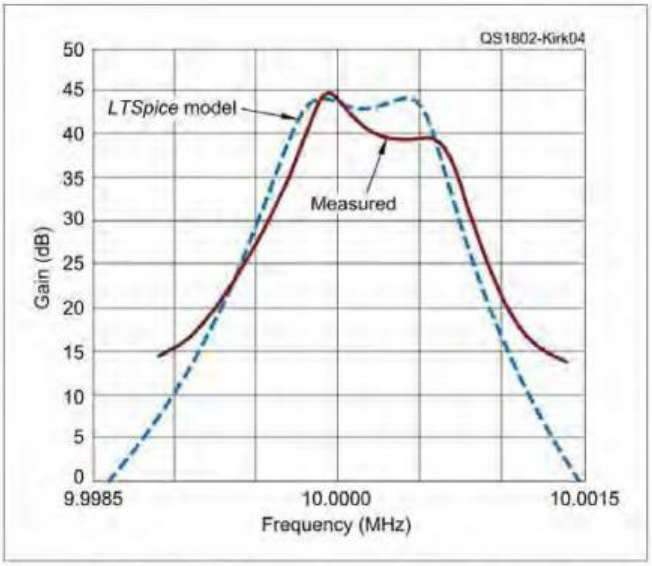


Figure 4 — 10 MHz TRF receiver measured (solid line) and modeled (dashed line) gain versus frequency.

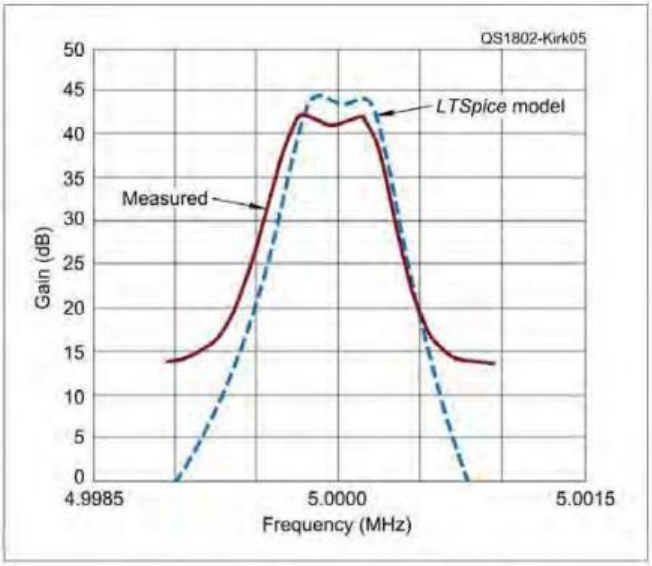


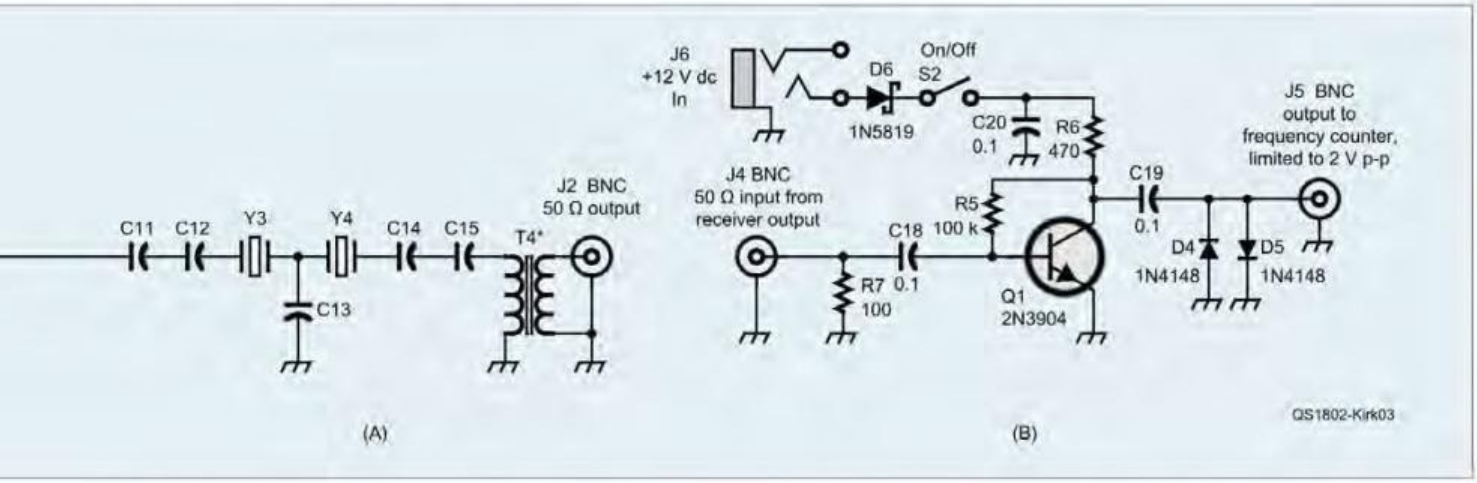
Figure 5 — 5 MHz TRF receiver measured (solid line) and modeled (dashed line) gain versus frequency.

sure. I connected a copper shield made from double-sided printed circuit board between T2 and the rest of the circuit board components. The copper shield is not required when the PC board is mounted in the aluminum enclosure, even when the aluminum top is not installed.

Building the TRF

A circuit board (see Figure 6) with all traces on the bottom allows easy duplication for those wanting to etch their own boards. I had three circuit boards professionally etched by a company called **BasicPCB.com** at a total cost of $36.75, including shipping.

The T1 primary winding is wound on top of its secondary winding, and the T2 secondary winding is wound on top of its primary winding. Evenly



5 MHz components:

C1, C4, C11, C15 — 33 pF MLCC type C0G NP0 (Mouser 594-K330J15C0GF5TL2)

C2, C3, C5, C12, C13, C14, C17 — 100 pF MLCC type NP0 (Mouser 594-K101J15C0GF5TL2)

T1 — primary 12 turns, secondary 35 turns, #26 AWG enamel on T50-2

T2 — primary 33 turns, secondary 10 turns, #26 AWG enamel on FT50-43

T3 — primary three turns, secondary six turns, #26 AWG enamel on BN73-202

T4 — primary six turns, secondary three turns, #26 AWG enamel on BN73-202

Y1 – Y4 — CTS Electronics MP05A 5 MHz parallel crystals (Mouser 774-MP05A).

Preamp components:

J4, J5 — BNC panel-mount jacks (Mouser 530-VB1094)

J6 — coaxial power jack, 2.1-millimeter ID, 5.5-millimeter OD (RadioShack 2741582 or Jameco 151555)

C18 – C20 — 0.1 µF MLCC (Mouser 581-SR155C104KAR)

D4 – D5 — diode 1N4148 (Mouser 512-1N4148)

D6 — Schottky diode 1N5819 (Mouser 625-1N5819-E3)

Q1 — 2N3904 (Mouser 512-2N3904BU)

R5 — 100 kΩ ¼ W

R6 — 470 Ω ¼ W

R7 — 100 Ω ¼ W

S2 — SPDT toggle switch (RadioShack 2750613 or Jameco 21910)

Enclosure — Bud Industries model CU-3003-A (Mouser 563-CU-3003A)

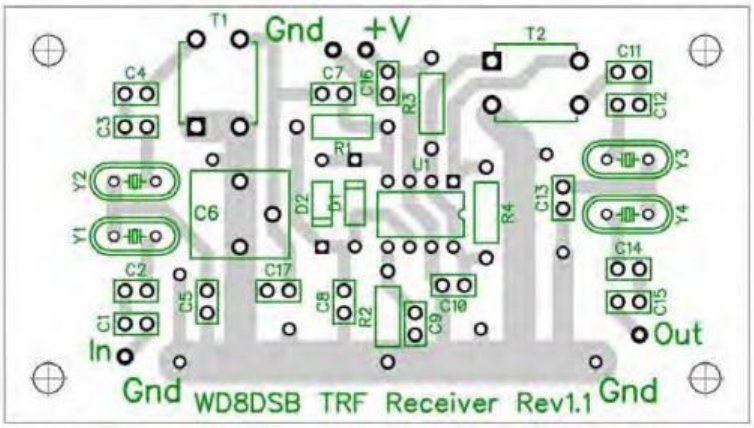


Figure 6 — Image of the TRF receiver 3.4 × 1.9 inch PC board.

spaced windings are used on both transformers.

Reverse polarity protection diode D3 is physically located between the on/off switch and the power jack. A wire as short as possible — approximately ½ inch long — should be soldered between the minus pin on the power jack and the main body of this jack to prevent the introduction of low-level noise when WWV is extremely weak.

Trimming of the legs on variable capacitor C6 using diagonal cutters or a Dremel® tool with thin cutoff wheel may be required to fit the circuit board holes (and be sure to wear eye protection when using a Dremel tool). Adjust C6 to maximize the output signal when receiving WWV.

Performance

The output of the TRF receiver is designed to generate a 2 mV_{p-p} (or 0.707 mV rms) signal for viewing on an oscilloscope, as long as the WWV signal is above 6 μV at the antenna. When the WWV signal is reasonably strong, the WWV TRF receiver output often peaks between 20 and 50 mV rms into a 50 Ω load, and at times peaks at 100 mV rms or more. Depending on the sensitivity of the frequency counter, this signal level may be adequate during short periods due to propagation fades for direct frequency counter measurement. Typically, a preamp is required for the direct calibration procedure.

A 20 dB broadband preamp (see Figure 7) connects to the output of the TRF receiver and provides a very large signal when WWV is reasonably strong. That easily drives my frequency counter. It all depends on propagation, antenna, and frequency counter sensitivity. I fabricated the circuit board for this preamp using a Dremel tool with thin cutoff wheel.

Ideally, the receive antenna should present an impedance of 50 Ω to the TRF receiver. A 50 Ω termination is used on the far end of the coax that is connected to the TRF receiver output to ensure a proper match for the output crystal filter of the TRF receiver.

When the WWV signal is very weak, various oscilloscope settings, such as bandwidth limiting and signal averaging, can be used to clean up the signal and make it usable when attempting the indirect calibration procedure.

The receiver draws approximately 14 mA, and the preamp another 12 mA, when powered by a 12 V dc power supply.

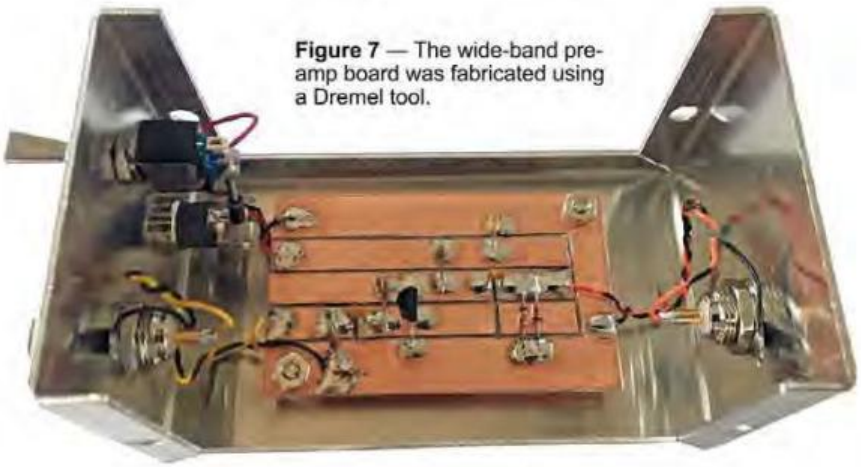


Figure 7 — The wide-band preamp board was fabricated using a Dremel tool.

The History of WWV

WWV, a special HF radio station operated by the National Institute of Standards and Technology (NIST), is the longest continuously operating radio station in the country since beginning transmission in May 1920. The station broadcasts extremely accurate time signals on 2.5, 5, 10, 15, and 20 MHz, and makes additional announcements of general interest, such as warnings for oceanic weather conditions. However, WWV's main function is announcing the official Coordinated Universal Time every minute; the time signals are regulated by an atomic clock using oscillations of Cesium atoms, making it accurate to 1 part in 1 trillion. The transmitting frequencies are accurate to 1 part in 100 billion. Thus, WWV provides a wireless time and frequency standard; by comparing signals to WWV, radio operators can see how accurate their device may be in terms of frequency.

"Ideally, the receive antenna should present an impedance of 50 Ω to the TRF receiver."

Summary

The ability to calibrate frequency counters directly or indirectly using a WWV TRF receiver is a fun and fascinating endeavor, and it's a more repeatable process than the zero-beat method. Calibration within 1 Hz of National Institute of Standards and Technology (NIST) should be possible using these TRF receivers. It is very rewarding to know that your equipment calibration is traceable back to NIST.

Acknowledgments

I designed my TRF receivers after viewing a YouTube video by Aaron Parks, KC8FQD, who showed his own 10 MHz WWV TRF receiver design that he used to calibrate his frequency counter. After designing my TRF receivers, I also found a 10 MHz WWV TRF receiver design on the internet by Clifton Gantt, W4CWG (now SK). His TRF receiver was based on the no longer produced NE614 FM/IF/limiter chip.

Notes

[1]J. Smith, K8ZOA, "Technical Correspondence," *QST*, Aug. 2007, pp. 74 – 75.
[2]H. Steder, DJ6EV, and J. A. Hardcastle, G3JIR, "Crystal Ladder Filters for All," *QEX*, Nov./Dec. 2009, pp. 14 – 18.

Don Kirk, WD8DSB, was first licensed in 1976 at age 16, and currently holds an Amateur Extra-class license as well as a General Radiotelephone Operator License. He received an Associate degree in applied science from Henry Ford Community College in 1983 and a Bachelor's in engineering technology (electrical/electronic) from Wayne State University in 1985. For the past 32 years, Don has been employed as a Senior Engineer by Magnequench, working in the rare-earth permanent magnetic materials industry. Don's technical passion is discrete electronics and microcontroller-based projects, and he enjoys chasing DX and contesting on 160 meters CW. Don and his wife, Chris, also enjoy tandem bicycle riding and ice skating. You can reach Don at **wd8dsb@aol.com**.

For updates to this article, see the QST Feedback page at www.arrl.org/feedback.

Strays

Hedy Lamarr Documentary Highlights Radio Invention

Hedy Lamarr found fame in movies through the 1930s and '40s, being dubbed "the most beautiful woman in the world," but audiences scarcely recognize the brilliance beyond her beauty. Zeitgeist Films' recently released documentary, *Bombshell: The Hedy Lamarr Story*, focuses on Lamarr's devotion to science and invention, particularly her conception of frequency-hopping. Written and directed by Alexandra Dean, the documentary finally allows Lamarr to tell the story of her life in her own words, using a rare recording from a 1990 interview with journalist Fleming Meeks. This interview was the first time Lamarr recounted the journey to her groundbreaking discovery.

In 1942, Lamarr and her co-inventor, composer George Antheil, patented an invention that utilized frequency-hopping as a secret communication tool to protect radio-controlled torpedo frequencies from being jammed by the enemy during World War II. But it wasn't until the Cuban Missile Crisis in 1962 — after her patent expired — that the tool began being widely used in the Navy. Nowadays, frequency-hopping is a critical part of both military and civilian communications, providing the backbone for the modern technology we rely on, including cell phones, Wi-Fi, and GPS.

It was decades before Lamarr was finally recognized for her contributions. *Bombshell* director Dean said, "It is my hope that this film will become the moment Hedy Lamarr, the legend who shaped our world, will come out of the shadows and take her place in history."

To view theaters and show dates for *Bombshell: The Hedy Lamarr Story*, in limited release, go to **https://zeitgeistfilms.com/film/bombshellthehedylamarrstory**, and check out our thoughts on Lamarr's incredible life story in our video, "How Hedy Lamarr Changed the World with Radio," at **www.youtube.com/arrlhq**. — *Assistant Editor Allison McLellan*

Bombshell: The Hedy Lamarr Story is in limited release through March 2018. [Photo courtesy of Zeitgeist Films]

Product Review

TYT MD-2017 Dual-Band Analog and DMR Handheld Transceiver

Reviewed by Pascal Villeneuve, VA2PV
va2pv@arrl.net

For several months, I was not very active on DMR (digital mobile radio), and when I started working on this review, I was surprised at how much activity has grown. Contacts occur almost continuously on my local reflector, and this suggests that DMR is doing very well among our local ham community. One reason it's so popular is the availability of low-cost, high-quality radios, such as those from TYT. These radios are built for commercial applications, but the TYT MD-2017 reviewed here better meets our operational needs than older models.

Overview

When I got the TYT MD-2017, I expected something very similar to the popular MD-380. The programming software does look alike for the most part, but the operation has been improved. Most DMR radios do not have direct access for frequency configuration, but this is possible with the MD-2017, as I will discuss later.

This radio is dual band — VHF (136 – 174 MHz) and UHF (400 – 480 MHz). It can monitor any frequency on VHF or UHF on both VFOs (V/V, U/U), in digital or analog (FM), but it can only receive one signal from one VFO at a time. It is compatible with DMR Tier I and Tier II (see the sidebar, "DMR Basics"), so it can be used on the ham radio repeater networks and with any digital hotspots compatible with DMR. It is IP67 certified (protected from water and dust), and can be equipped with an optional GPS (not included in our review unit). The MD-2017 has a long-lasting 2,200 mAh lithium-ion battery; 3,000 channels; tone capability (CTCSS and DCS) for conventional analog FM repeater use, and enough memory for up to 100,000 DMR contacts (more on this later). The maximum power output is 5 W (high). Low and medium settings are also available.

The box includes the radio, a dual-band antenna (SMA female), a battery, a belt clip, a desktop charger, and an instruction manual. Our package also included the optional programming cable. The cable is required to configure the radio (at least for the first time) and still uses the speaker/mic connector (see Figure 1), but it is different from the MD-380. Figure 2 shows various views of the radio.

Programming the Radio

Before you can program the MD-2017 manually, you must set it up initially using the programming software (*CPS*) and create a *codeplug*. The codeplug is a configuration file that includes memory channels, scan lists, user preferences, menu options, and other settings. Don't be confused by the DMR terminology — just keep in mind that to configure a memory channel for DMR, you need to set up a contact and a channel, and assign it to a zone.

Bottom Line

The TYT MD-2017 operates in DMR or analog FM on 2 meters and 70 centimeters, and is more ham-friendly than previous models. After initial setup, the configuration can be changed without the need for external programming software.

DMR Basics

There are three types of DMR — Tier I, Tier II, and Tier III. For this review, we will concentrate on the widespread Tier II DMR network, and we will refer to an earlier TYT DMR radio, the very popular MD-380. If you want to compare the MD-380 with the MD-2017, check out "Tytera (TYT) MD-380 Analog and DMR Handheld Transceiver" by Jim MacKenzie, VE5EIS, in the November 2017 issue of *QST*. To learn more about DMR in general, I strongly suggest that you read, "Introduction to Digital Mobile Radio (DMR)" by John S. Burningham, W2XAB, in the October 2015 issue of *QST*. Also, I have quite a bit of information about DMR and digital voice communication on my YouTube channel, **Laboenligne.ca** (or search for VA2PV). — *Pascal Villeneuve, VA2PV*

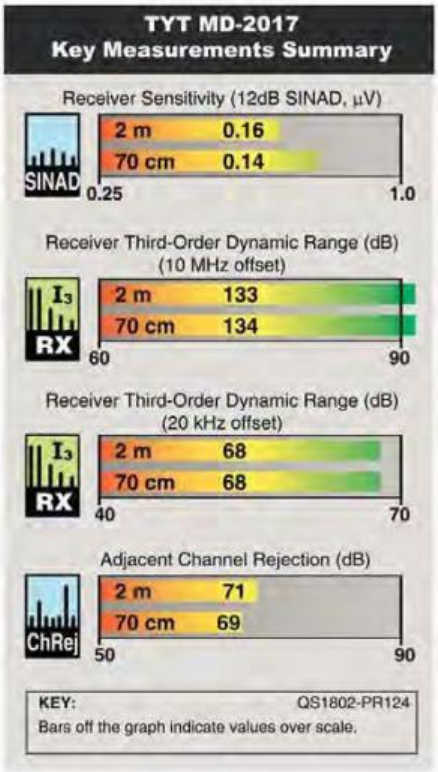


Table 1
TYT MD-2017, serial number 1706A00587

Manufacturer's Specifications	Measured in ARRL Lab
Frequency coverage: Receive, 136 – 174, 400 – 480 MHz.	As specified.
Modes: DMR, analog FM.	As specified.
Power requirements: 7.4 V dc (2,200 mAh Li-ion battery supplied).	Receive, 550 mA (max volume, backlight on); 445 mA (max volume, backlight off); standby, lights off, 80 mA. Transmit (high/medium/low): 146 MHz, 1.74 / 1.14 / 0.875 A 440 MHz, 1.59 / 1.16 / 0.9 A
Receiver	**Receiver Dynamic Testing**
Sensitivity: FM, 0.2 µV for 12 dB SINAD, digital, 0.25 µV (BER 5%).	FM, for 12 dB SINAD: 146 MHz, 0.16 µV; 440 MHz, 0.14 µV.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset: 146 MHz, 68 dB; 440 MHz, 68 dB. 10 MHz offset: 146 MHz, >133 dB; 440 MHz, >134 dB.
FM two-tone, second-order IMD dynamic range: Not specified.	146 MHz, 67 dB; 440 MHz, >134 dB.
Adjacent-channel rejection: Not specified.	20 kHz offset, 146 MHz, 71 dB; 440 MHz, 69 dB.
Squelch sensitivity: Not specified.	At threshold: 146 MHz, 0.16 µV (normal), 0.33 µV (tight); 440 MHz, 0.14 µV (normal), 0.28 µV (tight).
Transmitter	**Transmitter Dynamic Testing**
Power output: VHF, ≥4 W; UHF ≤5 W.	At 8.4 V dc (full charge), high/med/low: 146 MHz, 6.5 / 3.0 / 1.6 W 440 MHz, 5.0 / 3.0 / 1.7 W At 7.4 V dc, high/med/low: 146 MHz, 5.3 / 2.8 / 1.5 W 440 MHz, 3.8 / 2.6 / 1.5 W
Spurious signal and harmonic suppression: Not specified.	>70 dB; meets FCC requirements.
Size (height, width, depth): 5.5 x 2.5 x 1.3 inches (including protrusions). Belt clips, add 0.5 inches to depth. Antenna length: 6.3 inches. Weight: 10.6 ounces (including battery and antenna).	

The fastest way to get started in DMR is to ask a friend who is already active for a copy of his or her codeplug, which you can modify for your preferences. The codeplug needs to be compatible with your radio, though. The latest *CPS* software for the MD-2017 supports converting codeplugs for the MD-380, which are readily available.

In this review, I will cover only some of the *CPS* functions I used while programming the MD-2017. For more information about setting up a DMR radio, you can download a PDF from one of my previous reviews. That file, with more detailed screenshots to illustrate basic DMR programming steps, is available online from **www.arrl.org/qst-in-depth** (look for the March 2017 issue files).

Customizing the MD-2017 Using the *CPS*

First, I searched online for the latest firmware and programming software. I found that, at the time, the latest one was available only via TYT's Facebook page. Then I had to ask if I have the GPS version. The only clue that I had was the original firmware version in the unit, D003.033. When I downloaded the latest version, there were two firmware files available — D003.040 and S03.040 with GPS in the file name — so I used the D003.040 standard version. TYT support later indicated that the firmware version is the way to confirm if the GPS is present.

Using the *CPS* software (the new version, 1.17, included in the firmware file), I started creating the codeplug and found out that I could import configurations from my TYT MD-380 handheld. I worked on this for a full day, testing options while uploading different configurations into the radio.

Figure 1 — The TYT MD-2017 speaker/mic connector (programming cable).

Figure 2 — The TYT MD-2017 viewed from different angles.

General Settings and Customization

Figure 3 shows the **GENERAL SETTING** screen. The default voice announcement feature annoyed me, because it makes channel change a long process, as it must finish speaking before you can change channels again. This is a very important feature for those who need it, but I unchecked that option, and now the channels change with a normal delay.

The default setting for the display backlight timer shut off the backlight after 5 seconds of inactivity, turning the display completely black. I changed it to **ALWAYS**. The battery lasts a long time, and I prefer to leave the backlight on all the time.

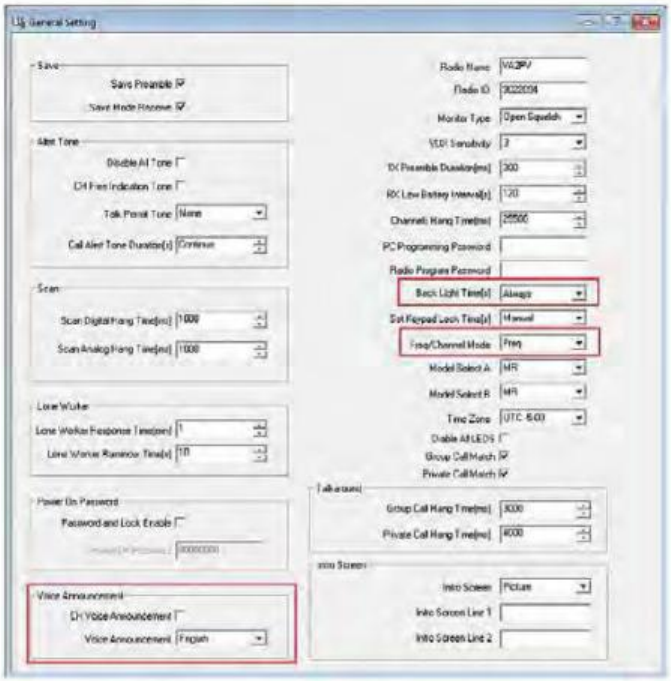


Figure 3 — The *CPS* version 1.17 **GENERAL SETTING** tab.

The third customization I made is the **FREQ/CHANNEL MODE**. By default, **CHANNEL** is selected, and in this mode, you cannot manually enter a frequency via the keypad. If you change it to **FREQ** while in memory mode (changeable via the radio menu), you can do a long push (1 second) on the **BACK** button, and go into VFO mode. After this maneuver, you can now enter a frequency directly on the keypad (with preselected configuration in the *CPS* **VFO MODE** tab). For this review, I preconfigured a digital channel for a hotspot on VFO A (top) and an analog frequency on VFO B (bottom). Now I can manually set up a frequency for common portable operations, digital hotspots, and simplex frequencies.

For more complex programming, such as an analog repeater with a tone or a digital repeater, you can add and edit a channel via the radio interface under **UTILITIES / PROGRAM RADIO / EDIT CHANNEL**. This is only possible if you have previously checked **PROGRAM RADIO** in the **MENU ITEM** tab in the *CPS* (codeplug).

While searching for the latest update, I found two versions of the same firmware (non-GPS versions). The first one can accommodate 10,000 contacts with 8 hours of internal recording time, and the second one supports 100,000 contacts with no recording capabilities. I selected the second one, went on the DMR-MARC website, downloaded the full worldwide database of DMR IDs, and uploaded the 72,530 contacts into the radio.

Loading the contacts requires some file manipulation skills. When you download the file, it will be called datadump.cgi. You need to change the file extension manually from .cgi to .csv. You may have to do some editing prior to uploading the file to the radio. For uploading, in the top

Figure 4 — With the full DMR-MARC ID database loaded, the MD-2017 displays call sign, name, and location for received stations.

menu of the *CPS*, go into the **PROGRAM** tab and select **WRITE CONTACTS**. Then import the .csv file, and click on **WRITE**. After the file is transferred into the radio, go into the **RADIO SETTINGS** menu, find **ContactsCSV**, and turn on the **.CSV LOOKUP**.

Previously, I was only seeing the call sign of an individual that I had manually programmed. Now, I can see the DMR ID, call sign, name, and location for all. This procedure needs to be done occasionally to update the radio with the latest added call signs.

There is a lighted button located in the center of the radio right under the display. It has arrows around it, but they are just for indication, as you need to use the center button like a trackball to navigate through the menus. I found the center button to be way too sensitive and hard to work with. Fortunately, you can customize buttons to do the same tasks. I use the orange button on the top of the radio to switch power levels (low, medium, and high), and the blue button above the PTT is used to switch between VFO A (top) and the VFO B (bottom). I use the up and down arrow buttons under the PTT to change channels in a zone on the active VFOs and to navigate through the menus.

If you want, you can even customize the welcome screen.

Operation on the Air

Operation became very easy once the MD-2017 was fully configured and customized for my needs. On VFO A, I usually monitor my digital hotspot. On VFO B, I have a simplex analog frequency or a local repeater. With the full DMR-MARC contact list loaded, I see all the information on the radio screen when a digital station is received (see Figure 4).

In analog mode, the MD-2017 has very good sensitivity. I compared it with several other handhelds, all using their stock antennas. While I was walking down the stairs into the basement, the MD-2017 was the last one to lose my local repeater signal.

The audio in DMR mode is nearly perfect in transmission and reception, and the receiver speaker sounds loud and clear. I received no complaints about my audio in either analog or digital mode while transmitting.

This radio can scan, but you will need to add the desired channels into the scan list first. This is also done via the programming software. Please note that all the channels created for each Talk Group (TG) need to be on the scan list, otherwise they won't be scanned.

Every time I use my MD-380 handheld, I feel stuck, because I have to go into the *CPS* software to make any changes to the configuration. With the MD-2017, I feel free to adjust settings a lot more easily.

Conclusion

While writing this review, I changed the firmware, changed the codeplug more than a dozen times, made a number of contacts, monitored local activities all day, and always had the display turned on — yet I never ran out of battery. At the end of a full day — more than 12 hours of operation — the MD-2017 was still working, although the battery indicator showed empty.

I'm very impressed with this radio. When configured properly, it is one of the most ham-friendly DMR radios

Get a DMR ID

Before you can be active on DMR, you need a DMR ID, so you must obtain a DMR-MARC digital ID, which is coordinated worldwide. This registration process is free, and the DMR-MARC team is very quick to respond. For details, see **dmr-marc.net**.

Visit https://youtu.be/Ekb0-4t9yNM to see our review of the TYT MD-2017 Dual-Band Analog and DMR Handheld Transceiver on YouTube.

I have used. I really enjoyed the fact that I could upload the full list of DMR IDs into it. This radio is just fun to play with, even if it took me some time to master the software. For the time spent studying the software, I was rewarded with some really interesting features.

If you need a good, customizable DMR/analog dual-band handheld, this radio is a good choice.

As we were going to press, TYT released a new firmware version with a number of changes and improvements. You can now store four radio IDs and change them at any time. The squelch now has nine levels instead of two, and the mic gain is adjustable with six levels. Users can add a group call contact list and new contact IDs from the radio. Check the TYT website and Facebook page for more information about these new features.

Manufacturer: TYT Electronic Co. Ltd., Block 39-1, Opto-electronics Industry Base, Nanan, Quanzhou, Fujian, China; **www.tyt888.com**. Available from many US Amateur Radio dealers. Price: $180.

Heil PR 10 Home-Station Microphone Package

Reviewed by Joel R. Hallas, W1ZR
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The Heil PR 10 microphone (see Figure 5) is a compact version of Heil's professional microphones, such as the PR 781. This microphone is currently offered only as part of a package with the LB-1 push-to-talk (PTT) table base stand and a special boom that can be used to extend the mic further forward, so the stand can be back and out of the way on the desk. While the microphone appears to have ports along the sides, they may be part of the off-axis rejection system. This microphone responds to input directly from the direction of the windscreen in the front, not from the sides.

The stand is worth a few comments by itself. The stylish stand with the PTT switch in its base is equipped with blue LED lighting at the front and surrounding the riser. The lighting is visible in the title photo, and is powered by two AA batteries located in the base bottom. A switch on the side allows the light to be always on, always off, or on just while the PTT switch is depressed. While a red version of the stand is available (LB-1R, $100), the black version that comes with the mic package does not appear to be available as a separate item, nor does the short boom.

The 8-inch boom extends to the rear of the mic up to 5.5 inches forward of the stand threads. It is clamped there by a thumbscrew through the plastic mounting clamp. A similar thumbscrew is provided to maintain the proper boom angle. The boom acts like an extension with the mic plugging into the front and the cable into the rear. With the boom and mic fully forward, there is considerable weight trying to "lower the boom," and I found my thumb not up to the task of keeping it in place, but pliers did the trick. The stand is heavy enough that it won't easily be knocked over or need to be chased around the desk. The PTT switch was in a good spot, but I found it a bit heavy to actuate, especially for long periods — perhaps that's adjustable, but I didn't explore.

The mic features Heil's dynamic element. This one has a 1⅛-inch-diameter, low-mass aluminum diaphragm and is specified with a frequency response of 85 to 16,000 Hz with an output level of –55 dB into a 600 Ω load. The response is almost flat, but has a slight rising characteristic at the higher ranges to provide improved articulation for voice use. The pattern is cardioid, with a rear null that can be used to reduce equipment noise pickup, as well as provide an aid to the anti-VOX functionality in your transceiver — if the rear points toward your speaker.

Hooking It Up

The microphone has a three-connection male XLR plug at the rear. The boom has a female XLR connector on one end to mate with the mic, and a male XLR on the other end

Bottom Line

The PR 10 microphone from Heil brings professional-quality sound to the amateur station. This high-quality mic can sound good as is, or can be easily tailored to your taste using the equalization found in many modern transceivers.

for the cable to the radio. XLR is the standard connector used in professional audio systems, delivering a nominal 600 Ω balanced connection, along with a ground lead. To hook the back end of the boom to your transceiver, you will need to either fabricate a cable or order one of the CC-1-XLR series adapter cables available from Heil. These are available to match the eight-pin round mic connectors used by Kenwood (also Elecraft), Icom, TEN-TEC, Yaesu, and others. A modular-plug version for Yaesu radios is also available.

These $40 cables include a breakout cable at the radio end that can accept a ¼-inch mono phone plug from the push-to-talk stand. A cable is provided with the stand that plugs into the ⅛-inch mono socket in the stand and connects to the ¼-inch socket at the CC-1-XLR radio end. The one apparent incongruity that baffles me is that, while the CC-1-XLR cables are 8 feet long, the supplied PTT cable that will usually go to the same place is only 2 feet long.

How It Plays

I tested the microphone with my Elecraft K3 transceiver, first using the built-in **MONITOR** function and then in on-the-air comparisons. For my monitor testing, I started with the transmit equalizer set to no compensation, or a flat response, with the transmit bandwidth set to ESSB, so I could hear more of the mic response. I compared the sound to that from my usual SSB desk mic, a 15-year-old Heil HC-5 element in an Astatic D-10 case on a grip stand. I thought that the PR 10 sounded crisper and more natural than my usual mic. When I set up my usual equalization, I still preferred the sound of the PR 10.

Next, I set the K3 transmit equalizer up the way I would usually if using a flat-response microphone. This had no base boost, a gradual increase to about 600 Hz and then a more rapid increase in the higher registers to +10 dB at the high end. By having more low-end response, I sounded much more natural, but having a lot of transmit power in the low-end speech components is not the most efficient, because the low end uses a lot of transmitter power without adding much to the information content. By reducing the response below 300 Hz significantly, I made it more efficient for communication. These are the settings I usually use for my mic with the articulation, and the articulation-focused PR 10 came out very well. I think the K3 equalizer really made the differences between mics much less significant. I would take the time to make sure the equalizer was adjusted to make my voice sound best with whichever mic I was using.

To finalize the comparisons, I called upon a friend in the next town who knows my voice very well. Bruce, N1ZU, suffered through blind testing, similar to what I did on my monitor. We picked 10 meters to avoid interference. Our signals were strong enough that there was little noise, so we could hear the audio response without external artifacts. Bruce thought that the PR 10 sounded much better than my HC-5-based mic, with a much more natural sounding low end and fewer artifacts.

My conclusion is that any mic you use with your transceiver, including this one, will do best with the equalization (if you have it) carefully adjusted. In fact, I have found that the equalization and compression settings are more important than the exact mic selected, although the mic has to provide sufficient clean and undistorted sound to give the equalizer something to work with. The PR 10 does that very well.

Figure 5 — A view of the PR 10 microphone removed from the stand and boom, to give a sense of its size.

Depending on your voice, if you don't have equalization settings, you will likely be happy with the PR 10, and may like it even more with some added equalization to make it sound just the way you want.

Documentation

The PR 10 comes with a single folded information sheet describing the microphone, including its specifications and particular instruction on talking into the end, not the side. It also shows a number of the accessories including booms, stands, and switches, as well as a Bluetooth adapter.

Manufacturer: Heil Sound, Ltd., 5800 N. Illinois St., Fairview Heights, IL 62208; **www.heilsound.com**. Price: PR 10 Package, including LB-1 PTT stand and boom, $277; CC-1-XLR series adaper cable, $40.

Elenco DT-100 Diode/ Transistor Tester Kit

Reviewed by Paul Danzer, N1II
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I have a junk box full of parts left over from old projects, parts that I salvaged, and more parts I picked up at flea markets. The most valuable parts are, of course, the transistors and diodes. One day, I plan to sort them out and get rid of the ones that are defective — if only I knew which were good and which to toss.

Maybe that day is approaching. I just finished building and testing the Elenco DT-100 Diode/Transistor Tester Kit. It is not a laboratory-grade instrument and was probably originally designed for a classroom project, but it works surprisingly well for its price class. It's packaged in an attractive plastic box made to look like a piece of commercial test equipment.

This tester kit has an interesting design. Unlike many of the small kits available today, it does not include a microprocessor or any sort of programmable chip. Instead, it consists of a compact set of simple test circuits that might have been taken out of a handbook.

The DT-100 will classify bipolar transistors as NPN or PNP, test them for amplification, and provide a comparison of gain between two transistors. It will also test transistors in a circuit — no need to unsolder the part, as long as the resistance in circuit to the base of the device is greater than 100 Ω. In addition to transistors, you can test most common diodes (silicon or germanium), light-emitting diodes (LEDs), and Zener diodes rated at more than 6 V. The tester will identify the diode anode and cathode. These are the capabilities listed on the manufacturer's website, and I was anxious to see how well it really did.

Opening the Box

Small components and hardware are sorted in transparent envelopes. In addition to the plastic enclosure (6 inches long, 3½ inches wide, and 2 inches deep), the kit includes all the hardware and foot bumpers you would expect on a commercial test instrument. A roll of lead-free solder is included — more on this later.

You will need the usual set of kit tools — a 40 W pencil-point soldering iron, a good light, perhaps some desoldering braid, small clippers, and a fixture to hold the printed circuit (PC) board while soldering. A magnifier of some sort will help, as will an ohmmeter for measuring and sorting the resistors rather than trying to make out the tiny color bands.

The instruction manual is a cut above what I've often found with small, inexpensive kits today. It includes material for someone new to kit building, such as a full page of soldering suggestions and line drawings of parts so they can be more readily found when the assembly step calls for them. The resistors are listed with both values and color codes. Most assembly steps tell you where a part is to be inserted in the PC board by an arrow that links the description to a PC board illustration. When the instruction step calls for more than just inserting a resistor or capacitor, there is usually a detailed drawing on the page to help guide you.

Bottom Line

The Elenco DT-100 is an inexpensive solid-state device tester that lives up to its online description. The PC board quality is not great, and the supplied lead-free solder may present some challenges if you are not experienced with soldering.

About That Lead-Free Solder

As noted before, the kit comes with a roll of lead-free solder, and working with that environmentally beneficial material requires extra care during construction. Lead-free solder requires a soldering iron temperature about 100° higher than the old lead-based solder. Applying extra heat by keeping the iron in place longer and perhaps pressing harder is not beneficial to many printed circuit boards, including the one supplied with this kit. In addition, the solder pads on the board are probably tinned with lead-free solder, so soldering to them takes more care and effort.

After soldering a few points, I did not like the way they looked; they were grey and grainy instead of smooth and shiny. I finished the project with some old style, very thin-gauge lead-based solder.

Putting It Together

The instruction manual is very complete, and there are only a few small problems. The biggest one is trying to insert five LEDs. To orient them properly, you have to find a small flat surface on the device base, which indicates the positive lead. I found the flat spot hard to see or feel, so I used a magnifier to look down directly on the bottom of the LED. After soldering each LED in place, you might not yet cut the protruding LED leads flush, but leave a short stub to work with in case you have an LED in backwards.

A second, very small problem is an instruction step for installing a multiprong socket. The manual says to orient it so the index mark lines up with the index mark on the PC board. There is no index mark on the socket, which is okay, because the socket is symmetrical and does not need to be oriented any particular way. However, getting the eight pins of this socket into the eight matching holes in the PC board does take patience.

The assembled PC board is shown in Figure 6. Allow a couple of evenings or a long afternoon for assembly.

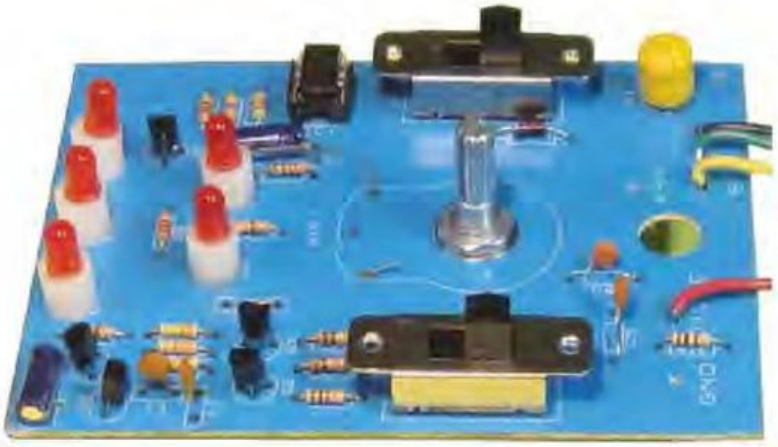

Figure 6 — The assembled board before going into the case. The transistor test LEDs and the **OK** LED are on the left, and at the right are the two **DIODE TEST** LEDs. At the upper right is a yellow eight-pin receptacle for small transistors. The transistor base current control is the potentiometer in the middle.

How Well It Works

I tested this unit with parts from my junk box. First, I switched the tester selector to the **DIODE** position and connected a diode between the red lead labeled **DIODE** on the lower panel and the black lead labeled **E**. Two front-panel LEDs are labeled **DIODE TEST**. After connecting the diode, push the **TEST** switch, and only one LED should light. Which one depends on the orientation of the diode. Two LEDs lit or no LED lit means a problem with the diode.

I tested the following diodes:

- 1N914 silicon switching diode, tested okay.
- 1N34 germanium diode, tested okay.
- Large stud-mounted power rectifier of unknown origin, tested okay.
- 1 kΩ resistor, tested as a shorted diode, and 100 kΩ resistor tested as a burnt-out diode.
- Tunnel diode of ancient origin, tested shorted (which from the current/voltage characteristic curve of a tunnel diode is probably correct).
- Zener diodes: 1N2033 (approximately 6 V) and several other Zeners marked only with their values of 5, 10, 12, and 15 V — all tested okay.

Next, I tried some transistors using the three colored leads (marked E, B, and C) to connect. You could also use the small yellow socket on the lower right. To test a transistor, select **NPN** or **PNP** on the left, move the right-hand slide switch to the **TRANSISTOR** position, connect the transistor, and press the **TEST** button. Rotate the **BASE CURRENT** control until the **OK** LED lights.

The circuit tests the transistor in a common emitter configuration. The higher you have to rotate the control, the lower the gain or β. If one transistor needs the control rotated to 70 for full brightness on the **OK** LED, and a second one needs rotation only to 20, the second transistor has higher gain. The test is, of course, only a rough measurement, but it does give you an idea of the transistor capability.

My junk box has two cans of old transistors, sorted into NPN and PNP. I reached into the cans and tested the following transistors:

- TP31 (a power NPN unit with a large heatsink), tested okay, medium gain.
- 2N2905 out of the NPN can, tested with a very low β. This was strange, so I checked and found it was actually a PNP unit. When I switched the test to PNP, the transistor tested with a medium gain.
- A 2N2102 (high-gain NPN) and 2N3906 (medium-gain PNP), both tested okay.

The Elenco DT-100 Diode/Transistor Tester does what it's supposed to do. It doesn't provide the exhaustive test results of an instrument costing several hundred dollars, but for the price, it is a handy thing to have around the shack for basic go/no-go testing.

Manufacturer: Elenco Electronics, 150 Carpenter Ave., Wheeling, IL 60090; **www.elenco.com**. Price: $26.50 kit, $44.95 assembled and tested.

HamGadgets Universal Keying Adapter 3+ Kit

Reviewed by Mark Wilson, K1RO
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In the January 2018 "Product Review" column, I wrote about reviving an old Heathkit HW-16 with some new power supply components from Hayseed Hamfest. After the initial thrill of working stations with my old straight key wore thin, I wanted to add the convenience of a CW keyer to the mix. One problem — I measured the voltage across the HW-16's **KEY** jack at about 85 V dc. That's typical of radios of this era, but beyond the capabilities of many modern keyers and computer keying interfaces.

One solution to safely keying vintage gear is the Universal Keying Adapter 3+ (UKA 3+) from HamGadgets. This is the latest version of a keyer-to-transmitter interface that's been featured as a project in the Station Accessories chapter of *The ARRL Handbook* for a number of years. Another application for this device is safely keying a high-voltage or high-current transmit-receive line on a vintage power amplifier with a modern transceiver.

The UKA 3+ has two keying inputs — one active high (apply 3 V or more to key) and one active low (short the input to key). You can key it with a typical CW keyer or from a computer serial or parallel port if your keying is via software. You can also key it with a straight key or even a mechanical bug. This offers the advantage of not having that 85 V from the **KEY** jack on your key terminals where you might touch it.

On the output side, the standard optically isolated solid-state relay is rated at up to 400 V ac or dc at 240 mA. If that's not enough, an optional heavy-duty relay can take that up to 800 V at 700 mA (or 1.8 A with a heatsink).

Building and Using the UKA 3+

The UKA 3+ is built on a single printed circuit (PC) board using a handful of through-hole components. All jacks and switches mount right on the board as well (see Figure 7). The well-illustrated, step-by-step instructions are excellent, and it took me less than an hour to put it all together. I built mine to run from a 12 V supply and slip inside the optional enclosure shown in the title photo. That way, I can use it with other vintage radios. If you plan to install the PC board inside a piece of equipment, you can bypass the connectors and solder wires to the two rows of holes on the board labeled JP1. The manual also includes instructions for using the UKA 3+ with various supplies from 3 to 16 V by changing two of the resistors.

The front panel has an **ON/OFF** switch and two LEDs. One LED indicates power, and the other lights when the UKA 3+ is keyed. The rear panel has a 2.5-millimeter ID × 5.5-millimeter OD coaxial power connector, a 3.5-millimeter stereo phone jack for the keying input line, and a phono jack for the keying output to the

Figure 7 — The completed UKA 3+ PC board. All components, including jacks and switches, mount on the board, so no additional wiring is needed.

Bottom Line

The Universal Keying Adapter 3+ from HamGadgets offers a safe way to interface a modern CW keyer with a vintage tube transmitter, or to safely key a vintage power amplifier with a modern transceiver.

Table 2
UKA 3+ Specifications

Power requirements: 12 – 13.8 V dc or ac at 40 mA. Can be modified for 3 – 16 V.
Active high keying input: –20 to +20 V max., ±12 V or less recommended.
Active high keying input impedance: 100 kΩ.
Active low keying input: 0 to +60 V max., 0 to +36 V recommended.
Active low current: 22 mA max.
Output keying voltage: 400 V max. (standard build option); 800 V max. optional.
Output keying current: 240 mA max. (ac or dc); 700 mA optional (1.8 A with heatsink).
Output on resistance: 6 Ω typical, 10 Ω max.
Turn-on time: <1 ms typical, 5 ms max.
Turn-off time: <0.05 ms typical, 0.2 ms max.

transmitter. I had to hunt through my parts drawer and box of surplus wall transformers to find a power connector that fit. It would be helpful if HamGadgets included one with the kit.

The keying input jack uses the sleeve and tip for active-low keying, and the sleeve and ring for active-high. You can have both connected at the same time (for example, to switch between your computer serial port and CW keyer). If you're not using the active-high input, it can be grounded or left open.

I hooked up the UKA 3+ between my keyer and HW-16, turned it on, and I was able to key the radio with no problems. While I did remember how to send with a straight key, I was glad to be able to use my keyer again.

Manufacturer: HamGadgets, 6493 Thompson Dr., Fort Collins, CO 80526; **www.hamgadgets.com**. Price: Universal Keying Adapter 3+ kit, $24.95; assembled, $39.95; enclosure, add $14.95; heavy-duty relay, add $13.95.

AlexMic Speaker/Microphone for the Elecraft KX2 and KX3

Reviewed by Phil Salas, AD5X
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I've had an Elecraft KX3 for several years, and it is a fine low-power/portable transceiver. However, many folks, myself included, have complained about the audio quality of the radio's tiny internal speaker. Further, the internal speaker/audio amplifiers in the KX2 and KX3 transceivers are a bit anemic for use with speakers in noisy portable environments, as they are specified at 0.5 W and 1 W peak audio power, respectively. An improvement over the KX2/KX3 internal speaker, especially for SSB/AM/FM operators, is the AlexMic. This is a speaker/microphone with a built-in speaker-amplifier created specifically for the KX2 and KX3 transceivers.

The AlexMic was designed by Alex Grimberg, PY1AHD, who is known for his AlexLoop antenna.[1]

[1]P. Salas, AD5X, "The AlexLoop Walkham Portable Antenna," Product Review, *QST*, Nov. 2013, p. 67.

The AlexMic includes a high-performance condenser microphone element and an internal speaker and amplifier capable of 2.5 W peak audio power. An internal rechargeable lithium battery powers the AlexMic's speaker-amplifier. The AlexMic specifications are given in Table 3.

The AlexMic is slightly wider and thicker than the Elecraft MH3 microphone. The AlexMic's additional thickness is due to the rotatable belt/lapel clip. And the AlexMic has an **ON/VOLUME** control in lieu of the **VFO UP/DOWN** buttons on the MH3.

Bottom Line

Elecraft KX2 and KX3 phone operators will like the additional volume and convenience of the AlexMic.

Table 3
AlexMic Specifications

Microphone sensitivity: –42 $dB_{\mu V}$ ±3 dB.
Maximum audio output: 2.5 W.
Frequency response: 200 Hz – 8 kHz.
Power source: Internal lithium battery. Charges via included USB cable.
Battery operation time: 8 hours minimum.
Size (height, width, depth): 2.7 × 2.4 × 1.7 inches, including all projections (except the cord). Weight: 7 oz. (including the cord).
Price: AlexMic $125; protective case $25.

Using the AlexMic

The AlexMic's internal lithium battery comes fully charged, which gives about 8 hours of operation. Lithium batteries don't self-discharge like NiMH batteries, so you can expect the AlexMic's battery to be fine for many months after it is charged. The charging cable plugs into a 3.5 × 1.4 millimeter dc socket in the microphone base under a flexible cover, as shown in Figure 8. The other end of the charging cable plugs into any standard USB charger or a computer USB port. There is also a 3.5-millimeter mono headphone jack under the flexible cover that mutes the AlexMic's speaker when used.

A fully discharged AlexMic lithium battery can be fully charged in about 2 hours. The AlexMic's indicator LED glows blue under normal operating conditions, and turns amber when charging. When the battery is fully charged, the AlexMic's internal smart charger stops charging and the amber-glowing LED extinguishes.

The AlexMic's speaker/mic coiled-cord cable breaks out into a 3.5-millimeter mono speaker plug and a four-conductor, 3.5-millimeter microphone plug. The KX2/KX3 internal speaker and amplifier are muted when the AlexMic's speaker plug is plugged into the radio, which also extends the KX2/KX3 battery life. In order to avoid any confusion, the speaker and microphone cable ends are clearly marked, as shown in Figure 9.

The AlexMic condenser microphone draws operating bias from the radio, so the radio's **MIC BIAS** menu setting must be turned on. As the AlexMic does not have **VFO UP/DN** buttons, set the KX2/KX3 **MIC/BTN** menu setting to **PTT**. If you've previously adjusted your KX2/KX3 microphone gain, compression, and equalization for the MH3, you will probably find that nothing needs to be changed when the AlexMic is plugged in — at least that was my experience. However, it is easy to tweak these parameters for best audio quality using the KX2/KX3 monitor function as described in the manuals.

Of course, the real advantage of the AlexMic is the impressive receive audio. The speaker sound is much more pleasant than the radio's internal speaker. That's probably due to the AlexMic's frequency response, which can be further adjusted using the radio's receiver equalizer if desired. And the AlexMic can provide a comfortable sound level in virtually any environment, especially because the speaker/mic can be placed close to your ear if necessary. Finally, should the AlexMic's lithium battery become discharged and you want to continue operating, simply unplug the **SPKR** plug from the radio and continue using the AlexMic as a standalone microphone.

Finally, there is an optional carrying case available. As Figure 10 shows, this nice-looking cloth case protects the AlexMic and even provides a separate compartment for the charging cable. I also found that this is a perfect case for housing and protecting the Elecraft XG3 signal generator.

Conclusion

The AlexMic amplified speaker/mic provides improved listening pleasure compared with the internal speaker in Elecraft KX2 and KX3 transceivers. The AlexMic has a wider frequency response and offers much higher volume than the internal unit. The higher volume is particularly valuable in portable/outdoor environments.

Manufacturer: Alexandre Grimberg, PY1AHD, **www.alexloop.com**. Available in the United States from Ham Radio Outlet, **www.hamradio.com**.

Figure 8 — The charging jack is on the left, and the 3.5-millimeter mono headphone jack is on the right.

Figure 9 — The clearly marked AlexMic cable ends.

Figure 10 — The AlexMic and charging cable fit neatly in the optional carrying case.

SOTABEAMS Click2Tune Accessory for Icom Transceivers

Reviewed by Steve Ford, WB8IMY
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I recently purchased an Icom IC-7300 transceiver, which I use with my inverted-L antenna system. The antenna is 102 feet in length, with about 25 radial wires nestled in the soil. At the base of the antenna is a remote RF-sensing automatic antenna tuner, which manages to match the antenna quite well on all bands from 160 through 6 meters. All it needs is a little RF to trigger the tuning process, and then I'm good to go.

But to safely operate the remote antenna tuner with my IC-7300, I must do the following, in order:

- Find a clear frequency and reduce the output power to less than 20 W. (Asking the tuner to find a match with 100 W applied to its relays would be tempting fate, to say the least.)
- Switch to a mode, such as RTTY, AM, or FM, that generates a steady carrier.
- And, finally, press the **TRANSMIT** button and wait until tuning is complete.

I must execute these steps every time I change bands, and sometimes if I make a large frequency excursion within a given band.

A Solution in Hand — Literally

SOTABEAMS has crafted an elegant alternative to the three-step hassle: the Click2Tune.

Click2Tune attaches to my IC-7300 at the rear-panel **TUNER** socket (see Figure 11). A 3-foot cable ends at a narrow printed circuit board that sports a sizeable blue button (see Figure 12).

Figure 11 — The 3-foot-long Click2Tune cable connects to the transceiver's rear-panel Tuner Control socket.

Regardless of the operating mode I've selected — even SSB — when I press the blue Click2Tune button, the IC-7300 will instantly lower its output to 10 W and send a steady carrier. My remote antenna tuner will respond by quickly finding a match. When I release the button, the IC-7300 will jump back to receive and be ready to go at its full 100 W output (or at whatever I've set the output level to be).

You may have seen YouTube videos that describe what appears to be a similar solution involving a resistor and a capacitor attached to a Molex plug. It works, but it is far from elegant. With the homebrew solution, the tuning period is fixed and not easily disengaged if something goes haywire. With Click2Tune, I'm in complete control. I can immediately stop tuning whenever I wish by just releasing the button.

Bottom Line

The SOTABEAMS Click2Tune makes it convenient for owners of compatible Icom transceivers to generate a low-power signal for adjusting an external antenna tuner or power amplifier.

Figure 12 — Click2Tune fits easily in your hand. Just press the blue button and your transceiver will start generating a steady 10 W output.

One Catch

There is one issue with using the Click2Tune, although it is not the fault of the device. When tuning with Click2Tune, my IC-7300 will *not* display the antenna system SWR. To know when my remote antenna tuner has found an acceptable match, I must watch my external SWR meter. Alternatively, I could probably keep an eye on the IC-7300's RF output meter. When the meter indicates 10 W, it is a safe bet that the tuner has found an acceptable match because the SWR foldback protection circuit is not reducing the output.

Click2Tune works with several Icom transceivers, although for this review, I only tested it with the IC-7300. The current list includes the IC-7300, IC-7100, IC-730, IC-746, IC-9100, IC-706 (all models), and the IC-703. It is available pre-assembled and as a kit.

Manufacturer: SOTABEAMS, Unit 1, The Green, Fountain St. Macclesfield, SK10 1JN, United Kingdom. Sold in the United States by DX Engineering, **www.dxengineering.com**. Price: $27.95 built and tested; $15.95 kit.

Joel R. Hallas, W1ZR, w1zr@arrl.org

The Doctor is In

The ½-Wave Transformer May Be Just the Right Length

Q Ed, KD7TUN, and Darrel, AA7FV, both asked why I always turn to the ¼ transmission-line transformer to match different coax impedances, when the ½-wavelength transformer is often easier to make and use.

A My excuse is that it is easy to fall into familiar patterns, especially if they work. I am glad you reminded me of the ½-wave transformer, since it has real-world advantages compared to the quarter-wave transformer.[1] The ½-wave transformer (see Figure 1) uses two lengths of transmission line, each approximately ½ electrical wavelengths long.

In my mind, the big advantage of the ½-wave transformer is that the transforming lines are the same two impedances as those being matched, thus the line is available. This is in contrast to the quarter-wave transformer, as it often needs unavailable impedance line, such as the 61 Ω line needed to match 75 Ω to 50 Ω.

One disadvantage is that the ½ wavelength is not an exact length, but varies a bit depending on the ratio of impedances. The length is exactly ½ (0.083), only if the ratio of impedances is 1:1 — not a very interesting case, but it doesn't change much. For example, for a ratio of 1.5:1(such as to match 75 Ω to 50 Ω) the length is 0.0815 wavelengths and for 2:1 (such as to match 25 Ω to 50 Ω), it shortens to 0.078 wavelengths. A graph of the change is shown in Figure 2. The bandwidth is wide enough (see Figure 3), so it probably doesn't matter for most cases.

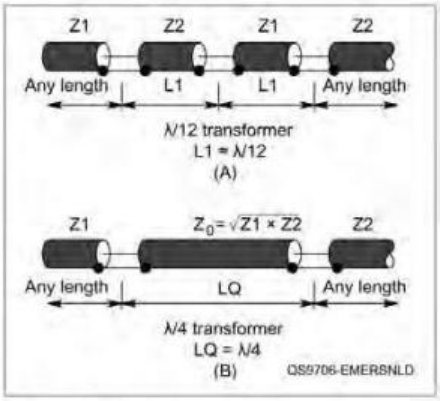


Figure 1 — Comparison of the ½-wave transmission-line transformer (A) to the more common quarter-wave version (B). Note that the ½ wave uses the same kind of coax that is being matched.

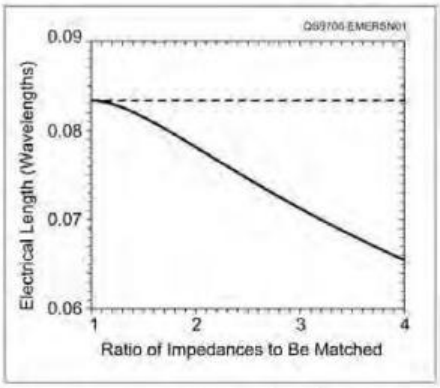


Figure 2 — Actual length of the ½-wave matching sections as a function of transformation ratio. The lengths are exactly ½ (0.083), only if the impedances are the same.

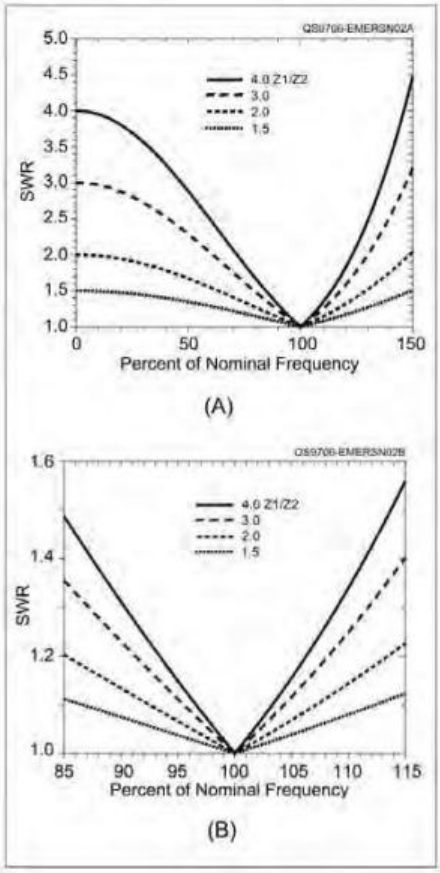


Figure 3 — The bandwidth of the ½-wavelength transformer. (A) shows the resulting SWR from frequencies from dc to 1.5 times the design frequency. For resistive impedance ratios of 1.5, 1.0, 3.0, and 4.0, (B) provides a closer look in the region within ±15% of the design frequency.

The other disadvantage is that two extra coax splices are required. For the case in which a quarter-wave transformer works with standard coax — such as matching a full-wave loop (110 Ω) to 50 Ω coax with a quarter wave of 75 Ω coax — that makes more sense. In other cases, usually two (or more) parallel cables are required to make the odd impedance, so it is about the same.

Q Marshall, KB4DX, asks: I am in the process of constructing a homebrew 10-, 15-, and 20-meter tri-band quad antenna. There is, of course, suitable antenna wire obtainable online, but hard-drawn or multi-strand copper wire is expensive. On the other hand, #14 or #12 AWG insulated wire can often be found at a lower cost from various local sources. I

have heard that there is a velocity factor that one must make allowance for if using insulated wire for an antenna. The few comments I could find online say that insulated wire must be cut 1 – 2% shorter than you would for bare wire, but none of them quote a credible source for that data, nor do they say if there is any difference caused by the varieties of insulation used. Can you shed some light on this?

A There is no question that insulated wire can work just fine as an antenna material. There are a number of potential issues, none of which need to be showstoppers if you take them into account.

- Soft copper wire, even insulated copper wire, will stretch. I would think that this would not be problematic in a quad because the lengths are relatively short and there is little stress, especially if you can anchor the feed point to the structure. It can, however, be a major problem with HF dipoles, especially long ones (80- and 40-meter half waves, for example) with coax hanging from the center. People find the antenna sagging and the tuning moving down the band. Eventually, of course, it will break.

- Yes, the dielectric constant and thickness of the insulation act to slow the wave on the surface, making the antenna seem too long. It usually amounts to 1 – 2%, with the exact amount depending on the parameters above. If you can determine the insulation thickness (using a micrometer) and material (manufacturer's internet specification sheet, perhaps), you could use *EZNEC* (or a similar antenna modeling program that allows dielectrics to be modeled) to determine the amount of shortening required for your quad.[2] Sometimes house wire will have two types of insulation: a thicker inner insulating layer, and then a thin outer protective jacket. *EZNEC* can only handle one, and the inner thicker one will have the most effect, so I always use the values for that dielectric material.

Another approach would be to make a resonant dipole of the same gauge wire without insulation. Carefully measure its length and then make a dipole of your insulated wire of the exact same length. Hang it in the same place at the same height with the same transmission line, and then measure its frequency of minimum SWR. Either make it the same exact length and see what the new resonant frequency is, or trim it to be resonant at the same frequency and measure the new length. The percentage difference in either case should apply to your quad elements as well.

Q **Doug, N8VY, asks: I have assumed that listening to my various antennas for best reception would tell me which antenna will be best for transmission. Is that always the case?**

A Well, reception is often a good measure of antenna transmission capability, with one caveat; The best reception usually implies the best receive signal-to-noise ratio (S/N), and the noise on each antenna may be different, making the results inconclusive. Also, some lower-frequency antennas designed for reception are very inefficient, but provide a better receive S/N ratio than many efficient antennas of the type used for transmission. Thus, a stronger receive signal may actually not sound better than a weaker signal with less noise.

I would revise the criterion to be that the antenna with the strongest receive signal is likely to be the best for transmission to the other station. Thus, rather than listening to the sound, look at the S-meter. You will often, but not always, come to the same conclusion.

Jim Kocsis, WA9PYH, dropped me a note pointing me to his article, "A Coax Bulkhead for Any Weather" from the November 2008 issue of QST, *in which he described his coax entrance panel.[3] That article was the basis for the entrance panel and pull-off connectors that I've been using for years.*

Jim notes that there is a problem with using a single bulkhead when winter temperatures go well below freezing. He said:

> *The feed through eventually reaches the same temperature as the outside air. This causes any humidity inside the house to condense on the coax fittings inside which, if cold enough, will form ice. When the temperatures moderate, the ice melts and gets inside the connector. During a really cold spell here in Indiana, I had ice ¼-inch thick all around the bulkhead connectors. To make matters worse, we had thunder snow and I couldn't disconnect the connectors to protect my station from a lightning hit. Luckily, no lightning hit nearby!*
>
> *I described a solution to this situation in my* QST *article. It's a bit more work than a simple bulkhead. It requires an additional bulkhead and two more PL-259 coax plugs for each coax line. A few winters ago, we had several days of below –10 °F temperatures and I had no ice form on my bulkhead. See my article for the details.*

Notes

[1]D. Emerson, AA7FV, "Try a Twelfth-Wave Transformer," *QST*, Jun. 1997, pp. 43 – 44.
[2]Several versions of *EZNEC* antenna modeling software are available from developer Roy Lewallen, W7EL, at **www.eznec.com**.
[3]J. Kocsis, WA9PYH, "Coax Bulkhead for Any Weather," *QST*, Nov. 2008, pp. 40 – 42.

Do you have a question? Ask the Doctor! Send your questions to "The Doctor," ARRL, 225 Main St., Newington, CT 06111, or e-mail your question to: **doctor@arrl.org**.

Also listen to the "ARRL The Doctor is In" podcast, sponsored by DX Engineering, on iTunes, Blubrry, Stitcher, or on the ARRL website at **www.arrl.org/doctor**.

Hints & Hacks

Organization Under the Radio Desk, LED Flashlight Modification, and More

Under-the-Desk Organization

I recently acquired another PC. I already had several other PCs under my radio desk — one for my primary PC work, one for APRS, RTTY, SSTV, JT65, and so on, and a third to experiment with. In Figure 1, you can see my current under-the-desk setup, made up of a 35 A power supply and the four Dell PCs (arranged from newest *Windows 10* to oldest *XP*), plus a beefy UPS to keep things running until they can be shut down properly.

The issue was figuring out a way to squeeze yet another PC under the desk with all my electronics, and the inevitable spaghetti bowl of wires that follows every PC installation — ac power, speaker out, mic in, Cat 5 ethernet, USB devices of all kinds, and even an old parallel-port printer. It's not easy to try and swap out anything behind that wall of electronics. I knew I needed something to help me access these areas quickly and with little fuss.

Now, all the equipment is sitting on top of a ¾-inch piece of plywood. That plywood pedestal is resting on a furniture dolly. This way, I can easily roll out the entire equipment complement for easy maintenance. The key to this working well is to allow enough slack in each of the various lines so that all the lines pivot from one side or the other in a smooth arc when swinging out the platform. Also, it helps to have a pretty good KVM (keyboard-, video-, mouse-sharing) device. I opted to have three of the PCs share peripherals, while the fourth is my ham radio PC and has its own set of peripherals (see Figure 2).

Figure 2 — A closeup of the pedestal swung out to the left, giving access to the backplane of all the equipment. [Dennis Merritt, W6UHQ, photo]

While equipment maintenance always comes with some level of stress, with this pedestal on a furniture dolly, access to the backplanes has become simple. And the price was right. The plywood was scrap, about 2 by 4 feet on the Harbor Freight dolly, which cost about $20. The KVM switch cost around $40, and was well worth it. — *73, Dennis Merritt, W6UHQ,* **demerit@comcast.net**

Figure 1 — The view under the author's radio desk, showing his PCs, 35 A power supply, and UPS on a plywood plank sitting on a furniture dolly. [Dennis Merritt, W6UHQ, photo]

Transformer Covers from IKEA Toothbrush Holders

There is a segment of audio enthusiasts who prefer the harmonic richness of vacuum-tube amplifiers over that of statistically superior solid-state amplifiers. The simple circuitry is popular with audio homebrewers who often like to display the tubes and transformers on an uncovered chassis. However, less expensive audio output transformers are not particularly display-worthy and are typically hidden under transformer covers. The problem is that these covers can cost as much or more than the transformers they are hiding.

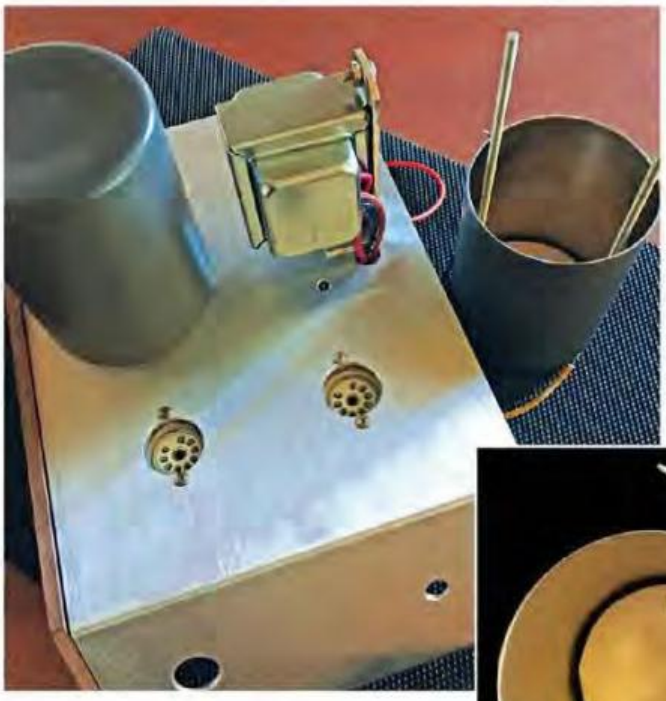


Figure 3 — Transformer covers fashioned from IKEA toothbrush holders. [Barry Shackleford, W6YE, photo]

Figure 4 — A cemented plywood disc with threaded brass inserts provides a mounting means. [Barry Shackleford, W6YE, photo]

The homebrew solution, of course, is to find an alternative item and repurpose it (i.e., "hack" it) to fit the new application. I found that IKEA's unpronounceable MJÖSA stainless-steel toothbrush holders (**www.ikea.com/us/en/catalog/products/90284952/**) make workable transformer covers. At $4.99 each, the price is hard to beat. The problem I faced was figuring out how to attach them to the chassis (see Figure 3).

My somewhat over-engineered solution was to put two threaded brass inserts into a plywood disc and cement it to the bottom of the holder with construction adhesive (see Figure 4). Threaded rods screw into the inserts and the assembly is pulled tight to the chassis by nuts underneath. Next time, I think I will simply use epoxy to fix either two decapitated screws or two threaded spacers to the inside lip of the holder. If you use this simpler method, take care not to over-tighten the chassis connection, which may cause the epoxy bond to shear. — *73, Barry Shackleford, W6YE,* **w6ye@arrl.net**

Small Call Sign Pin

The October 2017 "Hints & Hacks" column featured an item about Jay McClellan's, K8DC, circuit board badges and reminded me of something I did 10 years ago. Figure 5 shows the pin I made for myself. I put dry-transfer letters on a piece of brass strip from the local craft store as resist before etching. A salvaged pinback was soldered on and the etched area was filled with enamel, followed by a clear coat. A razor blade drawn across the face keeps the letters clear after enamel application. If you try this yourself, remember to solder the pinback before enamel, and to keep it level while the enamel dries. — *73, Phil Minch, K6MUG,* **ki4mug@gmail.com**

Figure 5 — A simple pin is an easy way to display your call sign. [Phil Minch, K6MUG, photo]

Diagnosing Problems with Sound-Card-to-Radio Connections

When I was in college, I worked at a stereo equipment repair shop. One of our most useful tools was a "signal tracer," which was simply an audio amplifier with a probe. With this tool, I could determine where in the audio signal path the signal disappeared and isolate the problem.

More recently, Rick Hall, K5GZR, and I were helping our mutual friend, Mike Davidson, N5MT, diagnose and fix a problem with his radio and an external sound card device. It occurred to me that a signal tracer would be the right tool to get to the bottom of the problem.

I didn't own one, but I did have a battery-powered audio amplifier, meant to be used with a portable music device. The audio amplifier has a ⅛-inch phone plug as its input. Different amplifiers may have different connectors, but the ⅛-inch phone plug is common. If you get a ⅛-inch phone socket, you will be able to con-

Figure 6 — The battery-powered audio amplifier, with mini grabbers for troubleshooting. [Bill Pellerin, KE5XV, photo]

nect probes or wires to the tabs on the socket (either permanently or temporarily). Figure 6 shows a pair of mini grabbers connected to the socket — black to ground and red to either of the stereo (in this case) channels.

From then on, diagnosing the problem consists of seeing where signals are present and where they are not present. If you pick an audio mode in your software (RTTY, PSK31, or any of the JT tune modes) and put that software in transmit (or tune) mode, there should be audio on the connector that connects to the radio (usually a DIN plug of some sort). If there's no audio, the problem could be in the configuration of the interface or in the setup of the software and sound card settings in the computer. If you hear the signal on your computer's speaker, it's because the software is configured to send the audio to the internal sound card and not the external one.

Likewise, you can check for audio out of the radio. Almost always in modern radios, the **DATA** port on the back of the radio provides a fixed level of audio output. Your homebrew signal tracer can amplify that signal if present and you should hear it.

If you are not using an external sound card, you can still use this approach to isolate the problem to the computer, the software setup, the connection from the computer to the radio, or the radio settings. Be sure the setting on the radio is such that it receives the audio from the back-panel **DATA** connector and not from the microphone. — *73, Bill Pellerin KE5XV,* **ke5xv@arrl.net**

Modifying a 27-LED Flashlight

I love the 27-LED flashlights sold by Harbor Freight (**https://www.harborfreight.com**). But I don't like that the flashlight alternates between the 3 LED and 24 LED modes (off, 3 LED, off, 24 LED), because it is never ready for the mode I happen to want at any given time. To fix this, I came up with a simple modification to make the flashlight turn on all LEDs at the same time. Here's how you can modify a similar flashlight yourself.

Figure 7 — The disassembled flashlight, ready for modification. [Joe Birsa, N3TTE, photo]

Figure 8 — The LED must be gently pried up in order to jumper from the LED/switch terminal to the other switch terminal using a small soldering iron. [Joe Birsa, N3TTE, photo]

Remove the back by unscrewing the three screws and take out the batteries. Then, disassemble the flashlight by unscrewing the four screws at the corners of the flashlight (see Figure 7). At this point, notice that the **ON/OFF** switch has two terminals on one side and one terminal on the other side. To modify the flashlight, we want to short the two terminals on the underside of the circuit board.

Carefully turn the circuit board over. Note where the switch terminals will be shorted. Gently pry up the end LED (see Figure 8). Tin a piece of bare wire (I used 20-gauge wire from a craft store) and jumper from the LED/switch terminal to the other switch terminal using a small soldering iron. I soldered the end of a long piece to the LED first, then cut it off and soldered the small terminal.

At this point, put the batteries in and verify the operation is off, then all LEDs on. It may be necessary to resolder the small terminal if the solder didn't take at first. When it works as intended, reassemble in reverse order.

It's worth noting that I always use a hot soldering iron with the temperature set for lead-free solder whenever I modify a circuit board. Also, it may be necessary to unsolder a wire between the batteries and the circuit board to flip the circuit board. Unsolder the wire at the circuit board. — *73, Joe Birsa, N3TTE,* **jjbirsa@yahoo.com**

"Hints and Hacks" items have not been tested by *QST* or ARRL unless otherwise stated. Although we can't guarantee that a given hint will work for your situation, we make every effort to screen out harmful information. Send technical questions directly to the hint's author.

QST invites you to share your hints with fellow hams. Send them to "Attn: Hints and Hacks" at ARRL Headquarters, 225 Main St., Newington, CT 06111, or via e-mail to **hh@arrl.org**. Please include your name, call sign, complete mailing address, daytime telephone number, and e-mail address on all correspondence. Whether you are praising or criticizing an item, please send the author(s) a copy of your comments.

Steve Ford, WB8IMY, wb8imy@arrl.org

Eclectic Technology

Antenna Reporting with *WSJT-X*

Sometimes it seems as though the *WSJT-X* software suite has taken over the HF digital world, and much of VHF as well. If you want to work FT8, JT9, WSPR, or MSK144, no other software will do. And while there are other programs for JT65, *WSJT-X* is now the leader for that mode as well. *WSJT-X* is free to download at **https://physics.princeton.edu/pulsar/k1jt/wsjtx.html** and there are versions for *Windows*, *MacOS*, and *Linux*.

Many of us enjoy using the various *WSJT-X* operating modes as a means of testing our antenna systems, or exploring the mysteries of propagation. One of my favorite ways of doing this is through a website known as *PSKReporter*. PSKReporter continuously collects reception reports on a variety of modes from stations throughout the world. It makes the information available in several forms, but many enjoy the map display (**www.pskreporter.info/pskmap.html**) in particular.

If you've enabled PSKReporter uploading in *WSJT-X*, as I urge you to do, your computer will automatically send your reception reports for others to view. This is a terrific crowd-sourced system and I'm grateful to Philip Gladstone, N1DQ, for making it available, but the signal reports are of greatest value when they include antenna information.

Tell Us About Your Antennas

PSKReporter will display a station's antenna information along with the signal report, but only if the user adds these details to *WSJT-X*. Many operators do not, and I'm guessing that this is due to a lack of knowledge of how to go about it. See the sidebar, "How to Add Antenna Information to *WSJT-X*," for some simple instructions.

Once you have this set up, each time your computer uploads reception reports to PSKReporter, the reports will include your antenna information. As you'll see in Figure 2, about 36 minutes before the image was captured, AJ6T received my FT8 signal on 12 meters at a strong –1 dB. I see that he has a SteppIR Yagi antenna at his station and, based on this report, I'll guess that it is pointed in my direction. If there was a station close to AJ6T that was also reporting antenna information, I might be able to make a worthwhile comparison.

The next time you are on the air with *WSJT-X*, take just a few minutes to add this valuable information to your automatic reports. Your fellow amateurs will thank you!

How to Add Antenna Information to *WSJT-X*

Step 1: Click **FILE** in the upper left corner of the *WSJT-X* application, and then click **SETTINGS**.

Step 2: Click the **FREQUENCIES** tab.

Step 3: In the **STATION INFORMATION** section at the bottom, *right click* your mouse cursor and you will be asked to **DELETE** or **INSERT**. Click **INSERT** and you can type in your antenna information for the band of your choice. If you use different antennas for different bands, *WSJT-X* lets you separate these details for each band (see Figure 1).

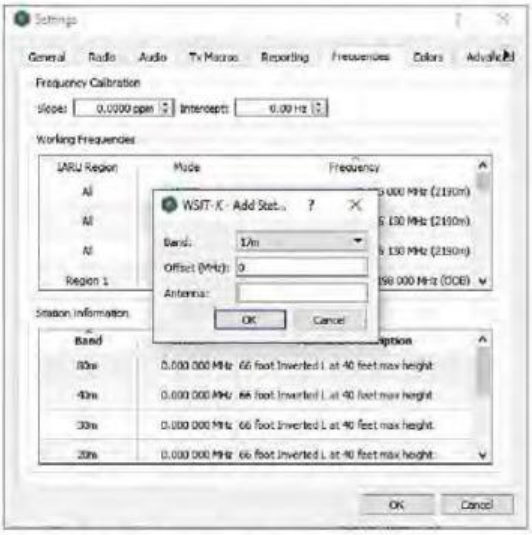


Figure 1 — In the **SETTINGS** menu, click the **FREQUENCIES** tab and find the **STATION INFORMATION** section. This is where you enter your antenna information (see text).

Figure 2 — PSKReporter showing reports of my FT8 transmissions on 12 meters. Notice that AJ6T has given my 20 W signal a nice –1 dB report (his report is visible in the lower left corner), but also notice that his report includes the fact that he is using a SteppIR Yagi antenna.

THE CIA, THE COLD WAR, AND AMATEUR RADIO

During the decades of the Cold War between the US and the USSR, both sides viewed Amateur Radio as a potential strategic asset. Declassified documents now available online in the Central Intelligence Agency (CIA) Freedom of Information Act (FOIA) Electronic Reading Room include excerpted translations of articles in East Bloc Amateur Radio magazines, as well as assessments of clubs, groups, technical training, and activity — even station equipment information derived from QSL cards — offering fresh insight into how Amateur Radio was used and perceived on both sides of the Iron Curtain.

Rick Lindquist, WW1ME

Released as part of the FOIA requirements on federal agencies, the declassified documents were only available previously in a closed system at the US National Archives. They relate readily available information in the form of excerpted translations of articles in East Bloc Amateur Radio magazines, as well as assessments of Amateur Radio clubs, groups, technical training, and activity — even station equipment information derived from QSL cards of the day.

Many of the often-redacted and otherwise "sanitized" PDFs appear to be scanned copies of copies of copies, and can be difficult to decipher. Amateur Radio is not the sole topic, although a search on "Amateur Radio" will yield many hits. Individual documents are not searchable, unfortunately.

East vs. West

The CIA kept tabs on random Amateur Radio activities in general, and on those in the Soviet Bloc in particular. Various documents reveal the dichotomy between the US's largely leisure pursuit of Amateur Radio and The USSR's far more institutionalized version. Amateur Radio behind the Iron Curtain was viewed as a patriotic pursuit, with radio amateurs as servants of the state, although not without a certain degree of prestige, because hams were in touch with — or at least listened to broadcasts from — the outside world.

The archive contents reveal how Soviet Bloc governments during the Cold War strictly controlled ham radio and attempted to "collectivize" it in the service of the state, as a means of enhancing the technological expertise of young people; indeed all "radio amateurs" belonged to clubs, and not all of these were hams, per se, but lay technologists.

Individual Amateur Radio stations did not come into being in the USSR until the mid-to-late 1950s, when the advantages of this approach to the state became clear. Ham radio gear in the Soviet Bloc was typically home built, although components were scarce. More on this later.

Western hams of that era were far more likely to concern themselves with the latest offerings from National, Hallicrafters, or Collins, recent exotic DX heard and worked, and occasionally, how to comply with the myriad of FCC rules back then.

"The archive contents reveal how Soviet Bloc governments during the Cold War strictly controlled ham radio and attempted to 'collectivize' it in the service of the state."

Exploring Amateur Radio as an "Asset"

The CIA at least considered the possibility that Amateur Radio could be co-opted as an information-gathering asset. The author of a once-secret 1948 memorandum, "Responsibility for Detecting those Activities of Licensed U.S. Amateur Radio Stations which are of Interest to U.S. Communication Intelligence Authorities," mulled the monitoring of licensed operators and of "clandestine transmissions," either for internal security or law enforcement reasons, or for foreign intelligence collection.

"In all probability, the foreign intelligence content is virtually negligible," the author concluded.

A 1949 memorandum discussed recruiting radio amateurs from among German nationals legally licensed to operate in the US Zone, "who could be of use in the period immediately following an outbreak of hostilities."

A 1954 CIA report pointed out that Soviet DXers had become accustomed to communicating in English through contesting, which, it said, hams universally regarded as "a giant, king-size game [sic] which definitely separates the men from the boys." The report cited [redacted] who "never heard any additional conversational comments or remarks of possible intelligence value."

A 1949 CIA memorandum, "Exploitation of Radio Amateurs," asserted:

> Except for possibilities in the counterespionage field, it is believed that exploitation of amateurs with reference to the USSR and satellites could lead at best only to information concerning the location of ham transmitters, an item of dubious intelligence value.

A few years later, in 1955, a CIA report of "unevaluated information" noted that the East German government had ordered systematic interception of "all radio traffic from West German radio amateurs," with special attention paid "to those messages in which the amateurs reveal the construction of their station and exchange technical advice." The order called for recording these communications and sending the tapes regularly to the government.

Although no reason for the order was given, "it is believed that the technical experiences of the West German amateurs and their technical possibilities are to be systematically exploited." A heavily redacted 1953 information report indicated that only members of the Socialist Union

Party-controlled Society for Sports and Technology could apply for a ham ticket in East Germany, "after appropriate recommendations have been made."

Regulation and Control

Wireless in general was arguably under the tightest control in East Germany (the German Democratic Republic). A report from 1953 provided information "regarding telecommunications, radio monitoring, and high-frequency installations," saying:

> The monitoring is carried out under great difficulties, because on the one hand, the installation is required to locate illegal transmitters or to observe a certain frequency, whereas on the other hand, it is forbidden to do direction finding. The monitoring installation is therefore forced to do direction finding illegally.

In this vein, secret information in a 1953 report said that, while there were no restrictions on purchasing a radio in Czechoslovakia, "group listening, as well as spreading what one heard, was forbidden and regarded as 'anti-state activity.'" An offender could get 3 years in the Czech slammer. Hams and even shortwave listeners (SWLs) were required to report unregistered transmitters to the Ministry of Posts in Prague.

A darker paragraph in the same document recounted that when a ham's call sign was "changed or abolished," the Ministry of Posts notified the rest of the amateur community. The Ministry of Posts could terminate a license, however. "In the few instances when this happened…reasons were never given; the person in question simply 'discontinued radio amateur transmissions.'" The deleted call sign was never reassigned.

Additionally, "[I]t was made clear to all operators that information on political affairs, locations of industrial installations, and other related classified matters would not be broadcast," the assessment said.

Sovietization

Another document recounted the gist of the editorial in the January 1953 issue of *The Radio Amateur* in Czechoslovakia, which "in typically Communist presentation" lamented "The Slow Progress of the Sovietization of Czechoslovak Amateur Radio."

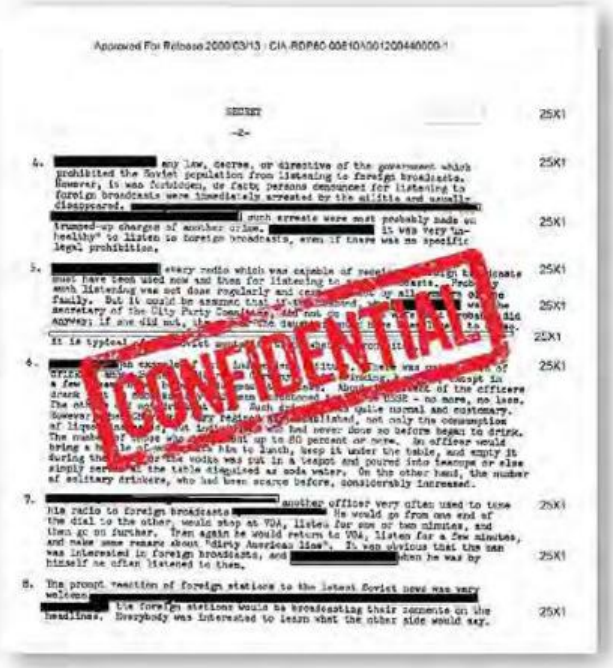
The reporter cited the editorial's effort to zero in on the problem. "One of our greatest faults was our inability to arouse interest in collective amateur work among those who are either active hams or interested in Amateur Radio," the editorial said. "There still are among us too many hams who do not comprehend the political aims of collective ham work and who do not lend aid in the fulfillment of these aims." The editorial touched upon a renewed effort to organize clubs and to train special communications groups of radio amateurs and concluded:

> The main purpose of all radio training will be the creation of politically and technically reliable cadres, which will aid our army, our industries, and other branches of our activities through which we are building up our socialist system and the defense of world peace.

Ham radio was serious business in the Soviet Bloc.

Similar sentiments appear in other documents, including assessments of radio-related activity in the USSR, where Amateur Radio came under the aegis of the paramilitary Volunteer Society for Cooperation with the Army, Aviation, and Fleet (DOSAAF), which reported directly to the Central Committee of the Communist Party.

The same report included a page of Morse code abbreviations that Soviet hams were using "in addition to the usual Q codes." A majority of these, the report noted, are abbreviated Russian words and expressions. Soviet hams also employed "Z Codes" — AFB for "strong fading," and ZMO for "wait a while," for example.



A "confidential" 1953 report referred to the same article, and acknowledged, "Since these abbreviations are completely different from those used so far in international amateur communications, they may be of use in monitoring Soviet hams' international traffic, as well as contacts with hams in the Iron Curtain countries."

A 1952 "restricted" document of information gleaned from "foreign documents or radio broadcasts" notes "the great success" of radio amateurs in Bulgaria who constructed a station at the Central Radio Club in Sofia:

> Thus, Bulgarian Amateur Radio operators maintain uninterrupted radio communication with ones in the Soviet Union and the People's Democracies, with whom they exchange expertise in radio communications.

It also noted that Bulgarian hams were doing their utmost to prepare for a radiotelegraphy competition and exhibition of radio equipment.

Radio Amateurism and Radiofication

One topic that comes up in a radio connection in these archived documents is something called "radiofication." In part, this involved the deployment of wired loudspeakers or receivers throughout a community, often in lieu of over-the-air receiving devices in each residence, although radios were also part of the plan. Radio amateurs were often drafted to carry out this work, in the service of advancing communist ideology through the diffusion of communication technology. The report mentioned above from sources in Bulgaria noted that a particular factory was mass producing several types of radio amplifiers, including a 40 kW amplifier for Sofia. "After the amplifier is assembled, the capital will be radiofied almost 100 percent," the report said, citing its source. That may be an understatement.

"Radiofication, in part, involved the deployment of wired loudspeakers or receivers throughout a community often in lieu of over-the-air receiving devices in each residence, although radios were also part of the plan. Radio amateurs were often drafted to carry out this work, in the service of advancing communist ideology through the diffusion of communication technology."

A 1950 "confidential" report cited a USSR *Radio* magazine editorial by Col. Gen. V.I. Kuznetsov, a decorated Soviet hero, that promoted the development of "radio amateurism." The colonel said it's evident that young people have a great desire to know about radio techniques. "We must aid in organizing clubs in every school and educational institution," he said. "Participation in the radiofication of our *kolkhoz* [collective farm] villages is one of the most important tasks before our radio clubs and all our radio amateurs."

Another *Radio* excerpt from 1950 said, "There is growing evidence of the fulfillment of Lenin's prophecy of complete radiofication of the country." The report continued:

> Young people are making great contributions to the radiofication of villages. In the RSFSR [Russian Soviet Federative Socialist Republic] and the Ukraine, Latvia and Estonia, Armenia, and Georgia — everywhere, new cadres of young enthusiasts, who will comprise the radio engineering experts of the future, are growing in numbers. The Soviet government gives these youngsters every opportunity to pursue their ambitions in this field.

A 1952 report derived from Russian documents or broadcasts outlined the "progress of radiofication" in the USSR, with 556,000 wired speakers in Moscow Oblast reported and just four radio receivers. In Smolensk Oblast, the report said, "Radio amateurs have installed around 1,400 vacuum-tube receivers [and] 20,000 crystal sets." (The grid may have been unreliable.)

P.O. Box 88, Moscow

A 1950 report cited a *Radio* magazine essay from the USSR, "Improving the Work of the Central Radio Club." The account characterized the founding of the Central Radio Club in Moscow as "another manifestation of the care of the party and state for the development of a mass radio amateur movement in our country." The report continued, "The club must become a model for all others. [I]t must procure quality equipment…and build a powerful, collective short-wave station for radio amateurs."

And later, "The doors should be thrown open to young people interested in short waves, receiver construction, television, and many other branches of radio engineering."

Other such reports reveal problems in manufacturing and obtaining quality parts for radio equipment. A CIA report of "unevaluated information" from Czechoslovakia noted the difficulty in procuring "condensers" (as capacitors were commonly called in that era) and resistors and quality new parts. The report said hams were kept busy repairing radios for their friends, "because repairs done at the nationalized shops are much worse in quality."

The CIA, in a confidential report that cited the USSR's *Radio* magazine, detailed the problem of manufacturing "reliable interstage and output transformers" for a particular receiver. Perhaps to highlight the state of the electronics industry in the great Soviet empire, this excerpt cited radio amateur A. Prokepenko, who said:

> It is impossible to repair these transformers, because they are wound without cores and impregnated with a resin compound. As we all know, there are no spare transformers on sale, and consequently damaged transformers cannot be replaced.

He continued:

> It seems to me that it should be possible to construct more durable transformers or at least to place the windings on a core and not impregnate them with resin, so that a radio amateur could rewind them.

So not only did residents of the satellite countries have to rely on hams to repair their radio sets, so did the citizens of Mother Russia.

Lifting the Ban

A somewhat redacted information report from May 1954 discussed the confirmation of a "grapevine rumor" regarding the lifting of restrictions by the USSR on long-distance radio and radiotelephone communication by Soviet hams with those in the Western World, particularly the US. It allowed, "DXers throughout the world have a strong common bond of technical interest and *personality characteristics* [emphasis added]."

"The reported relaxation of the Soviet ban on DX communication with the US in the near future may also, of course, have some military training or even intelligence significance," the report continued. It noted the "well-known fact" that the military services were Amateur Radio's best friend.

The report speculated:

> Were it not for their recognition of the wartime (auxiliary communication net) and peacetime (training and technical development) importance of "hams," the frequencies assigned for amateur use would long ago have been taken away by the governmental communication agencies, responding to pressure exerted through Congress by commercial communications companies who would like to have the amateur frequencies themselves.
>
> Therefore [redacted], if the Soviet military services are involved in the lifting of the ban, perhaps wishing to further develop the same type of benefits believed desirable by the US military services.

There's much more on Amateur Radio and related topics — including international broadcasting during the Cold War — in the CIA Reading Room. Those with an eye to Amateur Radio history will find many of them fascinating, too. You'll find the archive on the CIA's website at **https://www.cia.gov/library/readingroom/**.

ARRL News Editor Rick Lindquist, WW1ME, lives in Down East Maine and has been a radio amateur for nearly 60 years. He enjoys CW, contesting, vintage clocks, and photography. Rick is also managing editor of *National Contest Journal* (*NCJ*).

For updates to this article, see the QST Feedback page at www.arrl.org/feedback.

The Future of AMSAT: A Discussion with Joe Spier, K6WAO

The new president of AMSAT-NA addresses the current state of amateur satellites, and their future.

Steve Ford, WB8IMY

In October 2017, Joe Spier, K6WAO, became president of the Radio Amateur Satellite Corporation of North America, better known as AMSAT-NA.

Amateur satellites date to the dawn of the Space Age and, thanks to AMSAT, there are more Amateur Radio satellites in orbit than ever before. At the time of this writing, the most recent satellite to take to the skies was AMSAT-OSCAR 91, a miniature CubeSat that includes among its functions an FM repeater with an uplink on 435.250 MHz (67.0 Hz CTCSS) and a downlink on 145.960 MHz.

Last November, I had an opportunity to ask the new AMSAT-NA president a few questions.

Joe, tell me about your Amateur Radio career and what brought you to satellite operating.

I guess my amateur career started professionally. Many years ago, I was an avionics radio Airman in the US Air Force — nothing like airborne mobile HF DX! Professionally, everything just kept coming up radio, starting with VHF/UHF systems and progressing to telemetry and digital microwave data. So, about 20 years ago, I decided to get my amateur license.

My wife's family is into Amateur Radio mostly due to my brother-in-law, Bob Ludtke, K9MWM. Bob likes contesting, DX, repeaters, and satellites. In addition to Bob, both my father and mother-in-law, sister-in-law, niece, and nephew are hams. I felt more than a little pressure to get with the program because I'm supposed to be the radio guy!

I passed my Technician exam and, because my wife prepared me so well, she also decided to take the test and passed on the same day. This led to the purchase of handheld transceivers, followed by plenty of activity while skiing at Christmas, and a volunteer career with Placer County (California) Search and Rescue and the Mountain Rescue team. Somewhere along the line I upgraded to Amateur Extra.

I noticed Bob had some AMSAT stickers, and always seemed to have cool toys to communicate with satellites, so I started asking questions. I have always had an interest in space since the Apollo moon landings (all my heroes are named Buzz), and with AMSAT-NA participating with Amateur Radio on the International Space Station (ARISS), I saw ham satellites as a good match for me.

After a few years of investigation, I heard that AMSAT-NA was going to have a symposium in San Jose, California, so I went with the intention of joining and helping build satellites. But before I showed up, I felt that I had to make a quick first satellite contact, which I did with a low-elevation pass off my vertical dual-band base station antenna on AMSAT-OSCAR 51.

Barry Baines, WD4ASW, gave a presentation on AMSAT's needs at the time and the main need was in educational relations, not engineering. Having some training in teaching adults, that's the area where I volunteered. Since then, working with AMSAT-NA has been great fun. I still can't believe I get to do what I do!

What is your vision for the future of AMSAT-NA, and amateur satellites in general?

Let's start with amateur satellites in general. The compactness of CubeSats has created the ability to scale satellites from 1/8U and smaller up to 12U. [*CubeSats are designed in standard dimensional units of 10 × 10 × 10 centimeters known as "Us." A satellite can be 1U, 2U, 3U, and so forth, or fractions of a U.* — Ed.] Being able to design circuit boards into a 1U space frame provides a quantum leap in functionality. And although they are pricey, we are starting to see Reaction Control Modules (RCMs) for propulsion up to 1U in size.

AMSAT-OSCAR 91 is a CubeSat that includes an FM repeater with an uplink on 435.250 MHz (67.0 Hz CTCSS) and a downlink on 145.960 MHz.

New Satellites in 2018 and Beyond

- Fox-1D will carry several university experiments and a crossband FM repeater with an uplink at 435.350 MHz (67.0 CTCSS) and a downlink at 145.880 MHz. This satellite will also have the ability to switch to an uplink at 1267.350 MHz on command.
- Fox-1Cliff will be similar to Fox1-D and will also offer the ability to receive in the 1.2 GHz band.
- Fox-1E will carry a linear transponder to support CW and SSB contacts, along with a 1,200 bps digital telemetry beacon.
- GOLF-T and GOLF-1 are CubeSats that will travel in much higher orbits, allowing amateurs to enjoy longer contacts with more areas of the globe.

What challenges do you see on the horizon for the amateur satellite community?

In a word: *access.* Access to space is expensive. NASA's CubeSat Launch Initiative-sponsored flights have a $300,000 cap and have become increasingly competitive. We're not only in competition with universities, but also with commercial and military interests. Add the fact that access to radio spectrum is constantly under pressure from earthly commercial vendors, especially in the 5 GHz range. This is where AMSAT's partnerships with the ARRL and IARU really come into direct focus.

Access to knowledge is also a challenge. Most amateurs think that working a satellite is hard to do, so they tend not to try. While making contact through a satellite is a bit more challenging than working someone through a mountaintop repeater, the satellite is just a crossband repeater that moves across the sky.

Our intention with the Fox series was to create a series of FM satellites that could be used with handheld transceivers. Early testing and reports show that AO-91 does just that. I'd encourage *QST* readers to try it. With a little effort, they may end up being bitten by the satellite bug!

It gets a little more challenging using SSB, CW, or digital, but what band doesn't become more challenging with different modes? For those satellites, perhaps the greatest challenge is getting a radio with the right functionality.

AMSAT-NA also must develop a policy on the International Traffic in Arms Reduction/Export Administration Regulations (ITAR/EAR) to protect and aid our engineering teams. Policy aside, what is really needed is an exclusion for Amateur Radio satellites.

Will we ever see another HEO satellite?

First, let's define *HEO.* HEO, at least in the AMSAT world, is Highly Elliptical Orbit. That is simply an orbit with a high eccentricity, so perigee is low and apogee may or may not be above geostationary height. The high apogee allows the satellite to "see" an enormous portion of our planet.

I do think it's possible for a CubeSat to finally make it to HEO. It's about having the flexibility within the organization to adapt to new opportunities as they present themselves. One AMSAT-NA program is ASCENT (Advanced Satellite Communications and Exploration of New Technology), or as we call it, the AMSAT Skunk Works. Our engineers work on developing technology that may be used on future mission opportunities, including HEO.

Do you think there are prospects for a geostationary amateur satellite?

Yes, I do. AMSAT-NA has a ground-station development team that is working on designs to receive such signals should a geostationary bird become available. In fact, the Phase 4B satellite will have a viability decision made this summer. At some point, a viable ride share will become available and AMSAT needs to be ready for that eventuality.

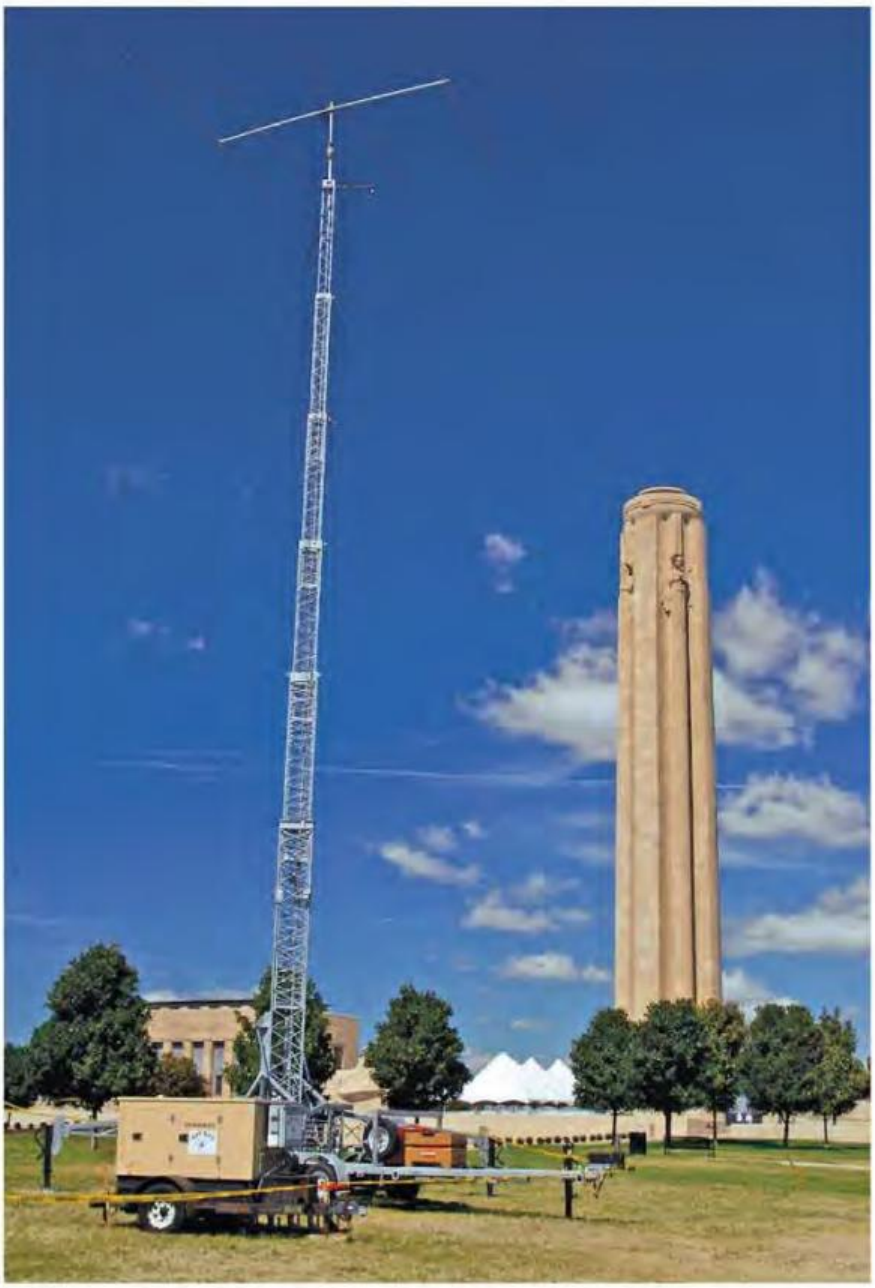
There are also other opportunities. There could be a Phase 5A (lunar) mission, or beyond. Since Amateur Radio is all about experimentation, why not explore? I'm hearing proposals for lunar repeaters, deep space gateways, CubeSat constellations for Mars, and the other planets, and much more. This will require the type of communication knowledge and experimentation in which Amateur Radio excels. Most of these ideas are only on drawing boards, but they are on the drawing boards for the next 10 to 15 years.

Steve Ford, WB8IMY, is the Editor of *QST*. You can contact him at **sford@arrl.org**.

WW1USA: A Series of Truly Special Events

Since June 2014, the WW1USA team has hosted 15 events to commemorate the centennial of World War I.

Randal R. Schulze, KD0HKD



Two different types of towers at the National World War I Museum and Memorial at Kansas City. [Raytown Amateur Radio Club, Inc., photo]

WW1USA is a series of special events (usually three to four each year) that observe the multiyear centennial of the first World War. Both indoor and outdoor events are held at the National World War I Museum and Memorial in Kansas City, hosted by the WW1USA team with assistance from the local Amateur Radio community, who round up operators and gear for event operations.

The team uses the events to commemorate significant points from the Great War, including the Assassination of Archduke Ferdinand (the event that many consider the trigger for World War I); the Christmas Truce; the Battles of Gallipoli, Jutland, and the Somme; the Beginning of War in the Air, and the entry of the United States into the war.

The team has both indoor and outdoor events to take advantage of Kansas City's seasonal weather, and we work closely with the Museum for logistical support. During the indoor events, the Museum provides internet access for operators looking to take advantage of remote-control technology, where the operators are working stations located elsewhere. For the outdoor events, the Museum provides tents. Local ham radio clubs muster radios, towers, and antennas, and set up stations similar to an ARRL Field Day event, while the Raytown Amateur Radio Club offers the use of its 15 kW portable generator to provide electrical power.

The History of WW1USA

The WW1USA Special Events were the brainchild of our friend, Clay Wilson, N0WWI (SK). Clay was a volunteer at the Museum, and was very passionate about history as well as Amateur Radio. In 2013, he presented the Museum's Board of Directors with his idea for an Amateur Radio special event to help commemorate the centennial of World War I. The aim was to bring positive, worldwide attention to the Centennial of the Great War, and to the National World War I Museum and Memorial. The Board agreed to go along with the idea for at least one Amateur Radio special event to see how well it proceeded.

The 80th Division Headquarters wireless station. In charge of Sgt. E.N. Wickliffe, who maintained communications back to corps and Army Headquarters. He received daily press reports from Eiffel Tower, Paris, Berlin, and Rome. First Lieutenant J.P. Ferriter, 80th Division radio officer. Ippecourt Department of Meuse, France. September 15, 1918. [National WWI Museum and Memorial, photo]

Ham Radio Heaven in the Kansas City Metro Area

Within the metro area Kansas City Amateur Radio community, there are about 30 separate Amateur Radio clubs and organizations, and they're all thriving. While many are general-interest clubs, some specialize in various aspects of this great hobby and avocation. Many individual hams are members of more than one of these clubs or organizations, so there's something for everyone.

While the WW1USA core team provides the overall management and direction for these special events, each event is managed and led by one of the individual clubs. And while an individual club might be the sponsor of a particular event, everyone is welcome to participate.

Without the coordinated efforts of these groups, operations would be nearly impossible, as neither the Museum nor the WW1USA team own any radio equipment, antennas, towers, etc. The necessary gear has been provided by Amateur Radio clubs, individual hams, manufacturers, or vendors.

For example, during a 2016 event, we were loaned a tower on wheels from the Ararat Shrine Amateur Radio Club, a generator from the Raytown Amateur Radio Club, two HF radios from Joe Krout, W0PWJ, and a prototype HF amplifier was given to us by Ralph Crumrine, N0KC.

The WW1USA special event series truly is an example of the power of mutual cooperation at its finest!

Hams from several local clubs work together at this indoor operation from February 2016. Seated left to right: Joe Krout, W0PWJ; Bruce Bielby, KD0VMM; Noah Bielby, N0AHB; Charles Vanway, N0CVW; John Morris, N0EI; Bill Gery, KA2FNK, and Herb Fiddick NZ0F. Standing: Rob Underwood, K0RU, and John Raydo, K0IZ. [Raytown Amateur Radio Club, Inc., photo]

The August 2014 outdoor deployment of a WW1USA special event. From left to right we see the communications trailer provided by US Towers on which a SteppIR vertical antenna is mounted, the operations tent with the Liberty Memorial in the background, a large tower on wheels provided by US Towers (background), and the tower on wheels provided by the Ararat Shrine Amateur Radio Club (foreground). [Raytown Amateur Radio Club, Inc., photo]

The first special event, due to its historical anniversary, coincided with 2014 ARRL Field Day. The weekend had many other events, ceremonies, dignitaries, and guests at the Museum to mark the centennial of the World War I. Many of these dignitaries and guests stopped by our operations tent to see what we were doing, and came away better informed about some history and about Amateur Radio. The Museum was so pleased and impressed with the outcome of our special event, they asked that we continue with more events through the next several years as part of the World War I centennial commemoration. Though Clay passed away in 2015, we were pleased he was able to see his vision come to life.

2018 Events: Work Us January 27 – 28

The first of WW1USA's upcoming operating events will be held on January 27 – 28 to commemorate Wilson's "14 Points" speech in January 1918.

The WW1USA team would be happy to gain the assistance and participation of all hams, anywhere! If you can come to Kansas City to operate at one of the special events, we'd love to have you.

For more information on how to participate, check out WW1USA's website (**ww1usa.org**) or Facebook page (**https://www.facebook.com/arcWW1USA**). Any station who makes contact with WW1USA can request a participation certificate or a QSL card.

Other 2018 events include:

- May 12 – 13: Commemorating the Battle of Cantigny
- September 22 – 23: Commemorating the Meuse-Argonne Offensive of World War I
- November 11: Commemorating Armistice Day

The National World War I Museum and Memorial

According to their website, the National World War I Museum and Memorial, located in Kansas City, Missouri, is America's leading institution dedicated to remembering, interpreting, and understanding the Great War and its enduring impact on the global community. The Museum holds the most comprehensive collection of World War I objects and documents in the world and is the second-oldest public Museum dedicated to preserving the objects, history, and experiences of the war.

In fulfilling this mission, the Museum strongly encourages public involvement through engaging events and exhibits. For example, the photographic exhibition *Fields of Battle, Lands of Peace: The Doughboys 1917-1918* is currently traveling the US, telling the story of the "healed scars of the first World War through our only remaining living witness: the fields of battle themselves." Another fascinating exhibit highlights the *Posters as Munitions, 1917*, recognizing wartime posters as the "spreading [form of] national propaganda with unlimited possibilities."

The Museum also offers online exhibits, such as *Home Before the Leaves Fall*, a Google Cultural Institute presentation on the assassination of Archduke Franz Ferdinand, as well as a slideshow of photos from a previous exhibit, *They Shall Not Pass*, which focuses on the pivotal battles of Somme and Verdun.

The Museum further proves its dedication to sharing, remembering, and understanding the Great War in the development of its searchable database of educational resources to aid with lesson plans, assignments, and field trips.

The partnership between WW1USA and the Museum has grown very strong over the past 4 years. Because education and public involvement remains a priority for both the Museum and the WW1USA team, the Museum offers a special discount admission during all of the WW1USA events. Anyone showing an Amateur Radio operator's license, including up to three additional people in their party, will pay only $5 admission. Making this offer even more special is that guided tours of this world-class Museum are provided to groups of Amateur Radio operators and their families.

The National World War I Museum and Memorial is open year-round. For more information about event dates, visit **https://www.theworldwar.org/**.

A Chronology Wall illustrates the World War I timeline, accompanied by photographs, objects, documents of first-person accounts, and short videos. [National WWI Museum and Memorial, photo]

Jamie Charlton, AD0AB, of the Johnson County (Kansas) Radio Amateurs and John Raydo, K0IZ, of Westcliffe, Colorado, lend their talents and support to the operation. [Charles Vanway, N0CVW, photo]

Charles Vanway, N0CVW, and John Raydo, K0IZ, work stations by remote control at the July 2016 indoor event. John's remote station is located on a mountaintop in Colorado. [Herb Fiddick, NF0Z, photo]

WW1USA Statistics 2014 – 2017

- 15 total operations
- Nine indoor, remote operations
- 18,125 total contacts
- 7,750 contacts from remote operations
- Worked All States on SSB and 20 meters
- 11 of 12 Canadian provinces, 64 countries
- Contacts on 12 different bands in five different modes
- Over 250 operators, including those from Kansas City Metro, St. Joseph, Warrensburg, Joplin, Colorado, and Michigan
- Participation has been sponsored by six different local and regional Amateur Radio clubs, including Raytown Amateur Radio Club, Santa Fe Trail Amateur Radio Club, Johnson County Radio Amateurs Club, Ararat Shrine Amateur Radio Club, Warrensburg Area Amateur Radio Club, and Joplin Amateur Radio Club
- Equipment sponsorship from Icom, US Tower, Associated Radio, and KC Web

2017 Events

Over the last year, WW1USA hosted four special events commemorating historical milestones such as the unrestricted German submarine warfare resuming (January 28 – 29), the United States entering the war and declaring war on Germany (April 29 – 30), the Battle of Passchendaele (July 22 – 23), and the US troops beginning combat operations (October 14 – 15).

The October 2017 event was a bit difficult, with severe storms and 40 – 60 MPH winds on the first day of operating. All operations were suspended until after the weather cleared early the next morning. Nothing was damaged, and no one was injured. In spite of losing over 12 hours of operating time, the team was still able to make 473 contacts for the weekend. Sunday provided beautiful weather, which allowed many visitors, both hams and non-hams alike, to stop by and take a look at what we were doing.

Get Involved in 2018

More participation is always welcome, and we'd love to be joined by any hams who want to guest operate in our 2018 events (see the sidebar, "2018 Events: Work Us January 27 – 28"). The first event will be held January 27 – 28, and if you can't operate, make sure to get on the air and contact us. For more information, check out our website or contact us at **ww1usa@theworldwar.org**. We'd love to hear from you.

Randy Schulze, KD0HKD, grew up in Kearney, Nebraska, and attended Kearney State College (now known as the University of Nebraska at Kearney) and Dana College (Blair, Nebraska), majoring in radio broadcasting. Randy served as a law enforcement officer for 16 years as a 911 communications operator, police officer, and chief of police before entering a career in information technology for the past 20 years. Although he was involved in radio communications professionally throughout his life, Randy did not get fully involved in Amateur Radio until spring 2009, upgrading to Amateur Extra class in 2012. Randy resides in Kansas City, Missouri, with his wife and family, and is a manager at IBM. He's an active member and president of the Raytown (Missouri) Amateur Radio Club and is the Chairman for the Mo-Kan Regional Council of Amateur Radio Organizations.

For updates to this article, see the QST Feedback page at www.arrl.org/feedback.

Nominations Sought for Annual Philip J. McGan Memorial Silver Antenna Award

The ARRL's annual Philip J. McGan Memorial Silver Antenna Award seeks to celebrate the efforts of individuals to create greater awareness and understanding of all the services and benefits that Amateur Radio provides to the general public.

Every day, Public Information Coordinators (PICs), Public Information Officers (PIOs), and other PR volunteers strive to keep Amateur Radio visible in their communities by publicizing and promoting special events to newspaper, radio, and television outlets and by maintaining good relations with local media representatives, as well as by creating content for social media platforms, and many other valuable activities. These efforts benefit us all.

The award is named for the late journalist Philip J. McGan, WA2MBQ, who served as the first chairman of ARRL's Public Relations Committee, and helped reinvigorate the League's commitment to public relations. Unfortunately, McGan never got to see how well his efforts paid off. To honor him, his friends in the New Hampshire Amateur Radio Association joined with the ARRL Board of Directors to create this award as a lasting tribute to the important contributions he made on behalf of Amateur Radio.

Who Can be Nominated

The McGan Award will go to that ham radio operator who has demonstrated success in Amateur Radio public relations and best exemplifies the volunteer spirit of Phil McGan. Activities for which the McGan Award is presented include efforts specifically directed at focusing the media's and the general public's attention on the value of Amateur Radio. This may include traditional methods, such as generating media coverage of a specific event, or non-traditional methods, such as hosting a radio show or being an active public speaker.

The award is named for the late journalist Philip J. McGan, WA2MBQ, who served as the first chairman of ARRL's Public Relations Committee.

If you're considering nominating someone in your area for the award, please ask yourself if your candidate's work fits the definition of public relations. (Public relations is about getting a message out to people, while public service is about providing a service.) Also, the McGan Award is for promotion of Amateur Radio to the non-amateur community; it is *not* awarded for work done within a club or organization that primarily benefits the Amateur Radio community.

The award is given only to an individual (not a group), and that individual must be a full ARRL member in good standing at the time of nomination.

The nominee must not be compensated for any public relations work involving Amateur Radio (including payment for articles) and may not be a current officer, Director, Vice Director, or paid staff member, or a member of the current selection committee.

Check out the specific criteria for nomination and the nomination form (in PDF format) at **www.arrl.org/phil-mcgan-award**, or e-mail ARRL Communication Manager Dave Isgur at **disgur@arrl.org** and ask for an official Philip J. McGan Memorial Silver Antenna Award entry form.

The deadline for submitting a nomination form to ARRL HQ is May 19, 2018. The ARRL Public Relations Committee will determine a winner, if any, from submitted material, subject to approval by the ARRL Board of Directors. The Board will make a final determination at its July meeting and the winner will be notified shortly thereafter.

Split Decisions

Snagging that prized contact may require you to be in two places at the same time.

Steve Ford, WB8IMY

Imagine that you sit down at your home station, pick a frequency, and start calling CQ. After a call or two, you receive a response and then commence chatting. One person, one response, one frequency.

But let's move your home to, say, Bouvet Island — one of the most sought-after DX Century Club entities in the world. Now you call CQ, but instead of one response, you receive hundreds! Your transceiver almost jumps off the table from the sheer riot of signals. You strain to pick out a single call sign, but the chaos is overwhelming. Keep listening and maybe you'll be able to hear a particularly strong signal among the screaming masses. With everyone piled up on a single frequency, however, you'll have your work cut out for you. The result is cacophony beyond compare.

There must be a better way.

Divide and Conquer

The most efficient way to manage such a miserable situation is to get everyone to stop transmitting on your frequency. Instead, you ask them to transmit on an entirely different frequency.

"That's absurd," you may say. "If I do that, I won't hear anyone!"

Au contraire! Instead of everyone calling endlessly at your transmitting frequency, you ask them to *listen* at your transmitting frequency, while *calling* you at a different frequency.

That calling frequency is usually a range of frequencies close by, such as 5 to 15 kHz above your transmitting frequency.

After calling CQ, you cruise through this range of frequencies, listening for stations and responding at your single transmitting frequency.

This is known as *working split* because you are transmitting and receiving on two diffrent frequencies, rather than on the same frequency (known as *simplex*). Nearly every DXpedition uses split-frequency operating to preserve the operator's sanity while making contacts with as many stations as possible.

It may seem counterintuitive, but if you're one of the stations crying out to be heard, working split *improves* your odds of contacting that desirable station.

How to Set Up Split Operation

We'll start with the assumption that you own a transceiver with dual VFOs and a "split" function. It is a rare rig that lacks these features.

Let's say you've stumbled across a split-frequency pileup at 14.190 MHz (see Figure 1). You'll know this because while you can hear the DX station calling at 14.190 MHz, no one seems to be answering.

Keep listening. A good DXpedition operator will periodically tell you the frequency range that he or she is listening to, by saying something like, "Listening up 5 to 15."

The operator is listening 5 to 15 kHz above the operating frequency, which means between 14.195 and 14.205 MHz. Tune up the band and you will likely run smack into the mob. The more desirable the DX station, the bigger and louder the crowd.

Return your VFO to 14.190 MHz. My guess is that you will be using VFO A. Leave VFO A parked on 14.190 MHz and look for a button that allows you to switch to VFO B. The button may be labeled **A/B**.

Push the button and your frequency display will change — you might even see it displaying a frequency on an entirely different band. No matter.

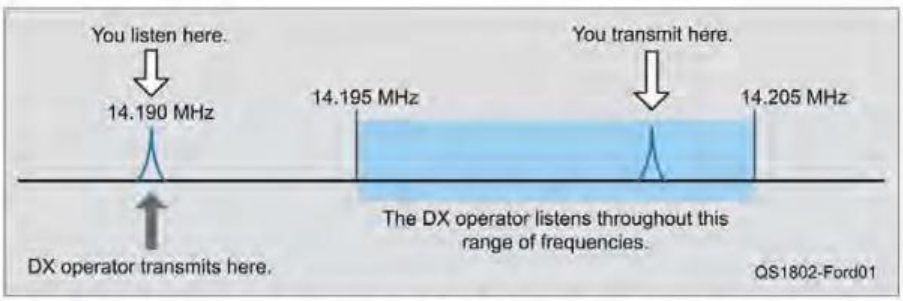


Figure 1 — The DX operator is transmitting at 14.190 MHz, but is listening for replies by tuning through a range of frequencies from 14.195 through 14.205. Translating to DX lingo, the operator is "listening up 5 to 15," meaning that he or she is listening 5 to 15 kHz above their transmitting frequency.

Switch bands or whatever else you need to do to bring the VFO B to a frequency within the range the DX operator is monitoring. Start wading through the multitude of signals. Try to find a relatively quiet place and then stop. This will be your transmitting frequency.

Push that VFO **A/B** button again to return to VFO A (see Figure 2). Your frequency display should return to 14.190 MHz. This is your listening frequency. Now look for a button labeled **SPLIT**. Press it and you should see an indication that you've entered the split-frequency mode.

Figure 2 — Switching from one VFO to another is often as simple as pushing a button to toggle between VFO A or B. You can see the **A/B** button in this photo. Also look for the **SPLIT** button. This will allow you to transmit on one VFO frequency and receive on another.

Congratulations! You're listening to the DX operator on 14.190 MHz and, when you transmit, your radio will automatically switch frequencies to the one you've chosen between 14.195 and 14.205 MHz.

Just to be sure that you've set up your transceiver properly, give your microphone push-to-talk button or your CW key a quick tap. You should see your radio's frequency display shift briefly to your transmit frequency.

> *"Once you understand the pattern, you can position your transmit signal on the frequency the operator is most likely to tune to next."*

Every transceiver is different, so the procedure I've described will vary. When in doubt, consult your manual.

Finessing the Split

How is the person at the other end of the path to find you? Is it safe to assume that he or she starts listening at 14.195 MHz and gradually moves up to 14.205 MHz, working stations in sequence along the way?

Maybe not. Yes, some operators select stations in a rather "linear" fashion, moving up in frequency from one station to the next, but others do not. Some operators jump from one frequency to another within their listening range, seemingly at random. This is where patience, combined with a bit of detective work, can pay big dividends.

Switch back and forth between listening to the DX station and listening to the mob. When you hear the DX station answer someone, quickly spin through the calling frequency range and see if you can find the station in question. Once the exchange is over, keep tuning through the signals and find the next lucky amateur to earn the favor of a call from the DX operator. Is his signal above or below the one you just heard? In other words, try to figure out which "direction" the DX operator is tuning. Every operator has his or her habits; everyone tunes in a particular way. A little time spent studying their behavior will usually reveal the pattern.

Once you understand the pattern, you can position your transmit signal on the frequency the operator is most likely to tune to next.

Always listen attentively to the DX operator. In particularly intense pile-ups, he or she may make certain requests such as "Europeans only." If you aren't among the requested stations, stop calling and wait.

In fact, whenever the DX operator answers a station, stop calling. If your transmit frequency happens to be near the frequency of the station the DXer is trying to contact, you'll cause interference and make it difficult for the operators to complete the exchange. The more time they spend struggling through your interference, the longer it will take for your turn to occur. (And if the DX operator picks up your call sign as the interfering perpetrator, he or she may add it to a blacklist and never answer you!)

As veteran DX hunters will tell you, the key to success is to listen, listen, listen. Follow the instructions of the DX operators and take the time to learn their patterns. Some transceivers make this even easier by allowing you to temporarily flip to your transmitting frequency and quickly tune through the mass of signals at the push of a button. Others offer *panadaptors* that will display the signals throughout the DX operator's listening range, allowing you to see the quiet spots where you can set up shop, so to speak. Panadaptors are also great tools for identifying the frequencies of the responding stations, making it easier to determine the DX operator's patterns.

Above all else, enjoy yourself. Pile-ups are challenging, but exciting. It's hard to beat the thrill that races up your spine when you finally hear that DX station calling *you!*

Steve Ford, WB8IMY, is the Editor of *QST*. You can contact him at **sford@arrl.org**.

Rick Lindquist, WW1ME, ww1me@arrl.org

Happenings

FCC Seeks Comments on Technological Advisory Council Recommendations

In a *Public Notice* released on December 1, the FCC's Office of Engineering and Technology (OET) invited comments on a wide-ranging series of Technological Advisory Council (TAC) recommendations that, if implemented, could alter the spectrum policy regulatory landscape — especially with respect to interference resolution and enforcement. Comments are due by January 31. An advisory body, the TAC's membership includes several Amateur Radio licensees. ARRL plans to comment in the proceeding, ET Docket 17-340.

The TAC has called on the FCC to:

- Consider adopting the spectrum management principles spelled out in the Council's *Basic Spectrum Principles* white papers of March 2014 and December 2015, and "set clear expectations about the affected system's capabilities regarding interference, such as harm claim thresholds."
- More broadly adopt risk-informed interference assessment and statistical service rules. "In judging whether to allow new radio service rules, the TAC observes that the Commission has to balance the interests of incumbents, new entrants, and the public," the *Public Notice* explained. "The process of analyzing the tradeoffs between the benefits of a new service and the risks to incumbents has, to date, been essentially qualitative."
- Implement "a next-generation architecture" to resolve interference and establish a public database of past radio-related enforcement activities.

The TAC also recommended that the FCC "incorporate interference hunters in the [interference] resolution process."

The TAC said that radio services "should expect occasional service degradation or interruption."

The TAC also posed three "Responsibilities of [Radio] Services" that, in part, state that "receivers are responsible for mitigating interference outside their assigned channels" and "transmitters are responsible for minimizing the amount of their transmitted energy that appears outside their assigned frequencies and licensed areas."

In another three principles under "Regulatory Requirements and Actions," the TAC suggested that the FCC may "apply interference limits to quantify rights of protection from harmful interference." The TAC "has recommended interference limits as a method for the Commission to communicate the limits of protection to which systems are entitled, without mandating receiver performance specifications." It has called for a "quantitative analysis of interactions between services" before the FCC could "make decisions regarding levels of protection," the OET said.

"[T]he TAC believes the principles can be applied to all systems and result in an optimal solution for each service," the *Public Notice* said. The TAC has suggested that the FCC not base its rules on exceptional events and worst-case scenarios, but on reality.

"The TAC recommends that the Commission start soon, and start small, and not attempt a major overhaul of its regulatory approach," the *Public Notice* said.

FCC Proposes $25,000 Fine for Breaking Now-Voluntary Labeling Rules

In a November 21 *Notice of Apparent Liability* (*NAL*), the FCC proposed fining Acuity Brands of Atlanta $25,000 for allegedly marketing radio frequency devices not labeled in accordance with the FCC Part 18 rules in place at the time. Application of the FCC logo was to inform purchasers that a device had undergone compliance testing and conforms to the rules. The FCC said Acuity continued to market two models of the ballasts for about 6 months after being notified, causing the Commission to increase the penalty.

Use of the FCC logo became voluntary last November 2, but Acuity's alleged violations occurred before that. The current FCC rule allows the logo to be affixed to a device at the discretion of the responsible party, consistent with §18.209, but "only if [the] device complies with the applicable equipment authorization rules."

ARRL has in the past — and without response — complained to the FCC regarding the marketing and sale of interference-causing lighting ballasts, as well as about a lack of required compliance notifications.

Matt Holden, K0BBC, is New Dakota Division Director

In a two-way race to fill the Dakota Division Director's chair being vacated by Kent Olson, KA0LDG, the Division's members elected Vice Director Matt Holden, K0BBC, of Bloomington, Minnesota. Holden received 698 votes, while Dean Summers, N0ND, of Dickinson, North Dakota, got 345 votes. Holden was appointed Vice Director in February 2016 after former Director Greg Widin, K0GW, became ARRL First Vice President. Olson announced earlier this year that he would not seek another term.

In a four-way race for the Vice Director's chair that Holden will vacate, the winner was North Dakota Section Manager Lynn Nelson, W0ND, of Minot. Nelson earned 427 votes; Tom Karnauskas, N0UW, of Owatonna, Minnesota, received 338 votes; Chris Stallkamp, KI0D, of Selby, South Dakota, got 175 votes, and Jay Maynard, K5ZC, of Fairmont, Minnesota, received 93 votes.

In the Atlantic Division, ARRL members chose former FCC Special Counsel Riley Hollingsworth, K4ZDH, of Gettysburg, Pennsylvania, as Vice Director. In the final tally, Hollingsworth received 2,559 votes, while Lloyd Roach, K3QNT, of Bedford, Pennsylvania, garnered 1,348 votes.

In the Midwest Division, Director Rod Blocksome, K0DAS, held off a re-election challenge from Cecil Miller, WB0RIW, of Wichita, Kansas, 1,249 to 792. Blocksome was elected Midwest Division Vice Director in 2011. In 2014, he was the only candidate to succeed retiring Director Cliff Ahrens, K0CA.

New ARRL Dakota Division Director Matt Holden, K0BBC.

Unopposed for new terms were Atlantic Division Director Tom Abernethy, W3TOM; Delta Division Director David Norris, K5UZ; Delta Division Vice Director Ed Hudgens, WB4RHQ; Great Lakes Division Director Dale Williams, WA8EFK; Great Lakes Division Vice Director Tom Delaney, W8WTD, and Midwest Division Vice Director Art Zygielbaum, K0AIZ.

Ballots were counted on November 17 for contested races. Three-year terms for all successful candidates began on January 1.

Arizona Repeater Association Joins Maxim Society

At the December 2 Superstition Hamfest in Mesa, Arizona, the Arizona Repeater Association (ARA) presented its annual donation of $2,500 to the ARRL Spectrum Defense Fund. This marks the fourth consecutive year that the club has contributed.

"ARRL is deeply appreciative to all the members of the Arizona Repeater Association for their ongoing support to the ARRL Spectrum Defense Fund," said ARRL Development Manager Lauren Clarke, KB1YDD. "With ARA's most recent gift of $2,500 to this important fund, ARRL is pleased to welcome the Arizona Repeater Association into the Maxim Society!"

The honor is reserved for individuals and organizations contributing at least $10,000.

The ARA contingent, headed by Brian McCarthy, AK7F, presented a symbolic check to ARRL Southwestern Division Vice Director Ned Stearns, AA7A; ARRL Arizona Section Manager Rick Paquette, W7RAP, and other Arizona Field Organization staffers.

ARRL Southwestern Division Vice Director Ned Stearns, AA7A (left), accepts an ARRL Spectrum Defense Fund donation from the ARA's Brian McCarthy, AK7F.

US Appeals Court Upholds Dismissal of Lawsuit in Ames v. ARRL

On November 11, the US Court of Appeals for the Third Circuit upheld a lower court's dismissal of a defamation lawsuit filed by former ARRL Eastern Pennsylvania Section Manager Joseph Ames, W3JY, of Malvern, Pennsylvania, against ARRL and several of its officers and Board members. The US District Court in Philadelphia had dismissed the lawsuit with prejudice in December 2016, and Ames filed an appeal of that decision.

In its opinion, the appellate court wrote, "...because the record shows that Ames acted contrary to [an] August 2015 directive on at least two occasions, the [ARRL's] statement that Ames 'repeatedly acted contrary' to the directive is true and cannot support a claim for defamation...it is apparent on the face of the complaint and related documents that the statements in the [ARRL website news] article are true, and the District Court therefore correctly held that the defendants established a complete defense to Ames's defamation claim and appropriately dismissed the complaint."

In June 2016, the Executive Committee of the ARRL Board of Directors relieved Ames of his appointments in the ARRL Field Organization, including his position as Chairman of the ARRL National Traffic System™ Eastern Area.

In Brief...

This young Boy Scout got on the air at a JOTA station hosted by the Huntsville Amateur Radio Club, K4BFT.

- **Nearly 8,000 Scouts got on the air for the 60th Jamboree on the Air (JOTA) last October**, National JOTA Coordinator Jim Wilson, K5ND, has reported. In November, Wilson released the 2017 JOTA report, which declared, "Radio Scouting and Jamboree on the Air are alive and doing well." The tally for JOTA 2017 was 7,872 Scouts on the air, down from 10,761 in JOTA 2016. "Propagation wasn't our friend, but, even so, [radio amateurs in] almost 90 countries and all 50 states engaged in conversations with Scouts during the weekend," Wilson said.

- **The ARRL Board of Directors publicly censured ARRL Southwestern Director Dick Norton, N6AA**, acting on a recommendation of its Ethics and Elections Committee. On an 11-3 vote, with one member abstaining, the Board adopted a resolution to censure Norton for criticizing the ARRL Code of Conduct for Board members at an Amateur Radio gathering "by virtue of his characterizations thereof, thus criticizing publicly the collective action of the Board of Directors adopting said Code of Conduct and drawing the Board's collective decision making into disrepute." The Board admonished Norton that no further similar behavior would be tolerated. The Board's action related to a complaint filed with the Ethics and Elections Committee by an ARRL member. The Board met in special session by teleconference on November 14 to consider the matter. The minutes of the special ARRL Board of Directors meeting are posted on the ARRL website.

- **Jim Kvochick, K8JK, of Brighton, Michigan, is serving as Michigan Section Manager** for the first half of 2018. Michigan Section Manager Larry Camp, WB8R, stepped down at the end of his term after serving since 2012, and no candidates came forward to run for the position. An ARRL Life Member, Kvochick was licensed in 1968. He has been active in many facets of Amateur Radio, including public service, experimenting, and equipment restoration. Kvochick's appointment will bridge the gap until a Section Manager is elected.

- **The reputed world's oldest radio amateur, Jean Touzot, F8IL, of Albi, France, has died.** The "dean of French radio amateurs," Touzot was 109 and enjoyed operating CW with an old-fashioned hand key and a modern transceiver. He "retired from the airwaves for health reasons" at age 105. He was a member of France's International Amateur Radio Union Member-Society REF, as well as of the Union of French Telegraphists (UFT). No official records are kept to document who is the oldest radio amateur.

Ulrich Rohde, N1UL, Receives Wireless Innovation Forum Leadership Award

Ulrich Rohde, N1UL

The prominent amateur Ulrich Rohde, N1UL, is the recipient of the Wireless Innovation Forum Leadership Award (formerly International Achievement Award). The award recognizes "especially significant contributions in furthering the global mission of the Wireless Innovation Forum." A prolific technical author, academic, and engineer, Rohde is a partner of Rohde & Schwarz in Munich, Germany, and chairman of Synergy Microwave Corporation in Paterson, New Jersey.

While working under an RCA US Department of Defense contract in 1982, Rohde's department developed the first software-defined radio (SDR), which used the COSMAC (complementary symmetry monolithic array computer) chip. Rohde was among the first to publicly present on this topic with his 1985 talk, "Digital HF Radio: A Sampling of Techniques," at the Third International Conference on HF Communication Systems and Techniques in London.

"Since then, Rohde has actively driven innovation in the field of SDR, both in industry and academia," the Award announcement said. Rohde holds some 50 patents. In the 2017 edition of *Communications Receivers*, Rohde and his co-authors set SDR at the core of modern communications systems design.

A project in which Rohde & Schwarz is involved was also honored. The Wireless Innovation Forum conferred its Technology of the Year award on the German Armed Forces Joint Composite Radio Equipment Project; Rohde & Schwarz is lead industry partner.

Winners were announced last November at the Wireless Innovation Forum Conference on Communications Technologies and Software-Defined Radio (WInnComm 2017).

FCC Dismisses Radio Amateur's Petition to Revise Call Sign Rules

The FCC has dismissed a rule-making petition filed last May by Thomas J. Alessi, K1TA, of Stamford, Connecticut, that sought to amend the Part 97 rules regarding Amateur Radio Service call signs. The Commission action came in a November 28 letter from Scot Stone, Deputy Chief of the FCC Wireless Telecommunications Bureau Mobility Division. Alessi had asked the FCC to make call signs consisting of one letter, followed by two digits, followed by one letter (1 ×× 1 format) available to Amateur Extra-class licensees. Alessi asserted that the number of Amateur Extra-class licensees who desire short call signs exceeds the available supply of 1 × 2 and 2 × 1 call signs, and that his plan would make an additional 7,800 four-character call signs available.

"Approximately 15 million call signs are presently available in the sequential call sign system, but it does not include every amateur call sign that has been allocated to the United States," Stone wrote in denying Alessi's petition. He also pointed out that the FCC had rejected a similar suggestion in 2010 that would have made certain additional call signs, including 1 ×× 1 call signs, available to Amateur Extra-class licensees. "You have not demonstrated any changed circumstances or other reason that would warrant revisiting this decision," Stone concluded.

Section Manager Nomination Notice

To all ARRL members in Illinois, Indiana, Maine, Northern Florida, Oregon, Santa Clara Valley, Vermont, and Wisconsin: You are hereby solicited for nominating petitions pursuant to an election for Section Manager (SM). Incumbents are listed on page 16 of this issue.

To be valid, a petition must contain the signatures of five or more full ARRL members residing in the Sections concerned. It is advisable to have a few more than five signatures on each petition. A sample nomination form is available on the ARRL website at **www.arrl.org/section-terms-nomination-information**. Nominating petitions may be made by facsimile or electronic transmission of images, provided that upon request by the Field Services Manager, the original documents are received by the Manager within 7 days of the request.

We suggest the following format:

(Place and Date)

Field Services Manager, ARRL
225 Main St.
Newington, CT 06111

We, the undersigned full members of the _____ ARRL Section of the _____ Division, hereby nominate _____ as candidate for Section Manager of this Section for the next 2-year term of office.

(Signature____ Call Sign___ City___ ZIP___)

Any candidate for the office of Section Manager must be a resident of the Section, an Amateur Radio licensee of Technician class or higher, and a full member of the League for a continuous term of at least 2 years immediately preceding receipt of a nominating petition. Petitions must be received at Headquarters by 4 PM Eastern Time on March 9, 2018. If more than one member is nominated in a single Section, ballots will be mailed from Headquarters no later than April 2, 2018, to full members of record as of March 9, 2018, which is the closing date for nominations. Returns will be counted May 22, 2018. Section Managers elected as a result of the above procedure will take office July 1, 2018.

If only one valid petition is received from a Section, that nominee shall be declared elected without opposition for a 2-year term beginning July 1, 2018. If no petitions are received from a Section by the specified closing date, such Section will be resolicited in the July 2018 issue of *QST*. A Section Manager elected through the resolicitation will serve a term of 18 months. A Section Manager vacancy occurring between elections is filled through appointment by the Field Services Manager. — *Norm Fusaro, W3IZ, Radiosport Department Manager*

SM Nomination Petition Resolicitation

Because no nomination petitions were received for East Bay, Michigan, New Mexico, and Santa Barbara by the nomination deadline of September 8, 2017, nominations are hereby resolicited. See above for details.

Rick Palm, K1CE, k1ce@arrl.org

Public Service

LEDs Light Up Your Field Operations

On field deployments we tend to focus on radios, antennas, coax, and power supplies, but shuffle equally important gear to the bottom of the deck. This includes lighting. If we can't see our radio panels at night, then we can't operate. Adequate lighting is also a safety issue. This month, we'll look at some portable lighting solutions for your field station.

Figure 1 — Mounted Husky 1,000-lumen, 19 W, LED work light illuminates the operating position/platform at K1CE. [Rick Palm, K1CE, photo]

Setting Up Some Tests

As part of my research for this column, I used an inverter[1] to simulate field operation at my portable station, starting with a traditional 60 W incandescent bulb screwed into a job site-style fixture, and connected a voltammeter between the inverter and batteries. The light drew about 4 – 5 A and became hot to the touch.

I then went to a home improvement store and bought an LED work light, mounted it on the scaffold frame (I use scaffold framing to mount my station for portable applications[2]) behind my operating position, and had plenty of light at only 1.5 A — that's a ⅓ energy savings (see Figure 1). The LED light emitted very little heat, making it much safer to use. LEDs are the way to go for station lighting in the field.

Comparing Halogen and LED

To be more specific on light output comparison, according to the Energy Department's information, a 60 W incandescent bulb emits approximately 800 lumens (measured amount of light). I looked at the specs for my new LED work light: 1,000 lumens, 19 W, which closely matches the light brightness and power consumption experience of my raw field test. My previous experience with a similar halogen work light was that it burned extremely hot, with a delicate, easy-to-break lamp tube, requiring a wire cage to protect it and the consumer. For further comparison, a halogen work light can offer more light — one I found, for example, puts out 4,000 lumens — but at a cost of 250 W or roughly 3 A at 110 V ac.

As far as pricing goes, I found a small, portable Husky 1,000-lumen LED work light for $12. For larger field applications, I found a 3,500-lumen LED portable work light for $50.

Energy-Efficient LEDs

According to the Department of Energy (DOE), the light-emitting diode (LED) is one of today's "most energy-efficient and rapidly-developing lighting technologies." The DOE states that quality LED light bulbs last longer, are more durable, and offer comparable or better light quality than other types of lighting.

The LED is a type of solid-state lighting that uses a semiconductor to convert electricity into light. LED bulbs can be six to seven times more energy efficient than conventional incandescent lights and cut energy use by more than 80%, which is critically important for radio stations in the field that are typically powered by 12 V dc batteries.

Good-quality LED bulbs can have a life of 25,000 hours or more, meaning they can last more than 25 times longer than traditional light bulbs. (That is a life of more than 3 years if run continuously.) Unlike incandescent bulbs, which release 90% of their energy as heat, LEDs use energy far more efficiently, with little wasted heat. They are low cost, compact in size, easy to maintain, resistant to breakage, and focus the light in a single direction. They contain no mercury.

Testing Some Work Lights

Other LED work light solutions leave out the inverter, running directly off the 12 V dc batteries that are popular power sources for amateur station field applications. I braved the holiday crowds to purchase off-road vehicle LED lamps to try (see Figure 2). I ended up buying an Alpena QuadFire™ 1,400-lumen, 15 W four-LED light, housed in a heavy-duty die-cast aluminum frame, which I easily mounted onto my operating platform. It worked great for station component illumination, until I quickly realized that it emitted RF noise — so much so that it pinned my S-meter. Repositioning the unit back from my radio by 20 feet mostly solved the problem.

I purchased a NEBO® WORKBRITE™ PRO 630-lumen LED work light from Batteries Plus (**www.batteriesplus.com**) that seemed to be an ideal solution for my portable field station needs. It's weatherproof, with an impact-resistant body, and runs on three choices of power sources (*Flex-Fuel* is their marketing title): a 110 V ac wall-wart power adaptor (included), six AA 1.5 V batteries, or just three AA batteries (six AA batteries are included). The label on the back of the unit states that the light will burn for 7.5 hours on the high setting (630 lumens) or 16 hours on the medium setting (290 lumens) with six AA batteries installed; 4.5 hours on the high setting (430 lumens) and 12 hours of burn time on the medium setting (210 lumens) with just three AA batteries installed; and continuously on the high (610 lumens) and medium (240 lumens) settings using the ac adaptor.

To test it, I left the unit on the high setting (430 lumens) with just the three AA batteries installed, and noted a real-life burn time as stated by the manufacturers.

This unit turned out to be my most favored because it's constructed well and it's lightweight, rugged, and cool burning. It provided plenty of light for my small portable station. I would recommend having at least one to illuminate the front of the operating position, and another one or two to light up the back. The WORKBRITE PRO 630-lumen work light is expensive, however, at $59 each.

Figure 2 — Solutions for portable station lighting, clockwise: NEBO WORKBRITE PRO 630 lumen LED work light, Energizer 300-lumen LED headlamp, NEBO one AA LED flashlight, and Alpena QuadFire™ 1,400-lumen, 15 W four-LED light. [Rick Palm, K1CE, photo]

Testing Flashlights and Headlamps

LED technology has also revolutionized hand-sized flashlights, another indispensable tool for field applications, of course. I purchased a small NEBO one AA LED flashlight for personal purposes prior to the arrival of Hurricane Irma over peninsular Florida. The light is constructed well with aircraft-grade aluminum, bright LED, and light director. It cost less than $20. I keep it in my truck's glove compartment.

A flashlight is of good utility on a field deployment, but I much prefer using my Energizer 300-lumen LED headlamp, leaving my hands free for operating and often overlooked, but necessary, functions such as looking at the back panels of radios and peripheral equipment for adjustments and cable plug-ins, etc. My headlamp gives me plenty of light and leaves my hands free for connecting coaxial antenna connectors, mic/key cables, power cables, and minor adjustments. My headlamp uses three AAA batteries and has different brightness settings, and a red flashing light function for safety when walking at night.

Experiment at Home First

Experiment with different lighting configurations in your backyard, simulating an operating field site, before an actual deployment. Ambient light can be considered: an incident command post will likely be illuminated to some degree. And finally, consider how much light you may need on the periphery of your site.

Notes

[1]R. Palm, K1CE, "Add an Inverter to Your Field Operation Kit," *QST*, Jan. 2018, pp. 85 – 86.

[2]R. Palm, K1CE, "The Ultimate Portable/Mobile Field Station Operating Platform," *QST*, Mar. 2017, pp. 86 – 87.

Classic Radio

The Shure 55 Microphone

John Ellis, NP2B
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Originally intended for commercial and broadcast use, the well-known Shure 55 microphone is excellent for ham radio. It performs especially well on SSB, due to its smooth frequency response. The instantly recognizable design of the iconic mic adds a touch of classic elegance to any setup, as can be attested to by its popularity with various public figures over the years. It accompanied singers like Ella Fitzgerald and Frank Sinatra. President John F. Kennedy used the Shure 55 during many of his speeches. It has even been referred to as the "Elvis mic," due to its popularity with Elvis Presley.

Background and Design

The Shure 55 microphone made its first appearance in 1939 as part of the company's Unidyne series, designed by engineer Ben Bauer. The Shure 55 was manufactured in three separate models: the 55A, with an output impedance of 30 – 50 Ω; the 55B, with an output impedance of 150 – 250 Ω, and the 55C, which was designed to work into a high-impedance load, such as the grid of a tube. The only difference between these microphones was the small transformer on the output of the cartridge. In 1947, the company put a three-position switch on the back of the microphone to select taps on the transformer ("H" for high impedance, "M" for 150 – 250 Ω, and "L" for 30 – 50 Ω), eliminating the need for three separate models.

In 1951, they changed the physical design to a slimmer model — the same size that is in production today. The pre-1951 models (referred to as "fatboys" because of their wider size) can still be found on sites like **eBay.com**. They command pretty high prices, especially if they are in good condition. Despite their age, these mics still sound good.

The original models employed a rather large transducer (the pickup element), which was over 1 inch in diameter, suspended by four springs that served as a shock mount. Eventually, the manufacturer transitioned to using smaller elements without the springs. In the early '60s, they changed the internal wiring from cloth to vinyl insulated wire. In 1978, they changed the output connector from the Amphenol 91-MC3F (the mate of which can be hard to find) to the more conventional, three-pin "XLR," and eliminated the impedance switch. Even though the Shure 55 has undergone a number of changes over the past 79 years, the same classic design remains in production today.

Amateur Radio Use

Because the Shure 55 was intended primarily for commercial broadcast and recording use, its output is balanced. This means that there are two conductors that comprise the mic's output — not a single conductor and a ground, required by most modern ham rigs. There is also no push-to-talk (PTT) switch on the '55. The principal advantage of the balanced output is to suppress, if not completely eliminate, hum and noise. This is generally not an issue in Amateur Radio use, but is intolerable in a commercial broadcast or recording application.

The easiest and least expensive way to solve the balanced to unbalanced problem is to simply tie one of the output conductors to the shield of the microphone cable (ground) at the microphone itself and treat it like a regular unbalanced output. This generally works because of the short length of microphone cables used in ham radio applications. Another possible solution is to use a separate microphone transformer with a balanced input and an unbalanced output, but that is often rather cumbersome, because of the space it takes at the operating position. A third potential solution is to utilize a separate equalizer or voice processor with a balanced input and an unbalanced output, but that is also likely to be cumbersome, especially if

> *"The Shure 55 has even been referred to as the 'Elvis mic,' due to its popularity with Elvis Presley."*

"The iconic Shure 55 microphone continues to be one of the most popular and most photographed microphones in history."

An example of an older Shure 55 with Amphenol 91-MC3 connectors and an "HML" impedance switch on the base of the microphone. [Jeanette Ellis, NP2C, photo]

you don't need the features that these external units provide.

Some Shure 55s have a switch on the front to turn the microphone on or off. The nomenclature of those models is "55SW" — the "SW" denoting the switch. It is nothing more than a single-pole, single-throw (SPST) switch that shorts the two output conductors of the microphone. Because all models of the Shure 55 have only three pins on the output connector (regardless of whether it is the Amphenol or XLR type), a PTT function can be provided by modifying the internal wiring to short one of the balanced output leads to ground, making it unbalanced, and rewiring the switch to use the third conductor as a PTT lead. If you do this, remember to put a label on the back to let any future user know that the microphone has been modified. The factory-supplied switch is a standard slide switch, so it can easily be replaced with a momentary (spring-loaded) version if desired.

The Shure 55 can be used with any conventional microphone stand; no special adapters are needed. It can also be used with a cantilever boom, but make sure that the springs are strong enough to suspend the microphone, as the '55 is not a lightweight piece of equipment.

Legacy of an Icon

The iconic Shure 55 microphone continues to be one of the most popular and most photographed microphones in history. The Shure Unidyne was even awarded the IEEE Milestone Award in 2013 — 75 years after its invention. Shure Historian Michael Pettersen wrote to the IEEE Committee, "The patented Unidyne was the first microphone to provide directional characteristics using a single dynamic element. This breakthrough offered lower cost, greater reliability, and improved performance for communication and public address systems."[1]

[1] **http://cdn.shure.com/brochure/upload/77/shure-the-unidyne-story.pdf**

Strays

Hams Giving Hope

In November 2017, the Portage County (Ohio) Amateur Radio Service donated $6,445 to the Center of Hope, an organization dedicated to enhancing the nutrition of low-income people in Portage County where local food pantries are not present. Hot meals are offered at no cost 5 days a week and are typically served to 75 – 100 individuals each day. Groceries are available monthly through the Christian Cupboard. Opportunities for socialization, cooking classes, and referral services are also offered.

From left to right: Rick Kruis, K8CAV, outgoing PCARS president; Mark Frisone, Executive Director of Family and Community services, parent organization of the Center of Hope, and Jim Wilson, AC8NT, incoming PCARS president.

Maria Somma, AB1FM, ab1fm@arrl.org

Exam Info

FCC Basic Qualification Question, New Form 605

In September 2017, the FCC revised the basic qualifications section of 605 Application Forms (FCC, NCVEC, and Club) to include a question regarding whether an applicant has been convicted of a felony in any state or federal court. This section enables the FCC to determine whether an applicant is eligible under §§ 310(d) and 308(b) of the Communications Act of 1934, as amended, to hold or have ownership interest in a station license.

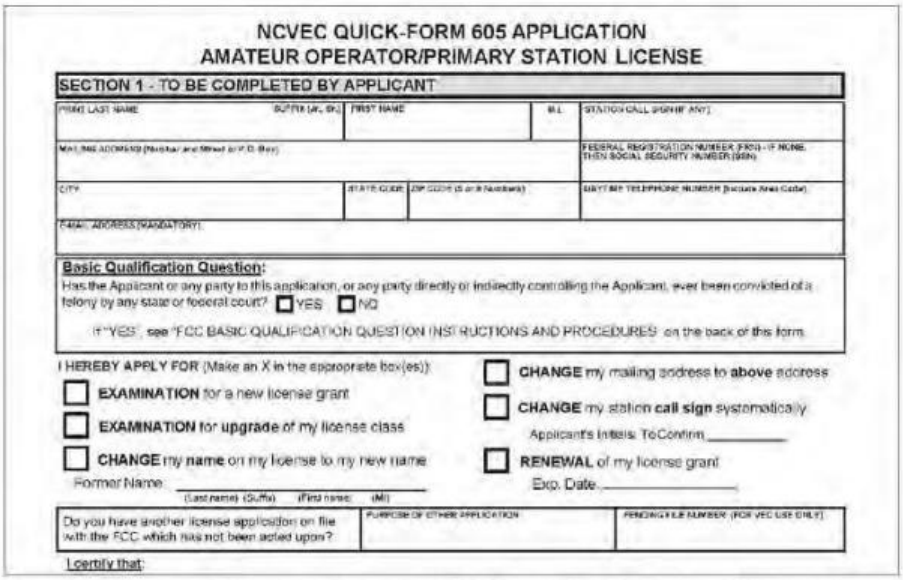
Applicants' responses and explanations to the basic qualification question (felony question) on the new forms will be used to determine eligibility to be a Commission licensee. Applicants are required to answer the question if they are filing any Form 605 for one of the following purposes indicated: new, amended, or renewal with modifications (upgrade or call sign change). The question does not have to be answered if the applicant is filing a renewal only or an administrative update to their license (change of address, name, e-mail, etc.). Applicants answering "yes" must provide an explanation to the FCC. Visit **www.arrl.org/fcc-qualification-question** for detailed information about the FCC's basic qualification question.

New Form 605

The new NCVEC 605 Application Form (September 2017 series) with the updated basic qualification question section must be used at exam sessions. Older versions of the form are not acceptable (see Figure 1).

For Amateur Radio examinees, this means they must pass the examination and they must meet the character requirements. If the answer to the basic qualification question is "yes," the applicant will submit a statement explaining the circumstances directly to the FCC as an exhibit. The application will be held for a basic qualification review. Examinees should not bring exhibits to exam sessions, and VE teams should never collect or send exhibits to the VEC.

Each applicant applying for a new or upgraded license must answer the basic qualification question. A question left unanswered will result in the application being rejected by the FCC. It's imperative for VE teams to ensure the applicants use the correct 605 Forms and the forms are accurately completed. The bottom line is the applicants who do not answer the mandatory basic qualification question or who use the outdated form will not be issued an FCC license. All current exam session forms and documents (print, download, or fill interactively) can be found at **www.arrl.org/resources-for-ves**.



NCVEC QUICK-FORM 605 APPLICATION
AMATEUR OPERATOR/PRIMARY STATION LICENSE

SECTION 1 - TO BE COMPLETED BY APPLICANT

FRONT: LAST NAME | SUFFIX (JR., SR.) | FIRST NAME | M.I. | STATION CALL SIGN (IF ANY)

MAILING ADDRESS (Number and Street or P. O. Box) | FEDERAL REGISTRATION NUMBER (FRN) - IF NONE, THEN SOCIAL SECURITY NUMBER (SSN)

CITY | STATE CODE | ZIP CODE (5 or 9 Numbers) | DAYTIME TELEPHONE NUMBER (Include Area Code)

E-MAIL ADDRESS (MANDATORY)

Basic Qualification Question:
Has the Applicant or any party to this application, or any party directly or indirectly controlling the Applicant, ever been convicted of a felony by any state or federal court? ☐ YES ☐ NO

If "YES", see "FCC BASIC QUALIFICATION QUESTION INSTRUCTIONS AND PROCEDURES" on the back of this form.

I HEREBY APPLY FOR (Make an X in the appropriate box(es))

☐ **EXAMINATION** for a new license grant
☐ **EXAMINATION** for **upgrade** of my license class
☐ **CHANGE** my **name** on my license to my new name
Former Name _____ (Last name) (Suffix) (First name) (MI)
☐ **CHANGE** my mailing address to **above** address
☐ **CHANGE** my station **call sign** systematically
Applicant's Initials To Confirm _____
☐ **RENEWAL** of my license grant
Exp. Date _____

Do you have another license application on file with the FCC which has not been acted upon? | PURPOSE OF OTHER APPLICATION | PENDING FILE NUMBER (FOR VEC USE ONLY)

I certify that:

Figure 1 — Important Reminder: The new NCVEC Form 605 (September 2017 series), which includes the updated basic qualification question section, must be used at exam sessions. Older versions of the form are obsolete.

The last major change to the NCVEC 605 Form occurred in April 2000. Thank you to our VE teams for acclimating to the new form and for your continued support in the field.

Current Question Pools

The three current question pools (and any exam designs based on these question pools) are valid as follows:

Current Technician class (Element 2) pool effective July 1, 2014, is only valid until June 30, 2018.

New Technician class (Element 2) pool will take effect on July 1, 2018, will be valid until June 30, 2022.

General class (Element 3) pool effective July 1, 2015, is valid until June 30, 2019.

Amateur Extra class (Element 4) pool effective July 1, 2016, is valid until June 30, 2020.

Contest Corral February 2018

Check for updates and a downloadable PDF version online at **www.arrl.org/contests**.
Refer to the contest websites for full rules, scoring information, operating periods or time limits, and log submission information.

Start - Finish				Bands	Contest Name	Mode	Exchange	Sponsor's Website
Date	Time	Date	Time					
1	1800	1	2200	28	NRAU 10 Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	www.nrau.net/activity-contests
2	1400	4	0200	All	YLRL YL-OM Contest	CW Ph Dig	Serial, RS(T), SPC	ylrl.org/index.php
3	1400	3	2359	1.8-28	FYBO Winter QRP Sprint	CW Ph Dig	RS(T), SPC, name, power, temperature	arizonascqrpions.apps-1and1.com
3	1400	3	2359	1.8-28	Minnesota QSO Party	CW Ph Dig	Name, county or SPC	www.w0aa.org
3	1600	3	1900	3.5	AGCW Straight Key Party	CW	RST, serial, class, name, age	www.agcw.org
3	1700	3	2100	3.5-28	FISTS Winter Slow Speed Sprint	CW	RST, SPC, name, mbr or power	fistsna.org
3	0000	4	2359	1.8-UHF	Vermont QSO Party	CW Ph Dig	RS(T), county or SPC	www.ranv.org/vtqso.html
3	0001	4	2359	28	10-10 International Winter Contest, SSB	Ph	Name, mbr or "0," SPC	www.ten-ten.org/
3	1200	4	1159	1.8-28	Black Sea Cup International	CW Ph	RS(T), club/org or ITU zone	bscc.ucoz.ru
3	1200	4	1200	3.5-28, 144	F9AA Cup, CW	CW	RST, serial	www.site.urc.asso.fr
3	1200	4	2359	3.5-28	Mexico RTTY International Contest	Dig	RST, XE state or serial	www.rtty.fmre.mx
3	1600	4	2359	1.8-28	British Columbia QSO Party	CW Ph Dig	RS(T), BC district or SPC	www.orcadxcc.org
4	0000	4	0400	3.5-14	North American Sprint, CW	CW	Other station's call, your call, serial, name, SPC	ncjweb.com/Sprint-Rules.pdf
5	1900	5	2030	3.5	RSGB 80 Meter Club Championship, SSB	Ph	RS, serial	www.rsgbcc.org/hf
6	0200	6	0400	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqrp.blogspot.com
7	2000	7	2100	3.5	UKEICC 80 Meter Contest	Ph	4-char grid square	www.ukeicc.com
10	1100	10	1300	7, 14	Asia-Pacific Spring Sprint, CW	CW	RST, serial	jsfc.org/apsprint/aprule.txt
10	1700	10	2100	3.5-28	FISTS Winter Unlimited Sprint	CW	RST, SPC, name, mbr or power	fistsna.org
10	1900	10	2300	1.8	RSGB 1st 1.8 MHz Contest	CW	RST, serial, UK district code (if any)	www.rsgbcc.org/hf
10	0000	11	2359	3.5-28	CQ WW RTTY WPX Contest	Dig	RST, serial	www.cqwpxrtty.com
10	1000	11	1000	1.8-28	SARL Field Day Contest	CW Ph Dig	RS(T), number of xmtrs, category, province (or "DX")	www.sarl.org.za
10	1200	11	1200	1.8-28	Dutch PACC Contest	CW Ph	RS(T), PA province or serial	pacc.veron.nl
10	1200	11	1200	1.8	KCJ Topband Contest	CW	RST, prefecture/district/continent code	www.kcj-cw.com
10	1200	11	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
10	1500	11	1500	1.8-28	OMISS QSO Party	Ph	RS, SPC, mbr (inf any)	omiss.net/Facelift/qsoparty.php
11	1200	11	1800	3.5, 7	Balkan HF Contest	CW Ph	RS(T), serial	arabih.ba
12	0100	12	0259	3.5-14	CQC Winter QSO Party	CW	RST, SPC	www.coloradoqrpclub.org
12	1300	16	2359	All (no WARC)	ARRL School Club Roundup	CW Ph	RS(T), Class (I/C/S), SPC	www.arrl.org/school-club-roundup
14	0000	14	2359	1.8-7	PODXS 070 Club Valentine Sprint	Dig	Name, OM/YL, SPC	www.podxs070.com
14	0130	14	0330	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
14	1900	14	2030	3.5	RSGB 80 Meter Club Championship, Data	Dig	RST, serial	www.rsgbcc.org/hf
17	0800	17	1000	7	SARL Youth Day Sprint	Ph	RS, age	www.sarl.org.za
17	1900	17	2059	1.8-28	Feld Hell Sprint	Dig	RST, name, mbr, SPC, grid	sites.google.com/site/feldhellclub
17	0000	18	2359	1.8-28	ARRL International DX Contest, CW	CW	W/VE: RST, SP; DX: RST, power	www.arrl.org/arrl-dx
17	1200	18	1159	1.8-28	Russian PSK WW Contest	Dig	RST, Oblast or serial	www.rdrclub.ru
17	2300	18	2300	1.8-14	AWA Amplitude Modulation QSO Party	Ph	Name, SPC	www.antiquewireless.org
18	1300	21	0800	1.8-144	Classic Exchange, Phone	Ph	Name, RS, SPC, rcvr/xmtr model	www.classicexchange.org
19	0200	19	0400	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
21	1900	21	2030	3.5	AGCW Semi-Automatic Key Evening	CW	RST, serial, 2-digit year first used a bug	www.agcw.org
22	1900	22	2030	3.5	RSGB 80 Meter Club Championship, CW	CW	RST, serial	www.rsgbcc.org/hf
23	2200	25	2200	1.8	CQ 160-Meter Contest, SSB	Ph	W/VE: RS, SP; DX: RS, CQ zone	www.cq160.com/rules.htm
24	0600	25	1800	3.5-28	REF Contest, SSB	Ph	RS, F Department or serial	concours.r-e-f.org/reglements
24	1300	25	1300	3.5-28	UBA DX Contest, CW	CW	RST, serial, ON province (if any)	www.uba.be/en
24	1500	25	0159	1.8-50	South Carolina QSO Party	CW Ph Dig	RS(T), county or SPC	scqso.com/rules
24	1800	25	0559	3.5-28	North American QSO Party, RTTY	Dig	NA: Name, SPC/DC; DX: Name	www.ncjweb.com
25	0900	25	1700	3.5-28	High Speed Club CW Contest	CW	RST, mbr or "NM"	www.highspeedclub.org
25	1300	25	1600	3.5-14	SARL Digital Contest	Dig	RST, serial	www.sarl.org.za
25	1500	26	0059	3.5-144	North Carolina QSO Party	CW Ph Dig	NC county or SPC	rars.org/ncqsoparty
28	0000	28	0200	1.8-28	SKCC Sprint	CW	RST, SPC, name, mbr or power	www.skccgroup.com
28	2000	28	2100	3.5	UKEICC 80 Meter Contest	CW	4-char grid square	www.ukeicc.com

All dates refer to UTC and may be different from calendar dates in North America. No contest activity occurs on the 60-, 30-, 17-, and 12-meter bands. Mbr = Membership number. Serial = Sequential number of the contact. SPC = State, Province, DXCC Entity. XE = Mexican state. Listings in blue indicate contests sponsored by ARRL or *NCJ*. The latest time to make a valid contest QSO is the minute listed in the "Finish Time" column. *Data for Contest Corral is maintained on the WA7BNM Contest Calendar at www.hornucopia.com/contestcal and is extracted for publication in* QST *2 months prior to the month of the contest. ARRL gratefully acknowledges the support of Bruce Horn, WA7BNM, in providing this service.*

2017 ARRL 10 GHz and Up Contest Results

Mark, WB8TGY, took this photo on the Sunday night of the second contest weekend, looking west across Lake Michigan from his operating position in Manistee, Michigan (EN64tf). [Mark Korroch, WB8TGY, photo]

Call Area Leaders

10 GHz		10 GHz & Up	
Call	**Score**	**Call**	**Score**
Area 0		**Area 0**	
K0CQ	42,216	WB0LJC	48,997
K0MHC	37,936	W0ZQ	36,012
WA2VOI	37,691		
AD7OI	37,577		
Area 1		**Area 1**	
W1AUV	17,330	N1JEZ	25,584
K1GX	14,536	AF1T	25,420
K1CA	14,340	W1MKY	24,617
W1AIM	13,030	W1GHZ	23,710
Area 2		**Area 2**	
N1DPM	20,614	K2DH	21,328
AA1I	20,598	VE2UG	2,418
N3RG	10,213		
KA2LIM/R	6,846		
Area 3			
WA3GFZ	15,419		
K1RZ	14,893		
WA3PTV	8,388		
W2RMA/R	6,550		
Area 4			
K4RSV/R	2,379		
N9ZL	1,959		
AB4CR	1,284		
Area 5		**Area 5**	
WA5YWC	10,509	W5LUA*	13,386
W3XO/5	4,920	AA5C	5,619
K5AND	4,600		
K5LLL	4,461		
Area 6		**Area 6**	
AD6FP	89,611	AA6IW	58,900
WA6CDR	56,815	K6GZA	50,570
KI7GVT	36,635	N9JIM	41,766
N6RMJ	30,482	W6BY	38,287
		W6QIW	38,265
Area 7			
KI5WL	1,866		
KB7NIE	959		
AG7BW	910		
K6JEY/7	111		
Area 8		**Area 8**	
KB8U	17,123	WB8TGY	21,304
WA3TTS	4,199	K8ZR	16,445
		WA8VPD	15,748
		K2YAZ	13,678
Area 9		**Area 9**	
K0KFC	43,301	K9PW	36,774
KA9VDU	11,367	W9SZ	25,543
N9LB	4,113	K9JK	22,168
KO0Z	1,719	W9SNR	17,160
Area 15 (Canada)		**Area 15 (Canada)**	
VE3FN	6,940	VA3ELE	17,445
VE3KH	2,948	VE3SMA	16,469
VE2GT	2,459	VE4MA*	11,944
VA3CDD	2,451	VE3EG	6,283
		VE3FHM	4,706
Area 20 (DX)			
XE2HWB	127		

(* = Includes one or more EME contacts)

Top Ten Scores

10 GHz Only		10 GHz & Up	
Call	**Score**	**Call**	**Score**
AD6FP	89,611	AA6IW	58,900
WA6CDR	56,815	K6GZA	50,570
K0KFC	43,301	WB0LJC	48,997
K0CQ	42,216	N9JIM	41,766
K0MHC	37,936	W6BY	38,287
WA2VOI	37,691	W6QIW	38,265
AD7OI	37,577	K9PW	36,774
KI7GVT	36,635	W0ZQ	36,012
KA9VVQ	33,267	N6NU	33,042
KC0IYT	33,264	N1JEZ	25,584

Best DX by Band in Kilometers

10 GHz		47 GHz	
Call	**Best DX**	**Call**	**Best DX**
VE4MA*	2,492	N1JEZ	276.6
W5LUA*	2,114	WA1MBA	126.2
W6SR	673	KA1OJ	126
K6GZA	660	W1FKF	126
WA6CDR	660	KA1NKD	126
K6ML	659	K9PW	105
N6NU	659	K2DH	93
K8ZR	658	W1GHZ	90
W3XO/5	657	AF1T	89.6
N9JIM	652	W1MKY	89.6
N6RMJ	651	WB8TGY	54
W6BY	651	WA8VPD	54
AD6A	620	W1JHR	23
K6TJ	619	W1EX	21.1
24 GHz		**75 GHz**	
Call	**Best DX**	**Call**	**Best DX**
W6BY	295.4	WA1MBA	21.1
K6ML	256	KA1OJ	21
N9JIM	255.8	VE4MA	1
K6GZA	236		
N6NU	209		
AA6IW	201	**300 GHz**	
N6TEB	201	**Call**	**Best DX**
KI6HQR	201	VE3EG	4
VA3ELE	198	VE3SMA	4
VE3SMA	197		
KA1NKD	194		
W1FKF	194		
K2DH	194		
N1JEZ	193.3		

(* = Includes one or more EME contacts)

Best Terrestrial DX by Band

Call	Band	Distance (km)
W6SR	10 GHz	673
W6BY	24 GHz	295.4
N1JEZ	47 GHz	276.6
WA1MBA	75 GHz	21.1
VE3SMA/VE3EG	300 GHz	4

Logs Received by Call Area

Call Area	Entries
0	18
1	20
2	6
3	6
4	3
5	16
6	25
7	4
8	8
9	9
VE	11
DX	1

Full Results Online

You can read the full results of the contest online at **www.arrl.org/contest-results-articles**. You'll find detailed analysis and more play-by-play, along with the full line scores. Improve your results by studying your log-checking report, too.

The 2018 ARRL 10 GHz and Up Contest will be held the third full weekends of August and September (August 18 – 19, 2018, and September 15 – 16, 2018).

2017 ARRL 222 MHz and Up Distance Contest Results

Participants chose to go the distance in this new contest.

John Kalenowsky, K9JK, k9jk@arrl.net

The first weekend of August 2017 brought the inaugural running of ARRL's 222 MHz and Up Distance Contest, replacing the August UHF Contest, which had a 38-year run from 1978 to 2015. This was one of the first major event revisions resulting from the efforts of the VHF and Above Contest Revitalization working group.

Among the major revisions were:

- Simplification of the category structure to just three categories — Single Operator, Multioperator, and Rover (no power level or band distinctions).
- Distance-based scoring with multipliers for different bands to encourage activity on less active bands.
- Establishment of 18 Regions, replacing the legacy Section and Division structure for competition.
- Implementation of Team competition within the contest (Small Teams with two to five members, and Large Teams with six to ten members).

The number of contacts submitted on each band.

- Reduction of the log submission period to 15 days after the end of the contest. Also, logs were only accepted electronically (mailed paper logs were not accepted).

Logs and Activity

Even with the shortened log submission deadline, 199 logs were submitted and accepted. By category, there were 34 Rovers, 158 Single Operators, and 7 Multioperators. Of the 18 competition Regions, logs were received from 15 of them. Single Operator logs were received from all 15, Rover logs from 13, but only 4 of the Regions garnered Multioperator log submissions. This is not too surprising, as the August UHF Contest typically experienced low Multioperator submissions as well.

There was no "rush" of activity on the bands with the higher score multipliers. Of the six bands with 20 times score multipliers (24, 47, 75, 122,

Activity by Band

Band	Logs	QSOs	Points
222 MHz	161	2,114	760,266
432 MHz	189	2,539	422,672
902 MHz	92	614	382,544
1.2 GHz	123	990	271,574
2.3 GHz	48	289	256,572
3.4 GHz	37	151	166,280
5.7 GHz	31	176	224,780
10 GHz	40	192	162,132
24 GHz	9	16	1,360

Club Competition — Medium Category

Club	Points	Logs
Mt. Airy VHF Radio Club	303,557	13
Florida Weak Signal Society	297,351	7
North East Weak Signal Group	209,522	13
Pacific Northwest VHF Society	98,731	21
New Mexico VHF Society	81,592	12
Roadrunners Microwave Group	65,503	3
Northern Lights Radio Society	59,572	6
Society of Midwest Contesters	23,353	3
Michigan VHF-UHF Society	22,890	4
Yankee Clipper Contest Club	5,439	3

Results Summary of Top Scores

Region	Rover	Single Operator	Multioperator
Washington, Oregon, British Columbia, Northwest Territories (25 entries)	WW7D/R 23,131	K7YDL 8,557	
Idaho, Montana, Alberta (no entries)			
California, Nevada (12 entries)	N6JET/R 15,547	KC6ZWT 15,202	
Colorado, Utah, Wyoming (9 entries)	N6NB/R 116,639	K6EY 25,086	W6TE 21,611
Arizona, New Mexico, and West Texas Section (17 entries)	K9PW/R 29,639	W7QQ 22,210	KC5MVZ 326
North Dakota, South Dakota, Manitoba, Saskatchewan (3 entries)		NT0V 11,797	
Kansas, Nebraska, Missouri (3 entries)		WD0BQM 4,045	
Arkansas, Louisiana, Oklahoma, North and South Texas Sections (14 entries)	W5VY/R 116,639	W5LUA 41,126	
Illinois, Indiana (4 entries)	W9SNR/R 26,403	W9SZ 11,535	
Iowa, Minnesota, Wisconsin (11 entries)	W0ZF/R 1,718	W0UC 39,866	
Michigan, Ohio, Ontario, Northern and Western New York Sections, Western Pennsylvania Section (21 entries)	KF2MR/R 62,560	VE3ZV 46,217	N8ZM 38,771
Kentucky, Tennessee (7 entries)	AG4V/R 21,445	N4QWZ 30,454	
Alabama, Florida, Georgia, Mississippi (14 entries)	K4SME/R 73,542	K0VXM 90,542	
Delaware, North Carolina, Virginia, West Virginia, Maryland-DC Section (8 entries)	N9ZL/R 1,964	K1RZ 150,294	
New Jersey, Eastern New York, Eastern Pennsylvania, and New York City-Long Island Sections (25 entries)	NN3Q/R 48,182	N3RG 50,703	N2NT 37,478
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, Quebec (26 entries)	AA1I/R 11,947	K1TEO 146,148	
Maritime (no entries)			
DX/Any other areas including Alaska, Hawaii, US possessions and maritime mobile (no entries)			

Team Competition

Large Teams (6 – 10 members)	Score	Members
Californians and Friends Visiting Colorado	253,978	N6KYS, N6KLO, N6NB, W6TE, WB6ITM, N6EY, N6JMK, K6MI
Small Teams (2 to 5 members)		
Alpha Hotel	271,896	K4SME, K4RSV, N2CEI, K0VXM
Really Weak Signal Group	258,337	N1JEZ, K1TEO, W1AIM, AF1T
Roverunners	97,074	W7QQ, NK5W, KK6MC/R, K9PW/R, W0VOA/R
Going the Distance	34,280	K9JK/R, W9SNR/R, KO9A
UHF Da!	3,114	AE0EE/R, W0ZF/R

Jarred, KF2MR/R, shared that "A view down the 2304 MHz antenna revealed it was more crooked than I thought. Because it was working well, I didn't bother messing with it. This view is from FN02 in western New York, pointing toward EN94 in Canada." [Jarred Jackson, KF2MR, photo]

141, and 241 GHz), the only band with activity reported was 24 GHz, with a total of 16 contacts from 9 logs.

Strike up the Band(s)

The 70-centimeter band was the most popular (as it typically was in past UHF contests), with 189 logs reporting over 2,500 contacts. The 222 MHz band was not far behind with just over 2,100 contacts from 161 logs. The third most popular band was 1.2 GHz. The total number of contacts came in just under 1,000 at 990, with 123 logs showing activity there.

The impact of the multipliers on the distance points is interesting, with total points for the contacts on 222 MHz being almost 80% higher than the total points for 432 MHz.

About 75% of the logs received (149 out of 199) reported four (or fewer) bands used, with the bands frequently being from among the "bottom four" bands (222, 432, 902 MHz, and 1.2 GHz). This was true of all 25 logs from Region 1, all 12 from Region 3, and the 3 from Region 7 (though one of the logs from Region 3 skipped over the 1.2 GHz band to report a contact on 2.3 GHz).

The 50 logs reporting use of five or more bands were spread across the regions, with Region 4 being notable because eight of the nine logs from the region fit that criteria (thanks in large part to the "Californians and Friends Visiting Colorado" team that travelled there). Region 15 also carried its weight, with 11 of their 25 logs including contacts on five or more bands.

Teams and Clubs

Six team registrations were received — one Large Team and five Small Teams, each from a different region, so each team was the winner for their region. These teams only represented 25 of the logs submitted, leaving plenty of room for more team activity in 2018.

Over half the logs submitted (111 of 199) credited one of 30 clubs, but only 10 satisfied the criteria of a minimum of three logs to be eligible for the Club Competition. Thirteen logs from the Mt. Airy VHF Club Packrats netted an aggregate score of 303,557, to claim the Medium Club gavel for this inaugural event. The Florida Weak Signal Society gave the Packrats a run for their money, with an aggregate total of 297,351 from seven logs to finish 6,206 points (just over 2%) behind. The Pacific Northwest VHF Society deserves mention for overall participation, with 21 logs submitted.

Next Year

The first weekend of August 2018 will bring the second running of the 222 MHz and Up Distance Contest, starting at 1800 UTC on August 4 and ending at 1800 UTC on the 5th. Here's hoping that participation will increase, including more activity on the bands with higher point multipliers. Perhaps more teams will be formed as well. Start planning now for the 2018 222 MHz and Up Distance Contest.

Feedback

- In the article "Testing the Eclipse's Effect on 80 Meters with WSPR" by Barry Pfeil, K6RM, published in the January 2018 issue of *QST*, the arrow in the DXplorer graph on page 75 should be pointing to a sharp peak that occurred during the regular daytime lull between 1300 UTC on August 21 and 0100 UTC on August 22. In addition, it is important to emphasize that WSPR beacons on the HF bands must function with an operator in control, either on site or remotely, with the exception of beacons operating between 28.200 to 28.300 MHz.

Bernie McClenny, W3UR, w3ur@arrl.org

How's DX?

DXpedition Pet Peeves

Recently, I asked subscribers of "The Daily DX" and "The Weekly DX" to tell me one pet peeve that they have about DXpeditions, with suggestions for solving it.

The top three complaints were not knowing propagation differences around the globe, not identifying the split range, and failing to identify. Let's find out how we can avoid these missteps and respect the efforts our fellow Amateur Radio operators put into going on a DXpedition.

1 Paying Attention to Propagation

Some DXpedition operators do not realize there are major differences in propagation from the east to the west and from the north to the south, both in North America and Europe. The same can be said for Africa, Asia, South America, and the entire Pacific Ocean. As an example, "the distance between [the US] coasts are about 4,500 kilometers," noted Alan, K6SRZ. The path from the east coast to Europe and Africa are "over the water," while the west coast must go via a polar path to Europe and the Middle East.

Sometimes, the DXpedition operator will take the path of least resistance, contacting the loud stations that have longer propagation windows, neglecting the weaker stations from the more difficult propagation areas with shorter time frames.

Graham, VK3GA, suggests listening for weaker and/or less populated areas for about 5 minutes every 30 minutes or so, and posting likely times for these tougher areas on the team's website.

Many British Isles DXers often seem to get the short end of the stick; their window of opportunity typically peaks just after mainland Europe propagation begins to diminish and the North American east coast conditions begin. DXpeditions often miss this short time for contacting all the Gs, GMs, GWs, EIs, etc.

Solutions to solve some of the propagation issues include the DX community notifying the DXpedition's pilot station(s) of openings that the DXpedition may not be aware of. Team members should study propagation forecasts before heading to their DX destination. Club Log offers very good statistical information. It would also be a good idea for the DXpedition to have someone on the team reviewing log data from the previous day's activities to spot the unique openings and focus on the most difficult paths for the upcoming days. Above all, it's important for the DXpedition team to react quickly and notify the DX community of any special openings they wish to focus on. That can be done via the team's website, their pilots, and the various DX outlets.

2 Making Split Operations More Efficient for Listeners

The second biggest obstacle for contacting DXpeditions was operators not providing information about where they are listening. It is not enough for a DXpedition operator to give his call and just say, "Up." It is more helpful to indicate whether on SSB, CW, or RTTY, and to specifically say where you are listening. Otherwise, you may get someone calling up 1 kHz on phone or up

Resources for Mastering the Basics

Having a firm grasp on the fundamentals of DX operation will contribute to a better experience all around. I would highly suggest that anyone going on a DXpedition, or even just a holiday-style operation, read Wayne Mills's, N7NG, "DXpeditioning Basics" pamphlet at **http://www.arrl.org/files/file/DXCC/dx-basics.pdf**. Mills covers how to organize yourself and manage problems during DXpeditions while keeping in mind the main goal — having fun. Another recommendation is *DXpeditioning: Behind the Scenes*, by David Cheadle, G3NUG, and Steve Telenius-Lowe, G4JVG, a highly-rated manual covering all aspects of DXpeditions.

Wayne Mills's, N7NG, "DXpeditioning Basics" provides helpful tips.

DXpeditioning: Behind the Scenes describes what to do when on the other end of the pileup.

100 Hz on CW or RTTY, which will cause tremendous unnecessary interference very close to your transmit frequency. Just spinning your receiver dial after each contact sends the listening pileup into chaos that could be avoided by providing just a little more information.

Try saying, "Listening 5 – 10 kHz up," or, "I'm listening between 190 and 195." On CW, a typical good starting point for listening split is to go up or down 1 kHz. Instead of sending "TU UP" after each CW contact, it's best to send "TU U1" ("Thank you, up 1"). On SSB, one should start operating split at 5 kHz. It's always good practice to start with a minimum split and, if need be, enlarging the listening range. Regardless, DXpedition operators should announce their split ranges often, because every few minutes more listeners join the pileup.

3 The Importance of Identifying

The third biggest suggestion from DXers to DXpeditioners is to identify yourself. That is, give your call sign clearly and, if on phone, with recognized phonetics. If on CW, don't send your call at 40 WPM, and if on SSB, don't use alternate phonetics. It's not necessary to give your call after every contact, but probably best every three to 10 contacts. Not identifying often enough leads to chatter on top of the DX station, asking, "What's his call?" Also, if there are several DXpeditions happening at the same time, it helps lessen the confusion.

Wrap-Up

Keep an eye out for upcoming DXing tips. See you on the air from V47JA from January 29 to February 12. Don't forget to send your DX, IOTA, and contest expedition news to **Bernie@dailydx.com**. Until next month, see you in the pileups! — *Bernie, W3UR*

Additional Concerns

Interference Difficulties

DQRM, or deliberate QRM, was also cited as one of the bigger issues when trying to work a DXpedition. Although, for the most part, DXpeditions aren't really the cause of DQRM, it certainly is a widespread problem. The best reaction to DQRM is to ignore it on the air. If you can identify the offender, do so, and turn them over to the proper authorities, but do not engage with deliberate QRMers on the air.

Further down the list of objections is accidental QRM. We all need to realize people make mistakes. In instances where interference was likely accidental, we need to give the "offender" a break, rather than adding to the confusion.

Call Areas and Band Edges

If a DXpedition chooses to listen for call areas, they should be very careful to make sure they spend the same amount of time on each call area. If a DX station is contacting stations with the number 3, they should never contact other numbers. This frustrates the rest of the audience, who have been waiting patiently for their turn.

DXpeditioners operating on the digital modes (RTTY) should be aware of the band plans, especially on 17 and 30 meters. Mike, W2LO, noted, "DXpeditions will often start on 10,145 or 18,105 kHz and say 'Up,' but there isn't that much 'Up' left!" The digital band ends at 18,108 kHz (in the US) on 17 meters and, no matter what mode, ends at 10,150 kHz.

Second Century

(continued from page 9)

The danger is that the FCC could utilize this principle to (1) demand very specific operating parameters and hypothetical reference circuits to define and limit those amateur uses that are entitled to interference protection, or (2) determine that a given radio technique or emission type does not include sufficient interference rejection techniques in receivers to mitigate interference, and so deny interference protection arbitrarily.

If you've read this far, I thank you for your patience.

While there appears no cause for outright alarm, at this point, vigilance is the best posture. In the League's circles, the FCC Notice was sufficiently concerning that the ARRL Electromagnetic Compatibility Committee, chaired by Board member Kermit Carlson, W9XA, is gathering for an unscheduled meeting in Newington even as I write this piece in mid-December. Working together with ARRL Lab Manager, Ed Hare, W1RFI, and his staff; Regulatory Information Manager Dan Henderson, N1ND, and General Counsel Chris Imlay, W3KD, the team will spend the weekend beginning the process of formulating a persuasive set of comments for the Board to review in January.

In the meantime, I ask all of you to remain informed on this process. To repeat: it's important for all of us to understand fully, and respond appropriately to, these FCC spectrum policy proposals. Please read ARRL's comments and let your ARRL Board representative know your thoughts.

Tom Gallagher N4ARF

Jon Jones, N0JK, n0jk@arrl.org

The World Above 50 MHz

Exploring Sporadic-E Propagation with FT8

Sporadic E allows us to make contacts over thousands of miles on 50, 144, and even 222 MHz. Sometimes, even low-power and simple antennas work well. But the mechanism creating sporadic E is still not well understood by scientists, and predicting the occurrence of sporadic E is possible only in a general statistical way. We know sporadic E is most common in the months of May, June, and July in the Northern Hemisphere. There is a minor peak around the winter solstice. It peaks in the Southern Hemisphere during their summer. E_s tends to occur more often in mid-morning and early evening. Signals most often propagate "one hop" out to about 2,200 kilometers. Some days, when there is considerable E_s and the geometry of the E_s clouds lines up, signals can propagate two, three, and even four hops. There is signal loss with each hop, though. It appears the path from North America to Japan is open much more frequently and with higher signal levels than would be expected by traditional multi-hop sporadic E.

The generally accepted theory proposed by scientists for mid-latitude sporadic-E formation is that it is caused by wind shears occurring about 120 kilometers above the Earth. The wind shears compress and pile up meteoric dust ions present, such as Fe+, Mg+, and K+ into thin, dense layers. Electrons follow these ions, and these dense electron layers can then refract radio signals back to Earth. Joe Dzekevich's, K1YOW, article, "Upper-Level Low and 6-Meter Sporadic E," in the December 2017 issue of *QST*, discussed an interesting hypothesis that mid-latitude sporadic-E openings may be enhanced by "strong neutral atmospheric disturbances, like hurricanes." Amateur Radio operators' observational skills could help discover if there is a relation between lower atmospheric weather systems and the E-layer of the ionosphere. Low-pressure system enhancement along with E-layer wind shear might explain the extremely intense summertime sporadic E that can refract 144 and 222 MHz signals.

Joe, K1YOW, noted that the new digital modes for 50 MHz, such as JT65 and FT8, can be monitored by unattended stations. The Reverse Beacon Network (RBN) can also monitor CW stations and beacons. This allows more data to be gathered, as monitoring can be done 24/7. Another potential benefit of FT8 is that it can detect signals "below the noise."

In "Understanding Propagation with JT65, JT9, and FT8," from the October 2017 issue of *QST*, Carl Luetzelschwab, K9LA, discussed how the new digital modes can help

Figure 1 — Sporadic-E trans-equatorial propagation to Paraguay on March 10, 2005.

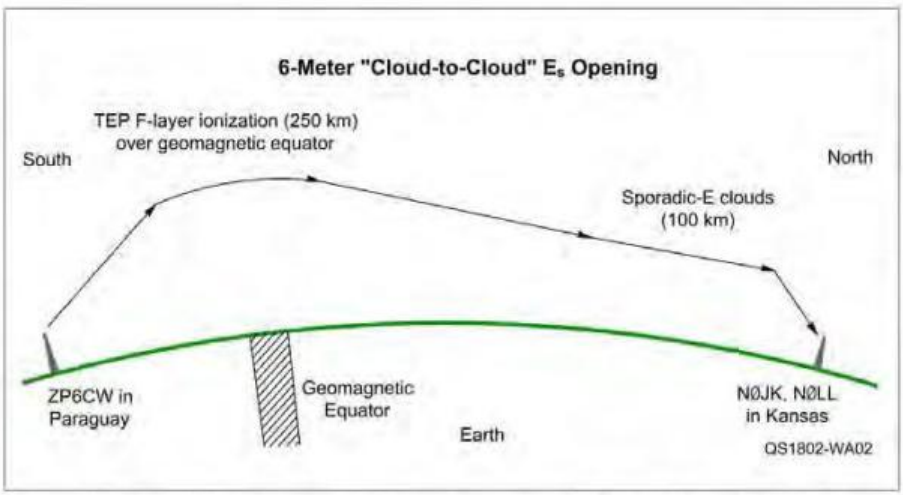


Figure 2 — F-layer ionization over the geomagnetic equator (TEP) during a combination TEP and cloud-to-cloud E_s opening contact from the midwest US to Paraguay on 6 meters on March 10, 2005. [Ken Neubeck, WB2AMU, photo]

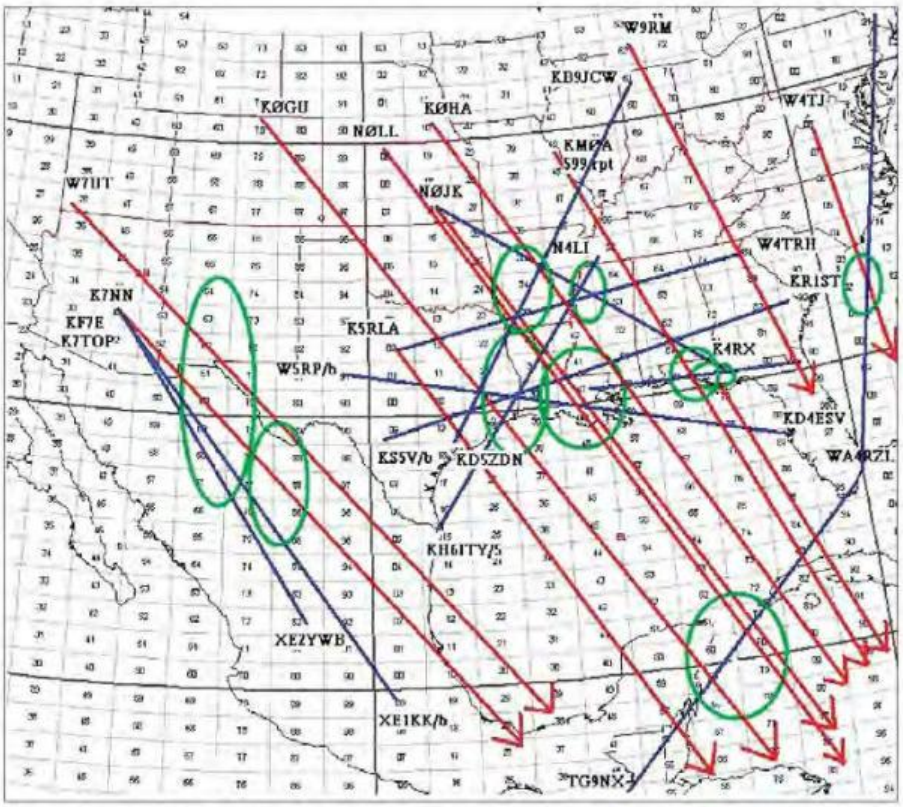


Figure 3 — ZP6CW's contacts (red) with one-hop E_s (blue) and E_s clouds (green ovals). These are for CW. FT8 and the RBN can now add more plots to better define openings like this.

us to understand propagation. Carl's article was about HF propagation, but the same principles apply to VHF sporadic E. FT8 may allow reception of signals "above the MUF" of sporadic-E clouds. Carl discussed an example of a 10-meter (28 MHz) path between Spokane, Washington, and Cleveland, Ohio, via the F2-layer. By using FT8, signals can be received on 28 MHz with an F2 MUF all the way down to 23 MHz. The signals propagate by "forward scatter," but with higher loss. The weak-signal capability of FT8 can make the path work. The same can occur on 50 MHz — weak signals may be detected by FT8 down to an E-layer MUF of around 45 MHz, or even lower. FT8 can help reveal some sporadic-E paths that may not be apparent to those using analog modes. FT8 may also help find 6-meter signals propagated by mid-latitude sporadic E to link to other exotic modes of propagation, such as trans-equatorial propagation (TEP), polar and equatorial sporadic E. A number of these unusual 50 MHz paths were worked during the summer and fall of 2017 by stations using JT65. Examples include New York to E51, Oklahoma and California to Argentina, Michigan to Australia, and the Middle East to New England. Some of the more interesting sporadic-E links to TEP occur around the equinoxes. On March 10, 2005, an extensive sporadic-E opening across much of the southern states and Gulf of Mexico created E_s links to TEP to Paraguay (see Figures 1 and 2). ZP6CW made many stateside 6-meter contacts that day (see Figure 3).

Amateur Radio operators have the opportunity to make significant contributions to the understanding of sporadic-E propagation. Our new digital tools, along with access to research papers in ionospheric sporadic-E propagation, global weather, and geomagnetic activity observations on the internet can let us contribute to the field of radio propagation science. Joe, K1YOW, concluded, "It is an exciting time for discovery."

Quick 6-Meter Mobile Antenna

Here is a construction project where you really don't have to build much. The popular ⅝-wave 2-meter magnetic mount whip antenna is ubiquitous, due to the high level of 2-meter FM activity. But if you need a quick, effective 6-meter mobile antenna, the 2-meter ⅝-wave whip is about ¼ wave long on 50 MHz. The loading coil is essentially invisible at 50 MHz. Thus, you have two bands — 50 and 144 MHz — mobile with one antenna. You may have to adjust the length a little to optimize the standing-wave ratio (SWR) on 50 MHz. For local and tropospheric work, SSB, CW, and digital stations use horizontal polarization. For sporadic E, the polarization of the antenna does not affect signals.

On the Bands

50 MHz. November showed the expected start of the winter sporadic-E season with a number of openings reported during the month. On November 2, WA2GFN (FN20) started off working KD4ESV (EL87). On November 4, he logged VE9WGD (FN57) and KT1R (FN54).

Aurora made an appearance on November 7. This was due to a fast-moving stream of solar wind from a coronal hole. It sparked a stronger-than-expected G2-class geomagnetic storm with visible aurora seen as far south as Nebraska. On 6 meters, K0SIX (EN35) and K0EKL (EN37) made SSB contacts in Wisconsin and Michigan around

Figure 4 — Brad Fuller's, WQ5S, setup from his recent grid expedition on November 2017. He credits Craig Nance, supervisor at the McDonald Observatory, for allowing him to operate. [Brad Fuller, WQ5S, photo]

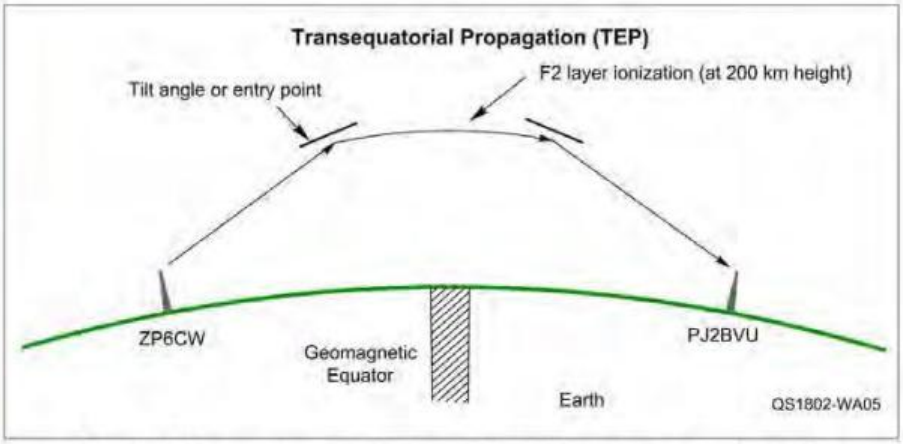


Figure 5 — ZP6CW's contact with PJ2BVU on 50.110 MHz via TEP on March 8, 2005. [Ken Neubeck, WB2AMU, photo]

2310Z. K8JA (EN82) reported an aurora contact with WU1ITU (FN65) at the same time. I saw radio aurora spotted on 6 meters as far south as N0AN (EN22) in Iowa. One reason this aurora was strong was the leading edge of the stream contained a co-rotating interaction region (CIR), which are transition zones between slow- and fast-moving streams of solar wind; they hold density gradients and strong magnetic fields.

On November 17 and 18, Brad, WQ5S, made a short weekend grid expedition to DM70 and DM80. He made five meteor scatter contacts from DM80 and seven from DM70. He even managed some mobile meteor scatter contacts from DM81, DM92, and EM02 with AI5I, N0LWF, and W0VTT (see Figure 4).

The month closed out with a major sporadic-E opening on November 28 – 29. From EM28 I heard the XE2O/b (EL05) and logged W1RAJ (EM72), W4RER (EL89 both SSB and CW), K5VWZ (EL28), NM5Z (EM41), K4DJ (EM95), and WB7PMP (EM95) from 0015 – 0200Z. AC2PB (FN20) heard NC6K (DM13) at 0053Z. Dave, NM5Z, reported 26 contacts, seven on CW, and the rest via FT8. Peter, WA2GFN, made 13 contacts, including a double-hop contact with N7HD (DM34). N2CJ (FN30) also worked N7HD at 0104Z. K1TOL spotted XE2JS (DL68) on FT8 at 0123Z. At 0225Z, WB7PMP (EM95) worked AA7WB (DM26) on SSB for another double-hop contact. There was a good mix of SSB, CW, and FT8 contacts spotted on the DX cluster. On November 30, KF4WE (EM56) had a strong opening at 0032Z to New England, putting K1MAA, KB1HY, WZ1V, N1KOH, K1IED (all FN31), and KA3QWO (FN20) in his log on SSB in a few minutes.

144 MHz. A few aurora contacts took place on 2 meters during the November 7 aurora. W9EWZ (EN52) spotted the N8PUM/b (EN66) starting at 2135Z, then K4RTS (FM08), K9MU (EN44), and KA1ZE/3 (FN01). Unseasonably warm weather occurred in many parts, and tropo appeared as well. On November 15, K5SW (EM25) worked KE8FD (EM64) at 1415Z on CW at 744 kilometers. Brad, WQ5S, found tropo from DM80 to the Dallas/Fort Worth metroplex. He worked AA5C, WA5TKU, and W5LUA (all EM13) using JT65 on tropo. He also made a few MSK144 meteor scatter contacts from both DM70 and DM80 (see Figure 5). Then K5SW worked XE2OR (DL98) with 58 signals at 961 kilometers at 0330Z on November 18. He says Rafael also worked W5FH (EL29) and N5SYV (EM32). On November 29, some trans-Gulf of Mexico tropo took place between Texas and Florida. W5FH (EL29) worked KD4ESV (EL87) with solid signals around 1300Z.

2304 MHz. Steve, N4PZ (EN52), worked WA6PY (DM13) on November 10 for his first EME contact on this band via CW with 549/559 signals. Steve runs 300 W. WA6PY is operational on EME for seven different bands from 144 MHz through 10 GHz.

Here and There

Regarding the first 6-Meter BBQ (pictured in the December 2017 "World Above 50 MHz" column), Bob, K6QXY, says he believes the picture was taken in 1984. In the middle row, Art is W6RXQ, "unknown" is Roy, W6UXN (SK). Bob says Roy was an early 6-meter operator from Los Angeles. In the front row, Al is K6MXI (SK).

Special Event Stations

Working special event stations is an enjoyable way to help commemorate history. Many provide a special QSL card or certificate!

Jan. 1 – Mar. 31, 0000Z – 2359Z, EI50AOM, Baltimore, County Cork, Ireland. EI2KA. **50th Anniversary of Tuskar Rock Air Tragedy**. 21.317 18.127 14.217 7.127. QSL. Tim McKnight, EI2KA, Gortadrohid, Ringarogy Island, Baltimore, County Cork, Ireland. **www.qrz.com/db/ei50aom**

Jan. 18 – Jan. 22, 0000Z – 0000Z, K7B, Lake Havasu City, AZ. London Bridge Amateur Radio Association. **Lake Havasu City 8th Annual Balloon Festival**. 18.145 14.255 7.255 3.900. Certificate. Garry F. Fisher, 1850 Rainbow Ave. S., Lake Havasu City, AZ 86403. *This listing reflects a date change from what appeared in the Jan. 2018 issue of* QST. **k9wzb1@gmail.com**

Feb. 1 – Feb. 28, 0000Z – 2359Z, N9SES, Lake Station, IN. Arab QRZ International. **JY1 Memorial Special Event**. 14.250 14.025 7.185 7.025. QSL. Ayman J. Azar, 8261 Decatur St., Lake Station, IN 46405. *Look for worldwide participating stations; some call signs are: 7X5TV, OD5NJ, OD5YY, 4X6TT, SU1HZ, KK4OW, KK4OK, KA2HTV, and N9SES.* **www.arabqrz.com/jy**

Feb. 3, 1600Z – 2300Z, K7T, Tucson, AZ. Oro Valley Amateur Radio Club. **170th Anniversary of the Treaty of Guadalupe Hidalgo**. 14.250 14.070 7.200 7.070. Certificate. Via e-mail only to: **hfsig@tucsosnhamradio.org** for PDF. *No paper QSLs, please.* **www.tucsonhamradio.org**

Feb. 3, 1700Z – 2300Z, K8PRC, Louisville, OH. Pedestrian Amateur Radio Club. **3rd Annual Cabin Fever Special Event**. 14.250 14.050 7.250 7.050. Certificate & QSL. K8PRC, 1661 Manor Ave. NW, Canton, OH 44708. **www.qrz.com/db/k8prc**

Feb. 3 – Feb. 4, 1500Z – 2200Z, K5C, Nacogdoches, TX. Nacogdoches Amateur Radio Club. **Space Shuttle *Columbia* Special Event**. 21.350 14.270 7.220. QSL. Nacogdoches Amateur Radio Club, 167 C.R. 2093, Nacogdoches, TX 75965. *All contacts will be confirmed via LoTW.* **w5nac.com**

Feb. 4 – Feb. 17, 1500Z – 0400Z, W9U, Terre Haute, IN. Wabash Valley Amateur Radio Association. **90th Anniversary**. 14.250 7.250 3.885. Certificate. Wabash Valley Amateur Radio Assoc. Inc., c/o W9U, P.O. Box 10081, Terre Haute, IN 47801.

Feb. 10, 1700Z – 2359Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum Ship. **Mt. Suribachi Flag Raising**. 14.320 7.250; PSK31 on 14.070; D-STAR on REF001C. QSL. USS *Midway* (CV-41) COMEDTRA, 910 N. Harbor Dr., San Diego, CA 92101.

Feb. 10 – Feb. 11, 1500Z – 1500Z, W1O, East Berlin, PA. WO4L. **O.M.I.S.S. QSO Party**. 18.155 14.265 7.185 3.830. QSL. Robert J. Hess, 74 Curtis Dr., East Berlin, PA 17316. *All QSLs go to home call WO4L or e-QSL (W1O), not to O.M.I.S.S. bureau, unless contact is on a regular net.*

Feb. 14 – Feb. 18, 0001Z – 2359Z, N4DAB, Daytona Beach, FL. Daytona Beach CERT Amateur Radio Club. **2018 Daytona 500 — Speedweeks**. 14.265 14.070. Certificate & QSL. Daytona Beach CERT ARC, c/o Steve Szabo, WB4OMM, 536 Central Park Blvd., Ponce Inlet, FL 32127. **wb4omm@arrl.org** *or* **www.daytonacert.net/?page_id=437**

Feb. 16 – Feb. 18, 1200Z – 2100Z, WA1WCC, Chatham, MA. WCC Amateur Radio Association. **ChathamRadio/WCC Transmitter Site 70th Anniversary Celebration**. 14.262 14.042 7.042 3.532. QSL. WCC ARA, P.O. Box 1528, West Chatham, MA 02669. **www.wccara.com**

Feb. 17, 1400Z – 2000Z, N4HLH, North Charleston, SC. Trident Amateur Radio Club. **SES *H. L. Hunley* Commemorative Station**. SSB: 28.462 14.262 7.262; CW 7.117 SSB. Certificate & QSL.* Brian Freedman W4BFZ, P.O. Box 60732, North Charleston, SC 29419. **tridenthams.org/hunley.htm**

Feb. 17, 1400Z – 2200Z, W0EBB, Leavenworth, KS. Kickapoo QRP Amateur Radio Club. **14th Annual *Freeze Your Keys* Day**. 14.058 14.325 7.035 7.240. QSL. Gary Auchard, 34058 167th St., Leavenworth, KS 66048. *Other bands possible if open.* **w0ebb@juno.com**

Feb. 17 – Feb. 18, 1400Z – 1800Z, K4US, Alexandria, VA. Mt. Vernon Amateur Radio Club. **George Washington's Birthday**. 14.260 7.040. QSL. MVARC, P.O. Box 7234, Alexandria, VA 22307. *Held in the Mt. Vernon estate greenhouse.* **www.mvarc.org**

Feb. 17 – Feb. 19, 1600Z – 2345Z, W0JH, Stillwater, MN. Stillwater Amateur Radio Association and Radio City. **Ice Station W0JH: Frozen Lake Portable**. 21.360 14.260 7.260 3.860. Certificate. Shel Mann, 1618 Pine St. W., Stillwater, MN 55082. *Certificates will only be sent via e-mail as PDFs (send requests to* **IceStationW0JH2018@radioham.org***). Operating portable from a frozen lake in Washington County, MN (grid square EN34).* **www.radioham.org** *or* **www.radioinc.com**

Feb. 24, 1500Z – 2100Z, W0WWV, Wood River, NE. ARAN. **Hastings Naval Depot 75th Anniversary**. 14.250 7.150. QSL. Michael Matthews, KD0QEO, 13330 W. Warren, Wood River, NE 68883. *The Depot produced 40% of all naval munitions for World War II and for the Korean War.* **kd0qeo@gmail.com**

Feb. 28, 1400Z – 2300Z, W7ASL, Mesa, AZ. Sunlife and Venture Out Ham Radio Clubs. **Snow Bird Field Day**. SSB: 28.490 24.980 21.440 18.158 14.340 7.295; PSK31 and FT8 on 20/30/40 meters; EchoLink W7ASL-L; 145.575 Simplex. QSL. Sunlife ARC, 739 N. 63rd Pl., Mesa, AZ 85205. **www.sunlifearc.org**

Certificates and QSL cards: To obtain a certificate from any of the special event stations offering them, send your QSO information along with a 9 × 12 inch self-addressed, stamped envelope to the address listed in the announcement. To receive a special event QSL card (when offered), be sure to include a self-addressed, stamped business envelope along with your QSL card and QSO information. *Note: Some clubs may ask for a nominal fee to cover the cost of the certificate or QSL. Request will be made on air during the event or on the club's website.

Special Events Announcements: For items to be listed in this column, use the ARRL Special Events Listing Form at **www.arrl.org/special-events-application**. A plain text version of the form is available at that site. You may also request a copy by mail or e-mail. Offline completed forms can be mailed, faxed (Attn: Special Events), or e-mailed.

Submissions must be received by ARRL HQ no later than the 1st of the second month preceding the publication date; a special event listing for **April** *QST* would have to be received by **February 1**. In addition to being listed in *QST*, your event will be listed on the ARRL Web Special Event page. Note: All received events are acknowledged. If you do not receive an acknowledgment within a few days, please contact us. ARRL reserves the right to exclude events of a commercial or political nature.

Special Events listed in this issue include current events received through December 10. You can view all received Special Events at **www.arrl.org/special-event-stations**.

Convention and Hamfest Calendar

Abbreviations

Spr = Sponsor
Tl = Talk-in frequency
Adm = Admission

ALABAMA STATE CONVENTION

March 2 – 3, Irondale, AL
D F H Q R S V
Friday 4 – 7 PM, Saturday 8:30 AM – 4 PM. *Spr:* Birmingham ARC. Zamora Shrine Temple, 3521 Ratliff Rd. *Tl:* 146.88 (88.5 Hz). *Adm:* $8. **www.w4cue.com**.

SOUTHWESTERN DIVISION CONVENTION

February 16 – 17, Yuma, AZ
D H Q S T V
Friday noon – 5 PM, Saturday 8 AM – 5 PM. *Spr:* Yuma AR Hamfest Organization. Yuma County Fairgrounds, 2520 E. 32nd St. Country store consignment sales, camping. *Tl:* 146.78 (103.5 Hz). *Adm:* $5. **www.yumahamfest.org**.

Arkansas (Hoxie) — Feb. 17
D F H R S V
8 AM – 3 PM. *Spr:* Lawrence County ARC. Hoxie Service Center, 500 SW Lawrence St. Winterfest 2018. *Tl:* 147.045. *Adm:* $5. **www.w5wra.org**.

Arkansas (Russellville) — Mar. 3
D F H Q R S V
9 AM – 2 PM. *Spr:* Arkansas River Valley AR Foundation. Boys and Girls Club, 600 E. 16th St. *Tl:* 146.22 (131.8 Hz). *Adm:* $5. **www.arvarf.com**.

Colorado (Brighton) — Feb. 18
D F H R S V
9 AM – 1 PM. *Sprs:* Aurora Repeater Association, Cherry Creek Young ARC, Rocky Mountain Ham Radio. Adams County Fairgrounds, 9755 Henderson Rd. RM Ham University Homebrew and Kit-Building Expo. *Tl:* 147.15 (100 Hz). *Adm:* $5. **n0ara.org**.

Florida (Brooksville) — Feb. 17
D F H R T V
8 AM – 3 PM. *Spr:* Hernando County ARA. Sand Hill Scout Reservation, 11210 Cortez Blvd. (Hwy. 50). *Tl:* 146.715. *Adm:* $6. **www.hcara.org**.

Florida (Sebring) — Feb. 17 F H R T
8 AM – 1 PM. *Spr:* Highlands County ARC. First Baptist Church of Lake Josephine, 111 Lake Josephine Dr. 25th Annual Hamfest. *Tl:* 147.045 (100 Hz). *Adm:* $5. **highlandsamateurradio.org**.

WEST CENTRAL FLORIDA SECTION TECHNICAL CONFERENCE

February 24, Winter Haven, FL
R S
9 AM – 5 PM. *Spr:* ARRL West Central Florida Section. Polk County Emergency Operations Center, 1890 Jim Keene Blvd. 4th Annual TechCon. *Tl:* 146.985, 444.625, 443.9, 444.95 (127.3 Hz). *Adm:* Free. **www.arrlwcf.org**.

Florida (Zephyrhills) — Mar. 3
D F H R T V
8 AM – noon. *Spr:* Zephyrhills Area ARC. St. Elizabeth Episcopal Church, 5855 16th St. *Tl:* 146.91 (146.2 Hz). *Adm:* $5. **www.zaarc.org**.

Indiana (Brazil) — Mar. 10 D F H Q R
8 AM – noon. *Spr:* Wabash Valley ARA. Clay County 4-H Fairgrounds, 6550 N. County Rd. 59. Terre Haute Hamfest and Computer Expo. *Tl:* 146.685 (151.4 Hz). *Adm:* $7. **w9uuu.org**.

Indiana (Brownsburg) — Feb. 24
D F H R
9 AM – 2 PM. *Spr:* Hendricks County ARS. American Legion Post 331, 636 E. Main St. *Tl:* 147.015. *Adm:* $5. **www.hcars.org**.

Indiana (Dugger) — Feb. 24 D V
8 AM – noon. *Spr:* Dugger ARC. City Park Community Bldg., 840 Hicum St. *Tl:* 147.775 (136.5 Hz). *Adm:* $5. **www.kc9ak.org**.

Indiana (La Porte) — Feb. 24 D F H R V
7 AM – 1 PM. *Spr:* La Porte County ARC. Civic Auditorium, 1001 Ridge St. *Tl:* 146.61 (131.8 Hz). *Adm:* $7. **lpcarc.org**.

Iowa (McClelland) — Mar. 3 D F H R
8 AM – 1 PM. *Spr:* Southwest Iowa ARC. McClelland Town Hall, 202 Main St. *Tl:* 146.82, 442.225 (136.5 Hz). *Adm:* $4. **swiradio.org**.

Iowa (Perry) — Feb. 24 D F H Q R S V
8 AM – noon. *Spr:* Hiawatha ARC. Perry National Guard Armory, 2930 Willis Ave. *Tl:* 145.19 (114.8 Hz). *Adm:* $7. **www.qsl.net/kd0neb**.

Kentucky (Cave City) — Mar. 3
D F H R T V
7:30 AM. *Spr:* Mammoth Cave ARC. Cave City Convention Center, 502 Mammoth Cave St. *Tl:* 146.94 (114.8 Hz). *Adm:* $6. **www.ky4x.org**.

Maine (Augusta) — Feb. 24
D F H Q R V
8 AM – noon. *Spr:* Augusta ARA. Le Club Calumet, 334 W. River Rd. *Tl:* 146.88 (100 Hz). *Adm:* $5. **www.w1tlc.org**.

Michigan (Livonia) — Feb. 18 D F H R
8 AM – noon. *Spr:* Livonia ARC. Civic Park Senior Center, 15218 Farmington Rd. 47th Annual Swap & Shop. *Tl:* 145.35 (100 Hz). *Adm:* $5. **www.livoniaarc.com/index.php?page=swapshop**.

Minnesota (Saint Cloud) — Jan. 27
D F H Q R S V
8 AM – noon. *Spr:* Saint Cloud ARC. Saint Cloud Armory, 1710 Veterans Dr. Cabin Fever Reliever Hamfest. *Tl:* 147.015 (100 Hz). *Adm:* $8. **hamfest.w0sv.org**.

NEBRASKA STATE CONVENTION

March 10, Lincoln, NE
D F H R S V
9 AM – 2:30 PM. *Spr:* Lincoln ARC. Lancaster Event Center, 4100 N. 84th St. *Tl:* 146.76. *Adm:* $8. **www.k0kkv.org**.

New Jersey (Annandale) — Mar. 10
D F H R S V
8 AM – 2 PM. *Spr:* Cherryville Repeater Association II. North Hunterdon High School, 1445 State Rte. 31. *Tl:* 147.375 (151.4 Hz). *Adm:* $5. **www.qsl.net/w2cra**.

New Jersey (New Providence) — Feb. 24 A F R
1:30 – 4 PM. *Spr:* New Providence ARC. New Providence High School, 35 Pioneer Dr. Annual Auction. *Tl:* 147.255 (141.3 Hz). *Adm:* $8. **nparc.org**.

NEW MEXICO TECHFEST CONVENTION

February 24, Albuquerque, NM
R S
8 AM – 5 PM. *Spr:* Rocky Mountain Ham Radio, New Mexico. NM Veterans' Memorial Event Center, 1100 Louisiana Blvd. SE. *Tl:* TBD (see website). *Adm:* $10. **www.rmham.org/wordpress/new-mexico-techfest**.

New York (Big Flats) — Feb. 24 D H R V
8 AM. *Spr:* LIM AR Group. Big Flats American Legion, 45 Olcott Rd. S. *Tl:* None. *Adm:* $5. **www.ka2lim.com/7.html**.

New York (Hicksville) — Feb. 25
D F H Q R S V
9 AM – 12:30 PM. *Spr:* Long Island Mobile ARC. Levittown Hall, 201 Levittown Pkwy. Long Island Hamfest and Electronics Fair. *Tl:* 146.85 (136.5 Hz). *Adm:* $6. **www.limarc.org**.

NORTH CAROLINA SECTION CONVENTION

March 9 – 10, Concord, NC
D F H Q R S V
Friday 3 – 7 PM, Saturday 8:30 AM – 4 PM. *Spr:* Mecklenburg ARS. Cabarrus Arena and Events Center, 4551 Old Airport Rd. Charlotte Hamfest. *Tl:* 146.655. *Adm:* Advance $8, door $10. **charlottehamfest.org**.

A = AUCTION
D = DEALERS / VENDORS
F = FLEA MARKET
H = HANDICAP ACCESS
Q = FIELD CHECKING OF QSL CARDS
R = REFRESHMENTS
S = SEMINARS / PRESENTATIONS
T = TAILGATING
V = VE SESSIONS

North Dakota (Bismarck) — Feb. 24
F R S V
7 AM – 1 PM. *Spr:* Central Dakota ARC. St. Mary's Grade School, 807 E. Thayer Ave. 28th Annual Hamfest. *Tl:* 146.85 (107.2 Hz). *Adm:* Advance $6, door $7. **www.cdarcnd.com**.

Ohio (Elyria) — Mar. 4 D F H R
8 AM – noon. *Spr:* Northern Ohio ARS. Lorain County Community College, 1005 N. Abbe Rd. *Tl:* 146.7 (110.9 Hz). *Adm:* $7. **noars.net**.

Ohio (Mansfield) — Feb. 18 F H R S V
7 AM – 3 PM. *Spr:* InterCity ARC. Richland County Fairgrounds, 750 N. Home Rd. *Tl:* 146.94 (71.9 Hz). *Adm:* $5. **www.w8we.org**.

Oklahoma (Elk City) — Mar. 3 F H R V
8 AM – 4 PM. *Spr:* West Central Oklahoma ARC. Community Civic Center, 1016 E. Airport Industrial Rd. *Tl:* 146.76 (88.5 Hz). *Adm:* Advance $5, door $8.

Oregon (Rickreall) — Feb. 17 D F H R
9 AM – 3 PM. *Spr:* Salem Repeater Association. Polk County Fairgrounds, 520 S. Pacific Hwy. Overnight camping with hookups ($25). *Tl:* 145.33 (186.2 Hz). *Adm:* Advance $8, door $10. **www.w7sra.org**.

Pennsylvania (Harrisburg) — Jan. 13
F H Q R V
8 – 11 AM. *Spr:* Harrisburg RAC. Vietnam Veterans of America, 8000 Derry St. *Tl:* 146.76 (100 Hz). *Adm:* $3. **www.w3uu.org**.

Pennsylvania (South Park Township) — Feb. 25 D H Q R V
8 AM – 3 PM. *Spr:* Wireless Association of South Hills ARC. Home Economics Bldg., 3735 Buffalo Dr. WashFest 2018 (23rd Annual Hamfest). *Tl:* 146.955, 443.65 (131.8 Hz). *Adm:* $5 donation. **n3sh.org**.

Pennsylvania (Youngsville) — Mar. 10
D F H Q R V
8 AM – noon. *Spr:* BSA Venture Crew 73. Youngsville Volunteer Fire Dept., 222 E. Main St. Warren County Hamfest. *Tl:* 145.11 (186.2 Hz). *Adm:* $5. **www.kb3bsa.com**.

Tennessee (Tullahoma) — Mar. 10
D F H R S T V
8 AM – 2 PM. *Spr:* Middle Tennessee ARS. First United Methodist Church, 208 W. Lauderdale St. On-air HF digital demo on site. *Tl:* 146.7 (114.8 Hz). *Adm:* $5. **www.qsl.net/mtars**.

Texas (Orange) — Feb. 24 D F H R S T V
7:30 AM – 2 PM. *Sprs:* Orange ARC and Jefferson County ARC. Orange County Convention and Expo Center, 11475 FM 1442. *Tl:* 147.18 (103.5 Hz). *Adm:* $8. **www.qsl.net/w5nd/index_files/HAMFEST%20INFO/hamfest%20info.htm**.

Utah (Farmington) — Feb. 24 F R
9 AM – noon. *Spr:* Utah VHF Society. Legacy Events Center, Bldg. #2, 151 W. 100 S. *Tl:* 147.04 (123 Hz). *Adm:* $5 (UVHFS members free). **utahvhfs.org**.

VERMONT STATE CONVENTION

February 24, South Burlington, VT
D F H Q R S V
8 AM – 2 PM. *Spr:* Radio Amateurs of Northern Vermont. Holiday Inn Convention Center, 1068 Williston Rd. HAM-CON, Special Event Station W1V. *Tl:* 145.15 (100 Hz). *Adm:* Advance $6, door $9. **www.ranv.org**.

Washington (Puyallup) — Mar. 10
D F H R V
9 AM – 3 PM. *Spr:* Mike and Key ARC. Washington State Fairgrounds, 110 9th Ave. SW. Overnight RV parking, consignments. *Tl:* 146.82 (103.5 Hz). *Adm:* $9, under 16 free with paying adult. **www.mikeandkey.org/flea.htm**.

To All Event Sponsors

Before making a final decision on a date for your event, you are encouraged to check the Hamfest and Convention Database (**www.arrl.org/hamfests-and-conventions-calendar**) for events that may already be scheduled in your area on that date. You are also encouraged to register your event with HQ as far in advance as your planning permits. See **www.arrl.org/hamfest-convention-application** for an online registration form. Dates may be recorded up to 2 years in advance.

Events that are sanctioned by ARRL receive special benefits, including an announcement in these listings and online. Sanctioned conventions are also listed in *The ARRL Letter*. In addition, events receive donated ARRL prize certificates and handouts. Once the form has been submitted, your ARRL director will decide whether to approve the date and provide ARRL sanction.

The deadline for receipt of items for this column is the **1st of the second month preceding publication date**. For example, your information must arrive at HQ by **February 1** to be listed in the **April** issue. Information in this column is accurate as of our deadline; contact the sponsor or check the sponsor's website for possible late changes, driving directions, and other event details. Please note that postal regulations prohibit mention in *QST* of games of chance, such as raffles or bingo.

Promoting your event is guaranteed to increase attendance. As an approved event sponsor, you are entitled to special discounted rates on *QST* display advertising and ARRL web banner advertising. Call the ARRL Advertising Desk at 860-594-0207, or e-mail **ads@arrl.org**.

February 2018 W1AW Qualifying Runs

Earn your Code Proficiency certificate or endorsements by listening to W1AW Qualifying Runs. Legibly copy at least 1 minute of text by hand and mail the sheet to:

W1AW Qualifying Runs, 225 Main St., Newington, CT USA 06111

Include $10 (check or money order) if this is a submission for your initial Code Proficiency certificate; $7.50 if you are applying for an endorsement (available for speeds up to 40 WPM). Your test will be checked against the actual transmissions to determine if you have qualified.

February Qualifying Runs will be transmitted by W1AW in Newington, Connecticut at 7 PM EST on Wednesday, February 7 (0000 UTC February 8) and at 4 PM EST on Thursday, February 22 (2100 UTC) at 1.802.5, 3.581.5, 7.047.5, 14.047.5, 18.097.5, 21.067.5, 28.067.5, 50.350, and 147.555 MHz. The West Coast Qualifying Runs will be transmitted by K9JM on Wednesday, February 21 at 9 PM PST (0500 UTC on February 22) at 3590 and 7047.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 35 WPM.

Strays

76 Years Between *QST*s

The November 1942 issue of *QST* introduced readers to the youngest Staff Sergeant in the United States Marine Corps at barely 18 years of age: Robert Enemark, W1NLL. Seventy-six years later, Robert Enemark is in *QST* once again as W1EC, a retired engineer and a very active ham.

Marine Staff Sergeant Robert Enemark, W1NLL, in 1942.

Robert Enemark, W1EC, at his home in Florida in 2018.

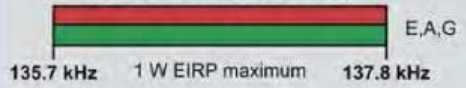
US Amateur Radio Bands

US AMATEUR POWER LIMITS — FCC 97.313 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.

ARRL The national association for AMATEUR RADIO

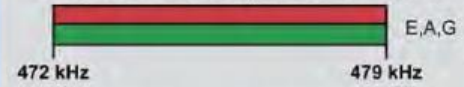
Amateurs wishing to operate on either 2,200 or 630 meters must first register with the Utilities Technology Council online at **https://utc.org/plc-database-amateur-notification-process/.** You need only register once for each band.

2,200 Meters (135 kHz)



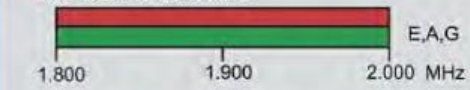
630 Meters (472 kHz)

5 W EIRP maximum, except in Alaska within 496 miles of Russia where the power limit is 1 W EIRP.

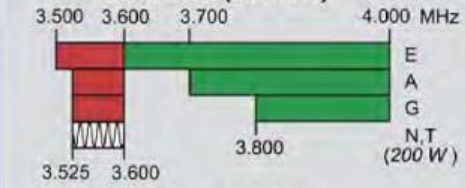


160 Meters (1.8 MHz)

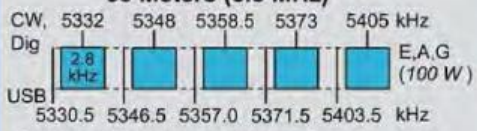
Avoid interference to radiolocation operations from 1.900 to 2.000 MHz



80 Meters (3.5 MHz)

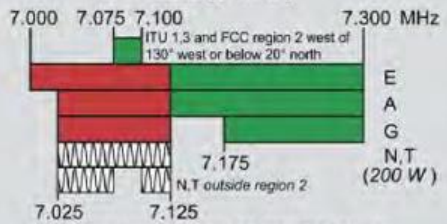


60 Meters (5.3 MHz)



General, Advanced, and Amateur Extra licensees may operate on these five channels on a secondary basis with a maximum effective radiated power (ERP) of 100 W PEP relative to a half-wave dipole. Permitted operating modes include upper sideband voice (USB), CW, RTTY, PSK31 and other digital modes such as PACTOR III. Only one signal at a time is permitted on any channel.

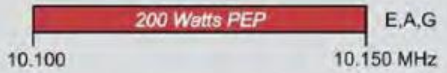
40 Meters (7 MHz)



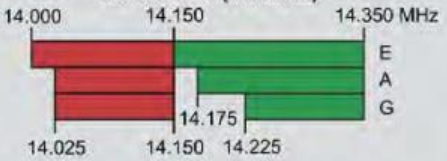
See Sections 97.305(c), 97.307(f)(11) and 97.301(e).These exemptions do not apply to stations in the continental US.

30 Meters (10.1 MHz)

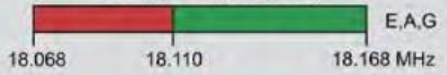
Avoid interference to fixed services outside the US.



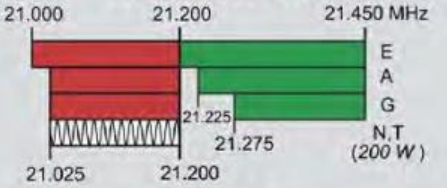
20 Meters (14 MHz)



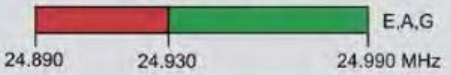
17 Meters (18 MHz)



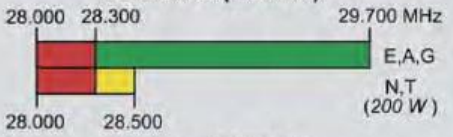
15 Meters (21 MHz)



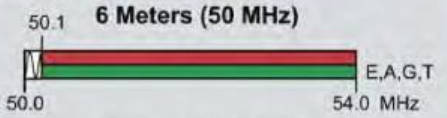
12 Meters (24 MHz)



10 Meters (28 MHz)

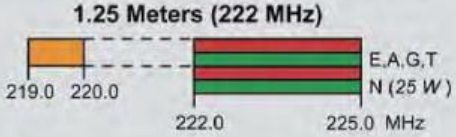


6 Meters (50 MHz)



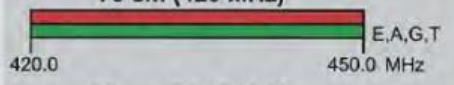
2 Meters (144 MHz)

1.25 Meters (222 MHz)

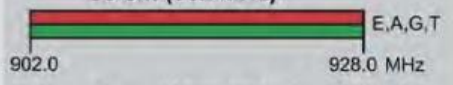


*Geographical and power restrictions may apply to all bands above 420 MHz. See *The ARRL Operating Manual* for information about your area.

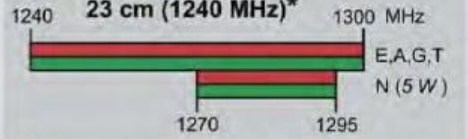
70 cm (420 MHz)*



33 cm (902 MHz)*



23 cm (1240 MHz)*



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

2300-2310 MHz	10.0-10.5 GHz ‡	122.25-123.0 GHz
2390-2450 MHz	24.0-24.25 GHz	134-141 GHz
3300-3500 MHz	47.0-47.2 GHz	241-250 GHz
5650-5925 MHz	76.0-81.0 GHz	All above 275 GHz

‡ No pulse emissions

KEY

Note:

CW operation is permitted throughout all amateur bands.

MCW is authorized above 50.1 MHz, except for 144.0-144.1 and 219-220 MHz.

Test transmissions are authorized above 51 MHz, except for 219-220 MHz

- = RTTY and data
- = phone and image
- = CW *only*
- = SSB phone
- = USB phone, CW, RTTY, and data
- = Fixed digital message forwarding systems *only*

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

See *ARRLWeb at www.arrl.org* for detailed band plans.

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 rev. 9/22/2017

Al Brogdon, W1AB

75, 50, and 25 Years Ago

February 1943

- The cover photo shows three hams admiring their portable generator built onto a small car trailer.
- The editorial addresses the subject of operating privileges being restored after the war, assuring members that the League was already working toward that end.
- Clinton B. DeSoto, W1CBD, continues his series of articles telling what our military is doing on the radio front in "*QST* Visits the Coast Guard." He describes the men's skill as radio operators, trained by "the longest and most intensive course now being given…in any of the military services."
- "The Tri-Part Plan," by George Hart, W1NJM, reports on the selection of frequencies for the War Emergency Radio Service (WERS).
- George Grammer, W1DF, presents Part I of "Elementary A.C. Mathematics," which discusses periodic phenomena. The article is in response to war-stimulated interest in more technical radio subjects, aiming to present the information less formally than a regular textbook.
- "An Avocation Becomes a Vocation," by Herbert Hamilton, W9MRQ, reports on the many hams who have turned their ham skills toward the manufacture of military radio equipment and other war efforts.

February 1968

- The cover photo shows a compact RTTY Transmitter-distributor that was built into an attaché case.
- The editorial asks, "What *Is* the American Radio Relay League?" as the first of a series describing the unique service ARRL provides to hams and the public.
- David Geiser, WA2ANU, describes "A Zero-Beating Method" that we can use for setting a frequency exactly, or for frequency measurement.
- Jack Althouse, WA6CEZ, presents an easy step-by-step procedure for "Modern Power-Supply Design" in order to obtain a desired output voltage and load-current capability while avoiding diode failure.
- Lew McCoy, W1ICP, gives us the design for "A Field-Effect Transistor Dipper," one of the most useful tools for experimenting, DIY building, and troubleshooting around the ham shack.
- In "The Wooden Yagi," Chris Sharo, VE2DBS, tells us about building a 10-meter beam using wood for the supporting structure.

February 1993

- The cover shows photos of the Russian *Mir* spacecraft and W0SL listening to its signals at the St. Louis Science Center station.
- The editorial tells of N9RGE, who, while listening outside the ham bands, heard distress signals from a sinking sailboat. He tuned his ham rig up on the frequency, made contact, and called the Coast Guard, who rescued the sailors. The story was picked up by the national news media, giving ham radio some excellent publicity.
- In "Hurricane Iniki Rallies Amateurs," Ron Hashiro, KH6JCA, tells the tale of ham radio supplying the communications backbone in the Hawaiian Islands following Iniki's devastation.
- Roger Burch, WF4N, notes that many hams shy away from going mobile on HF because they think it would be too expensive. He then tells us how we can cut the costs, in "*You* Can Operate HF Mobile!"
- Wallace Blackburn, AA8DX, tells us "Everything You Always Wanted to Know about Hardware for Computer-Controlling Modern Radios."
- "Classic Rigs and Amplitude Modulation: Friendly, Nostalgic Ham Radio Partners," by Paul Courson, WA3VJB, and Steve Ickes, WB3HUZ, reports on the fun enjoyed by families operating on AM together, using both vintage and modern equipment.

Field Organization Reports

November 2017

Public Service Honor Roll

This listing recognizes radio amateurs whose public service performance during the month indicated 70 or more points in six categories. Details on the program can be found at **www.arrl.org/public-service-honor-roll.**

340
K7OAH

336
WM2C

313
W7PAT

305
WS6P

304
KD8TTE

300
KW9EMG

298
W0KCF

290
W7WXW

284
WB8RCR

283
WA7PTM

257
K0IBS

235
N3KRX

228
KB1TCE

220
N2WGF

217
WB9FHP

210
N8SY
K2NYS

205
WA3EZN

200
K1XFC
KT5SR
AA7BM
W0DSF

195
KT2D
K2RMF

175
W0PZD

170
K9LGU
WB9QPM

165
WC9CW
K2TV

163
AL0Y

160
KK4PUX
WO2H
KB2KOJ

158
W6GSW

155
W3GWM
WD8USA
W5DY
WI2G

150
AC0KQ
KJ9JPE

145
WD3B
W2PH
WK4WC

142
WA2BSS

141
KF4DVF

140
KK3F
W3CB
W0LAW
W4DNA
WB2FTX

136
KD2LPM

135
KJ6PCC
W3YVQ

133
K8RDN

131
KE6XTA

130
N9TU
W8DJG
N2JBA
WB6OTS
K4IWW
KA2ZNZ
NA7G

128
K2UNI

125
W8IM

123
WK2RP

122
K9ILJ

120
WA1STU
AG9G
N9VC
WB9WKO
KA9QWC
WA4VGZ
KB4RGC

118
N7IE

117
K6JGL
WB8YYS
KB5PGY

116
KC8YVF

115
KO4OL
K8LPC

114
W9WXN

113
WA0UIG
WD8MWD
KE8CEH
N1LL

112
AC8NP

111
N2PQJ

110
K6HTN
W1KX
N3JUY
WC4FSU
N9MN
AF4NC
K3IN
WB8TQZ
WB8YLO
K6JT
KC5OZT
KF5IOU
KF5TTN
KB2YYA
KY2D

106
KC4BQK

105
KE4CB
KB0DTI
N5MKY
WB8QLT
N8CJS
KK7TN

104
K3JL

103
W8CPG

100
WA3QLW
KZ8Q
KA1G
W4CMH
NN7H
KN9P
NX9K
K0VTT
AA3SB
AC8RV
W8OLO
WB8SIQ
KC8WH
KA5AZK
KE5HYW
KD2MEN
KD2MDV
KA2GQQ

99
W4TTO

98
AD3J

96
K9DUR

95
WB3FTQ
N2DW
W7PHX

92
NC8V
KD2IWN

90
KD4EAQ
WB4RJW
NI2W
N3ZOC
K8ED
WB8WKQ
WD8DHC
K8KRA
KG5NNA
KC7ASA
AA3N
KA2HZP
N7EMH

89
N3RB

88
W2CTG

86
N9SE

85
AB9ZA

88
KD8KBX

87
KF7PDV

84
KJ4G

83
KA5DON

82
KJ6CNO
AB3WG

81
KE6RHV
KB1NMO

80
WB0B
KC3HWU
W9BGJ
KT4WX
KM4BRQ
KF7GC
KC7ZZ
KB2QO
KA0DBK
WD0BFO

78
K1HEJ

76
N6IET
KB3KYH

75
W4NHO

73
KL7RF

71
WB6YJJ
K6RAU

70
K0EK
KJ4HGH

The following station qualified for PSHR in previous months but were not recognized in this column yet. (Oct. 2017) K2RMF 195, KB2KOJ 160, WI2G 155, KA2ZNZ 145, KD2IWN 116, KB2YAA 105, KA0DBK 77. (Sept. 2017) K2RMF 195, KB2KOJ 161, WI2G 155, KA2ZNZ 145, KD2IWN 115, KB2YAA 105.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AL, AR, AZ, CO, CT, DE, EB, ENY, EPA, IA, IL, IN, KS, KY, LAX, MDC, ME, MI, MN, MO, MS, MT, NC, NE, NFL, NLI, NM, NNJ, OH, OK, OR, SD, SFL, SJV, STX, TN, UT, VA, WCF, WI, WNY, WPA, WV, WY.

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: AZ, CT, DE, EB, EPA, ENY, GA, IA, ID, IL, IN, KS, LA, LAX, MDC, ME, MI, MN, MO, MS, NE, NLI, NM, NNJ, NTX, OH, OR, PAC, SFL, SNJ, STX, SV, TN, WCF, WI, WNY, WPA, WTX, WV, WWA, WY.

Brass Pounders League

The BPL is open to all amateurs in the US, Canada, and US possessions who report to their SMs a total of 500 or more points or a sum of 100 or more origination and delivery points for any calendar month. Messages must be handled on Amateur Radio frequencies within 48 hours of receipt in standard ARRL radiogram format. Call signs of qualifiers and their monthly BPL total points follow.

WB9FHP 5276, WS6P 2236, KK3F 1711, NX9K 1361, K6HTN 1255, WB9WKO 842, KI0JO 750, K6JT 744.

Silent Keys

It is with deep regret that we record the passing of these radio amateurs:

N1AMX **Carlozzi**, Anthony, Brockton, MA
K1DMU **Kaufman**, Lyle M., Merrimack, NH
N1GOI **Baker**, David A., Hudson, ME
♦W1GWA **Bird**, Dennis J., Fairfield, CT
•W1HLM **Cassella**, Albino, Riverside, CA
KA1HR **Marmon**, Bradley S., Lakewood Ranch, FL
KB1IET **Babbitt**, Donald, Valley Falls, NY
WT1K **Keating**, William N., Saint Albans, ME
•W1MYB **Bancroft**, George, South Windsor, CT
WM1N **Brown**, Robert G., Granville, MA
♦N1PC **Eanes**, David C., Axton, VA
W1PZE **Graham**, George R., Englewood, FL
K1RKJ **Cooney**, Frederick G., Windsor Locks, CT
K1TKL **Wisiolek**, Paul, Escondido, CA
KA1VS **Godzyk**, John, Kensington, CT
•WB2BGC **Blau**, Richard F., Mineola, NY
WA2EVH **Gould**, Rodney M., Ridgefield, CT
N2HKD **Braun**, Curtis J., Cottonwood, AZ
•W2NTB **Hinrichsen**, Bernhard, Solon, OH
N2OH **Block**, Lawrence W., Lakewood, NJ
♦W2QL **Cipolla**, Anthony H., Sun City West, AZ
•WA2UEQ **La Munion**, Jean A., Utica, NY
KD2UY **Sladky**, James F., Flagstaff, AZ
WA3GDC **Metcalf**, Richard M., Braddock Heights, MD
W3GH **King**, Robert W., Apollo, PA
KE3LU **Wickline**, Lee E., Bowie, MD
KB3MZT **Crowley**, Roger, Somerset, PA
♦N3NOP **Fulton**, Robert, Jr., Berwick, PA
♦K3RYA **Jacobs**, William P., Mount Lebanon, PA
•K3TRK **Hane**, Dale R., Sunbury, PA
N3TS **Anderson**, Robert C., Jr., Johnstown, PA
K3UBH **Albrecht**, Joseph N., Memphis, TN
♦N4AA **Smith**, Carl E., Leicester, NC
K4ADJ **Elkins**, Ira Dean, Henderson, KY
♦WB4AOT **Sharp**, Jerry W., New York, NY
W4ARI **Baker**, William D., Cottevah, TN
K4BNR **Riggins**, Billy N., Knoxville, TN
KC4CFE **Parker**, Joe E., Cocoa Beach, FL
•K4CIT **Garrett**, Leon, Jacksonville, FL
KJ4DDG **O'Keefe**, Patrick S., Tavares, FL
KI4DSP **Slaton**, Hoyt "Sonny" D., Southside, AL
♦KS4EN **Acree**, Carl L., Oak Island, NC
KF4ERU **Stallings**, Frank C., Germantown, TN
KI4FPP **Booth**, Robert, New Smyrna, FL
AK4G **Owen**, Elbert L., Harvest, AL
•AB4GK **King**, John W., Wilmington, NC
•♦WB4JM **Duck**, Edward E., Raleigh, NC
K4KKX **McGraw**, Hershel E., Bay Minette, AL
KB4LAV **Powell**, Robert K., Mobile, AL
K4LLS **Smith**, Lytle L., Louisville, KY
WA4MBI **Harrington**, Freeman G., Sr., Winter Park, FL
W4NSO **Sosebee**, James Donald, Gainesville, GA
W4NYC **Wallace**, James E., Huntsville, AL
AC4PM **Budlong**, Albert H., Warrenville, IL
•K4RHQ **Towers**, Clayton N., Bridgewater, VA
KA4RKS **Thompson**, Jack R., Covington, KY
KS4RL **Lohmar**, Robert A., Kissimmee, FL
KD4RRY **Onuska**, William H., Sr., Hendersonville, NC
KC4RZW **Findlay**, Kimball R., Madison, AL
NC4SJ **Johnson**, Sam, Raleigh, NC
K4TGU **Dunn**, Ralph G., Andalusia, AL
KC4TV **Gray**, James "Frank," Jr., Cottevah, TN
•WA4TWX **Collins**, Delton, Columbus, GA
♦W4VEK **Weiss**, John R., Montgomery, AL
KM4WBL **Palmer**, Richard L., Phenix City, AL
N4XKF **Andrews**, Brian K., Augusta, GA
KG4YHT **Peeples**, Rodney A., Longmont, CO
W4ZMF **Magoun**, Robert A., Chesapeake, VA
AC5AJ **Simpson**, Earl R., Harrisburg, AR
KA5AOY **Dague**, Paul D., Richardson, TX
AA5CW **Kirkland**, Paul A., Richwood, TX
W5DED **Gordon**, Robert M., Albuquerque, NM
WA5DQF **Vance**, William M., Bayside, TX
WO5G **Bienvenu**, J. C., Saint Martinville, LA
KM5IJ **McAdams**, Reuben B., Moody, TX
K5LKY **Rider**, Robert Joe, New Braunfels, TX
W5RRY **Pearson**, James A., Garland, TX
W5TJO **Oyler**, Theodore J., Watonga, OK
KC5UPI **Adair**, Dale L., El Paso, TX
♦K5WLQ **Heye**, James D., Richardson, TX
NU5X **Strodtman**, Donald L., Broussard, LA
KI6AIE **McQuilling**, Kathleen M., Capitola, CA
AE6AV **Plummer**, Laurence R., Lemon Grove, CA
W6BBQ **Nieman**, Fred, El Sobrante, CA
K6CCX **Hosken**, Bruce A., Yorba Linda, CA
WD6CYZ **Cupp**, James E., Greeley Hill, CA
WD6DVG **Rischpater**, William E., Lakeside, AZ
KO6EE **Sweadner**, Walter, San Diego, CA
WB6FZH **Greenwood**, Gregory C., Sacramento, CA
K6HYM **Parker**, Richard O., Modesto, CA
KH6IRT **Brown**, Peter R., Honolulu, HI
N6JCK **Dickey**, Paul R., Danville, CA
♦WA6MUK **Palmer**, Theodore E., Pasadena, CA
KA6PFB **Quinn**, Allen A., Sr., Huntington Beach, CA
W6RTG **McWilliams**, James D., Sylvania, OH
WA6TWT **Barr**, Gary W., Lancaster, CA
•K6WAP **Pearson**, William A., Fresno, CA
KA6WXR **Rukavina**, Thomas G., Hibbing, MN
KA7ELA **Lang**, Dorothy, Miles City, MT
•W7ROF **Wallis**, J. D., Salt Lake City, UT
W7ILZ **Williams**, Franklin T., Walnut Creek, CA
K7KWH **Hunt**, Kenneth W., Klamath Falls, OR
K7LZF **Erny**, Robert M., Port Angeles, WA
N7MIT **Downing**, Alan R., Glendale, AZ
W7OTA **Letcher**, Donald W., Show Low, AZ
•W7POF **Sitterley**, Linda K., Chino Valley, AZ
K7RWF **Finuf**, Ronnie W., Idaho Falls, ID
K7TBC **Sherburne**, Terry, East Glacier Park, MT
AB7TJ **Turek**, Joseph J., Minden, NV
KC7TJH **Ernest**, Diane, Green Valley, AZ
W7TSQ **Preston**, Robert C., Edmonds, WA
KF7TWO **Wells**, Robert A., Boise, ID
KJ7WC **Hall**, Michael T., Seattle, WA
KL7XB **Kenyon**, Carlton W., Port Orange, FL
•AC7YH **Shaughnessy**, Patrick L., Raymond, WA
AB7ZU **Armstrong**, Michael J., Phoenix, AZ
K8DNE **Reynolds**, William H., Rowlett, TX
•W8EYC **Glasser**, Michael "Mick" M., Grawin, MI
KD8GY **Doughty**, John L., Gahanna, OH
•KD8HIF **Christensen**, Patricia A., Midland, MI
N8IFV **Stone**, Paul "Jim" J., Red Oak, MI
•W8JIG **Fornshil**, David A., Wayne Lakes, OH
WA8KHL **Rhoton**, Robert B., Brecksville, OH
W8MVM **Hawthorn**, Eugene, Washington Court House, OH
WD8NNB **Sulek**, Edward, Cincinnati, OH
♦WB8ONY **Whitmore**, Michael W., New Port Richey, FL
WD8PXG **Smalley**, Terry L., Leesburg, OH
W8QRB **Stuart**, Donald R., Rockford, MI
W8QIW **Rielage**, Charles W., Jr., Cincinnati, OH
K8SQT **Sande**, James A., Manchester, MI
W8UMH **Blizzard**, Donald T., Mount Vernon, OH
WB8WKV **Snyder**, Gene E., Graytown, OH
W8WGO **Goldfarb**, Jack, Orange Village, OH
KB8WHE **Murphy**, Evelyn J., McDermott, OH
KC8YKW **Armstrong**, Larry M., Lakeview, OH
K9BHA **Cassy**, Gene H., Granite City, IL
KC9DN **Albright**, Robert F., Indianapolis, IN
•W9DQX **Welisek**, Ben F., Barrington, IL
WD9ESS **Gifford**, Allen L., Arlington, WI
N9FJW **Clarke**, Clinton W., Cedar Rapids, WI
♦KA9FRC **Lauer**, Dannie H., Atlanta, GA
K9FTT **Maier**, Richard K., Bossier City, LA
WD9FTY **Johnston**, James D., Sr., New Lenox, IL
K9GDI **Hunter**, Leo "Bud" L., Cary, IL
K9GLC **Crank**, Gary L., Antioch, IL
NC9J **Mozzillo**, James J., Plainfield, IN
K9KJS **Konrad**, John G., Madison, WI
•KC9KT **Sapp**, William, Jr., Springfield, IL
KM9L **Chestney**, Denny R., Bloomington, IL
•WA9LCU **Clarke**, Jack W., Chalaska, WI
KB9LLQ **Kienzynski**, Leonard J., Bloomfield, IN
W9PAM **Burke**, William R., Belleville, IL
K9PUI **Hickok**, Richard W., Indianapolis, IN
KB9PXE **Fielkow**, Mark D., Milwaukee, WI
KC9QCM **Fiorini**, Raymond P., Oak Park, IL
W9UBT **Schram**, Charles B., Glenview, IL
KA9WIN **Reeves**, Harold E., Huntington, IN
KB9ZRM **Harris**, Kelly R., Midlothian, IL
NDABJ **Coulson**, James W., Fort Madison, IA
KDOAFT **Wendling**, Gerald R., Bellevue, NE
•KC0BHU **Rector**, Jack D., Cedar Rapids, IA
NDBRD **Hawkins**, Arthur "Sadie" W., Wentzville, MO
WBOCUZ **Knoepfel**, Harlan G., Grand Island, NE
KODEG **Oliver**, Kenneth V., Lake City, MN
KF0DH **Diez**, Alan R., Bessemer, AL
KE0DLN **David**, Thomas A., Newton, IA
AB0EG **Law**, Joanne, Harlingen, TX
NI0F **Stotler**, Dwight "Bud" E., Wentzville, MO
WOHRQ **Humke**, Frederick O., Jr., Bailey, CO
♦WOIHI **Hogie**, Weldon I., Northfield, MN
NA0L **Lorenzen**, Richard, Boulder, CO
NDLLB **Osborne**, Leon F., Jr., Grand Forks, ND
WOLTL **Zonnefeld**, Marlyn J., Tucson, AZ
•WOLVI **De Wolfe**, William E., Morrison, CO
KA0MIE **Chilcott**, Frederick E., Atlanta, KS
NONNK **Griffith**, Patrick M., Rockford, IL
KOQM **Harper**, Eugene I., Colorado Springs, CO
NOQPR **Dyni**, John R., Boulder, CO
•WORI **Smith**, Harold P., Jr., Ballwin, MO
KA0UKG **Gloystein**, Marvin, Seward, NE
WOYMG **Main**, Dennis A., Wichita, KS
♦WO2K **Richardson**, Marvin L., Northglenn, CO
WA0ZNI **Lorberg**, Joseph F., Cape Girardeau, MO
VE2GHZ **Jacques**, Rosaire, St-Joseph-de-Beauce, QC, Canada
VE3PLE **Boltwood**, Paul, Stittsville, ON, Canada
VE7ABK **Epp**, Werner "Vern," Kelowna, BC, Canada
PF7M **Minnema**, J., Lippenhuizen, Netherlands
V63YAH **Haped**, Albert, Ulithi Atoll, Yap, Micronesia

♦ Life Member, ARRL

• Former call sign

For information on how to list a Silent Key in *QST*, please visit **www.arrl.org/silent-key-submission-guidelines**.

Note: Silent Key reports must confirm the death by one of the following means: a copy of a newspaper obituary notice, a copy of the death certificate, or a letter from the family lawyer or the executor. Please be sure to include the amateur's name, address, and call sign. Allow several months for the listing to appear in this column.

Many hams remember a Silent Key with a memorial contribution to the ARRL Foundation or to ARRL. If you wish to make a contribution in a friend or relative's memory, you can designate it for an existing youth scholarship, the Jesse A. Bieberman Meritorious Membership Fund, the Victor C. Clark Youth Incentive Program Fund, or the General Fund. Contributions to the Foundation are tax deductible to the extent permitted under current tax law. Our address is: The ARRL Foundation Inc., 225 Main St., Newington, CT 06111.

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FTDX5000MP Limited | *200W HF + 6M Xcvr*

• Internal Power Supply • Two Totally Independent Receivers • Super Sharp "Roofing" Filters • High Performance Yaesu Custom- designed 32-bit Floating Point DSP • True Analog Meter Precision

FTDX3000 | *100W HF + 6M Transceiver*

• 100 Watt HF/6 Meters • Large and wide color LCD display • High Speed Spectrum Scope built-in • 32 bit high speed DSP /Down Conversion 1st IF

FT-991A | *HF/VHF/UHF All Mode Transceiver*

Real-time Spectrum Scope with Automatic Scope Control • Multi-color waterfall display • State of the art 32-bit Digital Signal Processing System • 3kHz Roofing Filter for enhanced performance • 3.5 Inch Full Color TFT USB Capable • Internal Automatic Antenna Tuner • High Accuracy TCXO

FTDX1200 | *100W HF + 6M Transceiver*

• Triple Conversion Receiver With 32-bit Floating Point DSP • 40 MHz 1st IF with selectable 3 kHz, 6kHz & 15 kHz Roofing Filters • Optional FFT-1 Supports AF-FFT Scope, RTTY/PSK31 Encode/Decode, CW Decode/Auto Zero-In • Full Color 4.3" TFT Display

FT-891 | *HF+50 MHz All Mode Mobile Transceiver*

Rugged Construction in an Ultra Compact Body • Stable 100 Watt Output with Efficient Dual Internal Fans • 32-Bit IF DSP Provides Effective and Optimized QRM Rejection • Large Dot Matrix LCD Display with Quick Spectrum Scope • USB Port Allows Connection to a PC with a Single Cable • CAT Control, PTT/RTTY Control

FT-857D | *Ultra Compact HF/VHF/UHF*

• 100w HF/6M, 50W 2M, 20W UHF • DSP included • 32 color display • 200 mems • Detachable front panel (YSK-857 required)

FT-2980R | *Heavy-Duty 80W 2M FM Transceiver*

• Massive heatsink guarantees 80 watts of solid RF power • Loud 3 watts of audio output for noisy environments • Large 6 digit backlit LCD display for excellent visibility • 200 memory channels for serious users

FTM-100DR | *C4FM FDMA/FM 144/430 MHz Xcvr*

• Power Packed System Fusion Transceiver • High Audio Output Power • Rugged Powerful Transmitter • Integrated 66ch High Sensitivity GPS • 1200/9600 APRS Data Communications

FTM-400XD | *2M/440 Mobile*

• Color display-green, blue, orange, purple, gray • GPS/APRS • Packet 1200/9600 bd ready • Spectrum scope • Bluetooth • MicroSD slot • 500 memory per band

FT-70DR *C4FM/FM 144/430MHz Xcvr*

• System Fusion Compatible • Large Front Speaker delivers 700 mW of Loud Audio Output • Automatic Mode Select detects C4FM or Fm Analog and Switches Accordingly • Huge 1,105 Channel Memory Capacity • External DC Jack for DC Supply and Battery Charging

FT-2DR *C4FM/FM 144/430 MHz Xcvr*

• Analog/C4FM Dual Monitor (V+V/U+U/V+U) • System Fusion compatible • 1200/9600 APRS Data Communications • Integrated 66ch High Sensitivity GPS • Wide Band Receiver • Snap-shot Picture Taking Capability With Optional MH-85A11U

FT-65R | *144 MHz Transceiver*

Compact Commercial Grade Rugged Design • Large Front Speaker Delivers 1W of Powerful Clear Audio • 5 Watts of Reliable RF Power Within a compact Body • 3.5-Hour Rapid Charger Included • Large White LED Flash-light, Alarm and Quick Home Channel Access

FT-60R | *2M/440 5W HT*

• Wide receiver coverage • AM air band receive • 1000 memory channels w/alpha labels • Huge LCD display • Rugged die-cast, water resistant case • NOAA severe weather alert with alert scan

5 Ways to Shop!

- RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday
- PHONE – Toll-free phone hours 9:30AM - 5:30PM
- FAX – All store locations
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The radio

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IC-9100 | *The All-Round Transceiver*

• HF/50MHz 144/43vvv0 (440) MHz and 1200MHz*[1] coverage • 100W on HF/50/144MHz, 75W on 430 (440) MHz, 10W on 1200MHz*[1] • Double superheterodyne with image rejection mixer

IC-7200 | *HF Transceiver*

• 160-10M • 100W • Simple & tough with IF DSP • AGC Loop Management • Digital IF Filter • Digital Twin PBT • Digital Noise Reduction • Digital Noise Blanker • USB Port for PC Control

IC-PW1 | *HF/50 MHz Amplifier*

• Wide freq. coverage - 1 kW from 1.8 MHz to 50 MHz (amateur bands only) • Wide ALC adjustable range • Full duty cycle • Auto antenna tuner built-in • Auto AC input voltage selector is employed

IC-7851 | *HF/50MHz Transceiver*

• 1.2kHz "Optimum" roofing filter • New local oscillator design • Improved phase noise • Improved spectrum scope • Dual scope function • Enhanced mouse operation for spectrum scope

IC-7100 | *All Mode Transceiver*

• HF/50/144/430/440 MHz Multi-band, Multi-mode, IF DSP • D-STAR DV Mode (Digital Voice + Data) • Intuitive Touch Screen Interface • Built-in RTTY Functions

ID-5100A Deluxe

VHF/UHF Dual Band Digital Transceiver

• Analog FM/D-Star DV Mode • SD Card Slot for Voice & Data Storage • 50W Output on VHF/UHF Bands • Integrated GPS Receiver • AM Airband Dualwatch

IC-7700 | *HF/50MHz Transceiver*

The Contester's Rig • HF + 6m operation • +40dBm ultra high intercept point • IF DSP, user defined filters • 200W output power full duty cycle • Digital voice recorder

IC-718 | *HF Transceiver*

• 160-10M** • 100W • 12V operation • Simple to use • CW Keyer Built-in • One touch band switching • Direct frequency input • VOX Built-in • Band stacking register • IF shift • 101 memories

ID-4100A | *VHF/UHF Dual Band Digital Xcvr*

• Compact, Detachable Controller for Flexible Installation • DV/FM Near Repeater Search Function • Apps for iOS™ and Android™ devices • Wireless Operation with VS-3 & UT-137 Bluetooth® Headset & Module • MicroSD Card Slot

IC-7610 | HF/50 MHz *All Mode Transceiver*

• Large 7-inch color display with high resolution real-time spectrum scope and waterfall • Independent direct sampling receivers capable of receiving two bands/two modes simultaneously

IC-2300H | *VHF FM Transceiver*

• 65W RF Output Power • 4.5W Audio Output • MIL-STD 810 G Specifications • 207 alphanumeric Memory Channels • Built-in CTCSS/DTCS Encode/Decode • DMS

IC-V80 | *HD 2 Meter FM Transceiver*

• Tough construction • 750mW loud audio • Powerful 5.5W of output power • IP54 and MIL-STD-810 rugged construction • Built-in CTCSS/DTCS • WX channel & weather alert function

IC-7300 | *HF/50MHz Transceiver*

• RF Direct Sampling System • New "IP+" Function • Class Leading RMDR and Phase Noise Characteristics • 15 Discrete Band-Pass Filters • Built-In Automatic Antenna Tuner

IC-2730A | *VHF/UHF Dual Band Transceiver*

• VHF/VHF, UHF/UHF simultaneous receive • 50 watts of output on VHF and UHF • Optional VS-3 Bluetooth® headset • Easy-to-See large white backlight LCD • Controller attachment to the main Unit

ID-51A PLUS2

VHF/UHF D-STAR Portable

• RS-MS1A, free download Android™ application • New modes for extended D-STAR coverage • Terminal Mode & Access Point Mode allow D-STAR operation through Internet • DV & FM repeater search function • Dplus reflector link commands

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TS-990S | *200W HF + 6M Transceiver*

• World's first dual TFT display • 200W output on all bands • ±0.1ppm TCXO ensures both high stability and reduced power consumption • Triple 32-bit DSP's dedicated to main/sub receivers and band scope • Main receiver employs full down conversion, new mixer & narrow band roofing filters • Third order intercept point (IP3) +40dBm for highest level of RX performance (main receiver)

Call For Special Price!

TM-D710G | *2M/440 Dualband*

• V+V/V+U/U+U operation • Built-in GPS • Built-in TNC for APRS & DX-Cluster operation • 50W 2M & UHF • 1,000 memories • Dual receive • Green or amber backlight colors • Latest APRS firmware w/new features • Sky Command II remote functions

Call For Special Price!

TS-480SAT/HX | *HF + 6M Transceiver*

• 480HX 200W HF & 100W 6M (no tuner) • 480SAT 100W HF & 6M w/AT • Remotable w/front panel/speaker • DSP built-in

Call Now For Low Price!

TS-590SG | *HF/50MHz Transceiver*

• Equipped with 500 Hz/2.7 kHz roofing filter as standard • ALC derived from TS-990S eliminating spike issues • Antenna output function (shared with DRV connector) • CW - morse code decoder function • Improved 1st mixer • New PFB key with multi-function knob • New split function enabling quick setting • LED backlight with selectable color tone

TM-V71A | *2M/440 DualBand*

• High RF output (50W) • Multiple Scan • Dual receive on same band (VxV, UxU) • Echolink® memory (auto dialer) • Echolink® Sysop mode for node terminal ops • Invertible front panel • Choice of green/amber for LCD panel • 104 code digital code squelch • "Five in One" programmable memory • 1000 multifunction memory

Call Now For Your Low Price!

TH-D72A

2M/440 HT w/extended RX

• 5W TX, RX 118-524 MHz, VxU, VxV, UxU • APRS w/built-in 1200/9600 TNC • Built-in GPS, Built-in USB, digipeater • Echolink® compatible, • Mil-Spec STD810

Call For Special Low Price!

TS-2000/2000X | *HF/VHF/UHF Transceiver*

• 100W HF, 6M, 2M • 50W 70CM • TS-2000X 10W 1.2GHz • Built-in TNC, DX packet cluster• IF Stage DSP • Backlit front key panel

Call For Special Price!

TM-281A | *2 Mtr Mobile*

• 65 Watt • 200 Memories • CTCSS/DCS • Mil-Std specs • Hi-quality audio

Call For Special Low Price!

TH-D74A

M/220/440 HT w/D-STAR!

• D-STAR compatible • APRS ready w/built in GPS • Color weather station information • Built-in KISS mode TNC • High-performance DSP voice processing • Standard compatibility for Bluetooth

Call For Low Price!

TH-K20A | *2M Handheld*

• 2M 5.5W • VOX • CTCSS/DCS/1750 Burst built-in • Weather alert

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ACOM-1000

• HF and 6 Meter 1KW Amplifier • Match 3:1 SWR with No Tuner • User Friendly QSK Operation • LCD Message Display • Single 4CX800a Tube • Vacuum Antenna Relays

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THE WORLD'S FAVORITE SDR RECEIVERS

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- Now includes the new improved RSP1A entry-level SDR
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- Built-in High performance Front-end Filters
- SDRuno Windows SDR software provided free-of-charge
- Also works with other platforms and popular SDR software
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- Superb review of RSP2pro in October 2017 QST magazine
- Backed by the biggest and best SDR support community
- Excellent value starting at $99.95

US TOWER

MA-40

• 40' Tubular Tower

Call For Latest Pricing!

MA-550

• 55' Tubular Tower • Handles 10 sq. ft. at 50 mph • Pleases neighbors with tubular streamlined look

Call For Latest Pricing!

All US Towers shipped by truck; freight charges additional.

BUY FROM HRO. The World's Largest US Tower Dealer

TX-455

• 55' freestanding crank-up • Handles 18 sq. ft. @ 50 mph • No guying required • Extra-strength construction • Can add raising and motor drive accessory • Towers rated to EIA specifications • Other models available at great prices!

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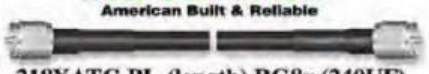
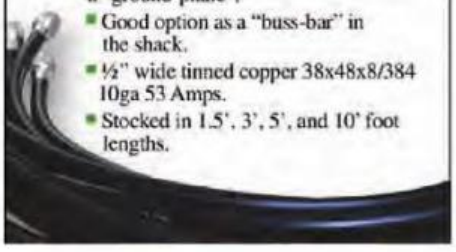


218XATC-PL-(length) RG8x (240UF) w/PL259 Connectors Each End. Weather-Proof Heat Shrink Tubing.

- Stranded Center Conductor.
- 95% TC Braid + bonded 100% Foil Shield.
- Very Flexible, Light Weight, and Smaller than RG8 sizes.
- Non-Contaminating-UV Resistant-Direct Burial-Black Jacket.

233/2-G4-(length).

- Unique design **(Nickel Grommets 4" Spacing)** allows for easy attachment to a vehicle's body or truck bed to create a "ground-plane".
- Good option as a "buss-bar" in the shack.
- ½" wide tinned copper 38x48x8/384 10ga 53 Amps.
- Stocked in 1.5', 3', 5', and 10' foot lengths.



REMOTE RIG

RRC-1258 MkII-S-Set

This set of interfaces allows remote control of your Amateur Radio Station via Internet in a user-friendly and cost effective way! RemoteRig gives you control of the radio coupled with crystal clear TX & RX audio and sending CW with your own Paddle!

New! Now Stereo Version for Dual Receiver radios.

Works with all Computer-controllable radios from: ***Alinco - Elecraft - ICOM - Kenwood - Yaesu***

For radios with detachable front panels no PC is required for: TS-480HX/SAT; TS-2000 (RC-2000 req'd); IC-703/Plus; IC-706 series; DX-SR8T; IC-2820H; IC-R2500

Just simply insert your control box in place of your front panel interconnect cable, place the body of the radio on the remote end and you are on the air as if you are there! Extra Controller and Remote interface units sold individually for multiple sites/users.

Now includes 12V power supply, $12.95 value!

Available exclusively from all HRO locations!

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With the Features Everyone Wants

HF/50MHz Transceiver
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7 inch Color Touchscreen Display
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Built-in High Speed Auto Antenna Tuner
SD Card Slot
Ethernet Port for IP Remote Control*
External Monitor Connectivity

*Optional RS-BA1 Software Necessary

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- ✓ Connect all the braid, not just a few strands
- ✓ High reliability
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Crimp-On Connectors

Excellent quality, no bargain basement stuff here. Adapters & connectors for most applications.

Powerpole Connectors

The standard for DC power connections. Power distribution, pre-built cables, mounts & more.

HAMMO-CAN™ Go Box

Ready to Go. Our new Hammo-Can™ line is a complete VHF-UHF station in a box. New! Get them with or without radios installed. Fits most FM mobiles & several HF radios, too. Powerpoles, USB & lighter socket & Voltmeters included!

Play-Series™ System

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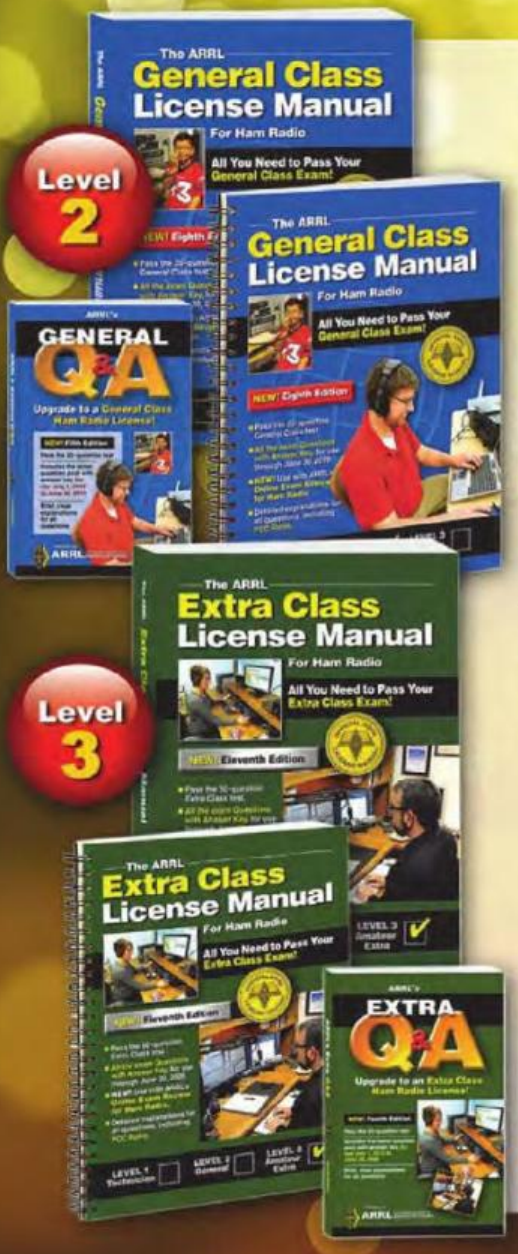

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Upgrade to General and experience the thrill of worldwide communications.

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The First Choice of Hams Around the World!

hy-gain® HF Rotators

HAM-IV – $649.95

The Most Popular Rotator in the World!

For medium communications arrays up to 15 square feet wind load area. Has 5-second brake delay, Test/Calibrate function. Low temperature grease permits normal operation down to -30 degrees F. Alloy ring gear gives extra strength up to 100,000 PSI for maximum reliability. *Precision* indicator potentiometer. Ferrite beads reduce RF susceptibility. Cinch plug plus 8-pin plug at control box. Dual 98 ball bearing race for load bearing strength and electric locking steel wedge brake prevents wind induced movement. North/South center of rotation scale on meter, low voltage control, max mast $2^{1}/_{16}$".

HAM-VI – $749.95 with DCU-2
HAM-VII – $799.95 with DCU-3

HAM IV and HAM V Rotator Specifications	
Wind Load Capacity (inside tower)	15 square feet
Wind Load (w/mast adapter)	**7.5 square feet**
Turning Power	800 in.-lbs.
Brake Power	**5000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**Dual race/96 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	26 lbs.
Effective Moment (in tower)	**2800 ft.-lbs**

TAILTWISTER SERIES II – $799.95

For Large Medium Antenna Arrays up to 20 sq. ft. wind load.

Has 5-second brake delay, Test/Calibrate functions. Low temp grease, tough alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, weatherproof AMP connectors plus 8-pin plug at control box, triple bearing race with 138 ball bearings for large load bearing, electric locking steel wedge brake, North/South center of rotation scale meter, low voltage control, $2^{1}/_{16}$" max mast. **MSHD, $109.95**. Above tower heavy duty mast support. T2X, HAM-IV, HAM-V, HAM-VI. Accepts $1^{7}/_{8}$-$2^{5}/_{8}$" OD.

T-2XD2 – $899.95 with DCU-2
T-2XD3 – $949.95 with DCU-3

TAILTWISTER Rotator Specifications	
Wind Load Capacity (inside tower)	20 square feet
Wind Load (w/mast adapter)	**10 square feet**
Turning Power	1000 in.-lbs.
Brake Power	**9000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**Triple race/138 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	31 lbs.
Effective Moment (in tower)	**3400 ft.-lbs**

CD-45II – $449.95

For antenna arrays up to 8.5 sq. feet mounted inside tower or 5 sq. ft. with mast adapter.

Low temperature grease good to -30 F degrees. New Test/Calibrate function. Bell rotator design gives total weather protection, dual 58 ball bearing race gives proven support. Die-cast ring gear, stamped steel gear drive, heavy duty, trouble free gear train. North center scale, lighted directional indicator, 8-pin plug/socket on control unit, snap-action control switches, low voltage control, safe operation, takes maximum mast size to $2^{1}/_{16}$ inches. MSLD light duty lower mast support included.

CD-45II Rotator Specifications	
Wind Load Capacity (inside tower)	8.5 square feet
Wind Load (w/mast adapter)	**5.0 square feet**
Turning Power	600 in.-lbs.
Brake Power	**800 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/48 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	22 lbs.
Effective Moment (in tower)	**1200 ft.-lbs**

AR-40 – $349.95

For compact antenna arrays and large FM/TV up to 3.0 square feet wind load area.

Dual 12 ball bearing race. Automatic position sensor never needs resetting. Fully automatic control -- just dial and touch for any desired location. Solid state, low voltage control, safe and silent operation. $2^{1}/_{16}$ inch maximum mast size. MSLD light duty lower mast support included.

AR-40 Rotator Specifications	
Wind Load Capacity (inside tower)	3.0 square feet
Wind Load (w/mast adapter)	**1.5 square feet**
Turning Power	350 in.-lbs.
Brake Power	**450 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/12 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**5**
Shipping Weight	14 lbs.
Effective Moment (in tower)	**300 ft.-lbs**

New!

Hy-Gain Programmable DCU-3 Digital Rotator Controller

DCU-3 – $449.95

Hy-gain DCU-3 Digital Controller lets you program 6 beam headings! Gives you full automatic or manual control of your hy-gain HAM or Tailtwister Rotators.

Press a memory button or dial in your beam heading or let *Ham Radio Deluxe* (or other) take control. Your antenna auto rotates precisely and safely to your DX.

DCU-3 automatically jogs your antenna free and safely unlocks it before rotating begins (*great for older rotators with "sticky" brakes*) then turns off your motor before reaching its final heading. Your antenna gently coasts to a stop before the brake re-locks -- greatly reducing damaging overshoots and extending rotator life.

Simply press *Left* and *Right* buttons for full manual control and fine tuning.

Bright blue LCD shows current, dialed in and computer controlled beam headings in one degree increments and your call.

Calibrate lets you accurately match your display to your true beam heading. Has USB/RS-232 ports for computer control. Adjustable LCD sleep time. Field upgradeable firmware. 8.5Wx4.3H x9D".

110 VAC. Order DCU-3X for 220 VAC.

DCU-2 Digital Rotator Controller – $399.95
Like DCU-3, but less programmable memories. 110 VAC. Order **DCU-2X**, for 220 VAC.

Replace your Yaesu Rotator Controller

YRC-1 – $329.95

Hy-gain YRC-1 -- more features, more robust, far less prone to lightning damage. Costs less than repairing!

Easy-to-use – dial in your beam heading and tap GOTO button. Exclusive 180 degree *AutoReversal*™ for fast longpath operation. All DCU-2 features. Bright blue LCD shows current, dialed-in, computer controlled beam headings, call. USB port for computer control. Extra heavy-duty AC power supply. Fast variable DC motor minimizes overshoot. Intuitive menu. Field upgradeable. For Yaesu G-800/1000/2800/G450/650. AC or DC motors.

YRC-3, $399.95. Like YRC-1 and adds 6 memories.

AR-303 Rotator/Controller – $129.95

For UHF, VHF, 6-Meter, TV/FM antennas.

Includes automatic controller, rotator, mounting clamps, mounting hardware. 110 VAC. One Year Warranty.

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QS1 2018

MFJ Cobweb Antenna

6-Bands: 20/17/15/12/10/6 M...Outstanding Performance!

Restricted space spoiling your operating fun? MFJ Cobweb puts your call back on the map!

This six-band (20, 17, 15, 12, 10, 6 Meters) full half-wave *Cobweb Antenna* is perfect for restricted space or portable operation. Sky-gray fiberglass spreaders and *nearly invisible* wire elements (flat 9 x 9 x 1/2 feet square. 8 pounds), blend in with your surroundings while standing tough against nasty weather.

Outstanding performance! Horizontally polarized for less local noise pickup plus solid gain over verticals will allow you to work DX easily – even on QRP. Omni-directional. No radials needed! Works great at low heights. Low SWR is due to MFJ's exclusive *Spider-Match*™ broadband network. Use lightweight TV hardware to mount on your chimney, balcony, mast.

Low in cost, but big on performance. MFJ *Cobweb Antenna* turns your space problem into a stack of QSL cards from far away places.

MFJ-1836HK34, $119.95. Add-on kit adds 40/30 Meters to MFJ-1835/1835H and MFJ-1836/MFJ-1836H cobweb antennas.

40-6 METER Cobweb Super Heavy-Duty, 1.5 kW

New! Super heavy-duty **40-6 Meter Cobweb Antenna.** MFJ-1838 **$399.95**

Built to survive harsh northern winters, heavy snow, ice and strong winds – has super-strong large diameter fiberglass and heavy-duty 14 gauge stranded hard copper wire. 8-bands: 40, 30, 20, 17, 15, 12, 10, 6 Meters, 1500 Watts. Turning radius: 12 feet, 23 lbs.

BigStick™ Portable Vertical

Strongest, loudest portable signal on the band! MFJ-2286 **$99.95**

Rugged stainless steel *17 foot* whip telescopes to *full 1/4 wave* from 20 to 6 Meters – gives you *full-size* performance for stronger, louder signals.

17-feet and ultra low loss, high-Q *air-wound* loading coil gives high efficiency on 30/40 Meters. Low SWR. 1 kW.

Includes: 17 foot whip, (27 in. collapsed), loading coil, counterpoise kit, SO-239 mount for mast up to 1 inch dia. Fits backpacks, suitcases! 2 lbs.

MFJ-2289, $179.95. 40-6M V-Dipole. Full size 20-6M.

18 Foot Telescopic Fiberglass Mast with Tripod

MFJ-1919EX, $159.95.

Put your antennas up high anywhere with this super-strong **18 foot telescoping fiberglass mast and MFJ-1919 heavy duty steel tripod** ***QuickClamps™ lower mast to 5 feet. Mast has thick 1/8 inch wall, .75" top, 1.5" bottom dia. 15 lbs. Black steel tripod has braced triangle base, non-skid feet, mast lock.***

MFJ-1918EX, $89.95.

MFJ-1918 *tripod with super strong 9.5 foot telescoping fiberglass mast.* 3.8 feet collapsed. *Quick-Clamps*™. Thick 1/8 inch wall, .75" top, 1" bottom diameters. 6.5 lbs.

Tripods Only

MFJ-1919, $89.95, *Large tripod.* Supports 100 pounds. 1.4 inch diameter mast extends 7.8 feet. Collapses to 4.5H x .5D feet. Triangle base spreads to 4.8 feet sides for extra strength. 9.75 lbs.

MFJ-1918, $49.95, *Smaller tripod.* Support 66 lbs. 1" dia. mast. 6 ft. extended, 3.2H x .3D ft. collapsed. Base sides spread to 2.75 ft. weighs 6.75 lbs.

17 Foot Stainless Steel Telescoping Whip

MFJ-1979, $59.95. Super-strong, super long *17 foot stainless steel* telescoping whip. 27 in. collapsed. 10 sections. 3/8-24 threaded base.
MFJ-1977, $44.95/12ft;
MFJ-1976, $39.95/10ft
MFJ-1974, $34.95/8ft;
MFJ-1972, $14.95/4 1/2ft

MFJ Rotatable Mini Dipoles

Lightweight, *isolated* mini-dipoles for imited space, temporary or permanent set-up. Rotate to null QRM, noise, direct your signal. 14 ft. long. Use mast up to 1.25" dia. For 40/30/20/17/15/12/10/6 Meters. Order **MFJ-22XX** (insert band in "XX") **$59.95.** 75/60 Meters, $49.95 each.

33 ft. Telescoping fiberglass Mast
MFJ-1910 **$79.95**
3.8 feet collapsed, 3.3 lbs. Super strong. Huge 1 3/4 inch bottom section. Flexes to resist breaking. Resists UV. Put up *full size* inverted Vee or vertical in minutes for *full size performance!*

MFJ-1704, $89.95 **Heavy** duty *antenna switch.* Select 4 antennas or ground. Unused ant. grounded. Lightning protection. Up to 500 MHz. 60 dB isolation at 30 MHz. 2.5 kW. <.2 dB loss.

MFJ-1700C, $119.95 *Antenna/ Transceiver Switch* selects 1 of 6 antennas and 1 of 6 xcvrs in any combination. Unused terminals grounded. Lightning protection. 1.8-30 MHz. 2 kW SSB. SO-239s.

MFJ-915, $29.95 Stop *RF* traveling down coax line, painful RF "bites" and erratic operation. 1.5 kW 1.8-60 MHz. 2Wx5H". SO-239s.

MFJ-918, $29.95 True 1:1 Current balun & center insulator forces equal antenna currents in dipole elements.

MFJ-1702C, $39.95 Like MFJ-1704 but 2 antennas.

MFJ-1701, $79.95 Select 1 of 6 antennas.

MFJ Enterprises, Inc. 300 Industrial Pk Rd, Starkville, MS 39759
Phone: (662) 323-5869 ■ **Tech Help:** (662) 323-0549 ■ **FAX:** (662) 323-6551 8-4:30 CST, Mon.-Fri.

MFJ Antennas

MFJ Super High-Q Loop™ Antennas

MFJ 36-inch diameter loop antenna lets you operate 10 through 30 MHz continuously – including the WARC bands!

Ideal for limited space -- apartments, small lots, motor homes, attics, or mobile homes.

Work exciting DX with low angle radiation and local close-in contacts with high angle radiation when mounted vertically. 150 watts.

Super easy-to-use! MFJ remote control auto tunes to your desired band. Fast/slow tune buttons, Cross-Needle SWR/Wattmeter lets you quickly tune to your exact frequency. No control cable needed.

World's most efficient small loop antenna has all welded construction, welded butterfly capacitor with no rotating contacts, large 1.050 inch diameter aluminum radiator – gives you highest possible efficiency.

Every capacitor plate is welded for extremely low loss and polished to prevent high voltage arcing.

Nylon bearing, antibacklash mechanism, limit switches, continuous no-step DC motor gives smooth precision tuning. Heavy-duty ABS plastic housing has ultraviolet inhibitor protection.

Cover 40-15 Meters. MFJ-1788, $499.95. Like MFJ-1786 but covers 40-15 Meters continuous. Includes remote control.

MFJ-1780, $329.95. Portable 24 x 24 x 5 3/4" box fan loop with carrying handle. 20-10 Meters continuous Fast/slow tune remote control. Highly efficient all-welded contstruction.

MFJ *no radial* Multiband Antennas...

...highly efficient end-loading gives full size performance

40/20/15/10/6/2M Vertical

Only 12 feet high with a tiny 24 inch footprint!

MFJ-1796
$299.95

Covers 40/20/15/10/6/2 Meters. Mount anywhere – ground level, tower top, roofs, patios, apartments and small lots.

Small and lightweight – perfect for DXpeditions, field day, camping, vacations.

Efficient end-loading, no lossy traps. Entire length radiates. Full halfwave on 2/6 Meters.

High power air-wound choke balun eliminates feedline radiation. Adjusting one band has minimum effect on others.

Automatic bandswitching, low radiation angle, omni-directional, handles 1500 watts PEP. Goes together in an afternoon.

MFJ-1796W, $299.95. WARC band version for 12, 17, 30, 60 Meters.

40/30/20/17/15/12/10M Vertical

MFJ-1797
$329.95

SkyMaster™ covers 40, 30, 20, 17, 15, 12, 10 Meters. Extra-long 40 Meter radiator gives super 40M performance!

Super low profile makes it perfect for roof mounting, ground mounting, on patio, tower top or to blend into the trees.

23.5 feet tall including extra-long 40 Meter radiator. Weighs just 7.5 lbs.

No ground or radials needed. 1000 Watts PEP. High strength 6063 aircraft aluminum. Use mast up to 1 3/4 inches.

MFJ-1797LP, $299.95. Like MFJ-1797 but without extra-long 40 Meter radiator. Less efficient with narrower bandwidth on 40M. 9 feet tall, weighs just 6 lbs.

80/40/30/20/17/15/12/10/6/2M Vertical

MFJ-1799
$399.95

All Bands HF through VHF!

Highly efficient endloaded 1/2 Wave vertical requires no radials, no lossy traps.

Only 20 feet high with a seven foot footprint so it mounts easily in a small area or patio.

High power air-wound choke balun eliminates feedline radiation. Automatic band-switching, low radiation angle, omnidirectional, 1500W PEP.

Built-to-last. Incredibly strong solid fiberglass rod and aircraft strength aluminum tubing are in the main structure.

MFJ-1799X, $349.95. Like MFJ-1799, but covers 40-2 Meters.

40/30/20/17/15/12/10 Meter ground mounted Vertical

MFJ-1794
$249.95

High performance, low cost, low profile, ground mounted. 7 bands: 40, 30, 20, 17, 15, 12, 10 Meters, full 1500 Watts PEP.

Permanent or temporary in antenna restricted spaces.

Full 11 feet collapses to 7 feet to hide behind fences, etc.

Automatic bandswitching, low radiation angle for DX, omni-directional. Highly efficient end-loading. Entire length radiates. Low SWR.

Ground or roof mount with radials, ground rod.

MFJ-1901
$109.95

Portable or permanent operation with **MFJ-1901**, $109.95 (left) 2 x 2 foot *ground-coupled* stainless antenna base. Hard-ware, U-bolts included.

MFJ-1795, $199.95. Like MFJ-1794 but covers 40/20/15/10M.

MFJ-1795W, $199.95. Like MFJ-1795 but for 12, 17, 30, 60 Meters.

9-Band *Rotatable* Mini-Dipole covers 40-2M

Low profile 14 feet...7 ft. turning radius...40, 30, 20, 17, 15, 12, 10, 6, 2 Meters... 1500 W

It's no Wimp! Its directivity reduces QRM/noise and lets you *focus* your signal in the direction you want to work *real* DX.

Operate major HF bands – 40, 30, 20, 17, 15, 12, 10 plus 6 and 2 Meters – and run *full 1500 Watts* SSB/CW on HF!

Automatic band switching. End-loading inductors and capacitive hats insures highest efficiency. *Entire length* radiates. 6 and 2 meters are *full-length* halfwave dipoles.

MFJ-1789 is low profile at fourteen feet – not much bigger than a TV antenna – and is easily rotated by inexpensive rotators like Hy-Gain's ***AR-303, $129.95***.

Built-to-last – incredibly strong solid rod fiberglass center insulator and 6063 T6 aircraft strength aluminum tubing radiator. Assembles in an afternoon. Adjusting oneband has little effect on other bands.

MFJ-1775, $319.95. Like MFJ-1789 but covers 40, 20, 15, 10, 6 and 2 Meters.

MFJ-1775W, $319.95. WARC band version for 12, 17, 30, 60 Meters only.

MFJ-1785, $399.95. 80/40/20M. Endloaded *rotatable* dipole 33 feet. 1500W PEP. 6063 T6 al. tubing, solid center fiberglass.

MFJ *G5RV Antenna*

MFJ-1778
$49.95

Covers all bands, 160-10 Meters with antenna tuner. 102 feet long. Can use as inverted vee or sloper. Use on 160 Meters as Marconi. 1500 Watts. Super-strong fiberglass center/feedpoint insulators. Glazed ceramic end insulators. All hand-soldered connections. Add coax, some rope and you're on the air!

MFJ-1778M, $44.95. G5RV Junior. Half-size, 52 ft. 40-10M with tuner, 1500 Watts.

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MFJ Weather-Proof Window Feedthrough Panels

Weather-proof window feedthrough panels bring coax, balanced lines, HF/VHF/UHF antennas, random wire antennas, ground, rotator/antenna switch cables and DC/AC power into your hamshack without drilling through walls!

MFJ Weather-Proof Window Feedthrough Panels mount in your window sill. Lets you bring all your antenna connections into your hamshack without drilling holes through walls.

Simply place in window sill and close window. One cut customizes it for any window up to 48 inches. Use horizontally or vertically. Connectors are mounted on inside/outside stainless steel plates and attached to a 4 foot long, 3 1/2 inch high, 3/4 inch thick pressure-treated wood panel.

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Inside/outside stainless steel plates ground all coax shields. Stainless steel ground post brings ground in.

MFJ-4603 Universal Window Feedthrough Panel

MFJ-4603 **$89.95**

Four 50 Ohm Teflon® SO-239 coax connectors lets you feed HF/VHF/UHF antennas at full legal power limit.

A 50 Ohm Teflon® coax N-connector lets you use any antenna up to 11 GHz, including 450 MHz, UHF, satellite, moon bounce and 2.4/5.8 GHz Wi-Fi antennas.

A 75 Ohm, 1 GHz F-connector makes it easy to bring in television, Satellite, HD, cable TV and FM radio signals.

A pair of high-voltage ceramic feedthru insulators lets you bring in 450/300 Ohm balanced lines directly to your antenna tuner.

Has random/longwire antenna ceramic feedthru insulator.

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Stainless ground post brings in ground connection, bonds inside/outside stainless steel panels together and drains away static charges.

MFJ's exclusive Adaptive Cable Feedthru™ lets you bring in rotator/antenna switch cable, etc. without removing connectors (up to 1 1/4 X 1 5/8 in). Adapts to virtually any cable size. Seals out rain, snow, adverse weather.

3 Coax, Balanced Line, Random Wire

Best Seller! 3 Teflon® coax connectors for HF/VHF UHF antennas. Separate high voltage ceramic feed-thru insulators for balanced lines and longwire/random wire, Stainless steel ground post.

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6 Coax

6 high quality Teflon® coax connectors for HF/VHF/UHF antennas. Stainless steel ground post. Full 1500 Watt legal limit.

MFJ-4601 **$59.95**

4 Balanced Line, 2 Coax

4 pairs of high-voltage ceramic feed-thru insulators for balanced lines and 2 coax connectors.

MFJ-4600 **New! $79.95**

5 Cables, any-size

5 Adaptive Cable Feedthrus™. Pass any cable with connector: 2 cables with large connectors up to 1 1/4 x 1 5/8 inches and 3 cables with UHF/N size coax connectors. Seals out weather.

MFJ-4604 **$99.95**

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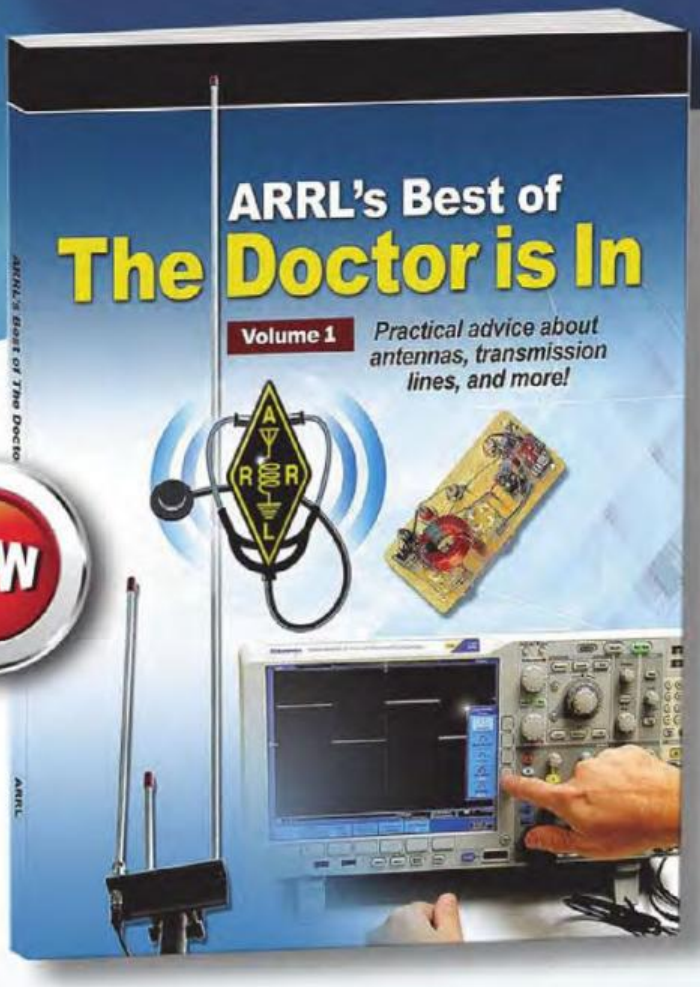
Volume 1



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MFJ-941E $149.95

MFJ-945E HF/6M mobile Tuner

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8W x 2H x 6D in. Lighted Cross-Needle SWR/Wattmeter. Lamp and bypass switches. Covers 1.8-30 MHz and 6 Meters. 300 Watts PEP. MFJ-20, $6.95, mobile mount.

MFJ-945E $139.95

MFJ-971 portable/QRP Tuner

Tunes coax, balanced lines, random wire 1.8-30 MHz. Cross-Needle Meter. SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ transceivers. Tiny 6½W x 2½H x 6D in.

MFJ-971 $129.95

MFJ-901B smallest Versa Tuner

MFJ's smallest (5W x 2H x 6D in.) and most affordable wide range 200 Watt PEP Versa tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-901B $99.95

MFJ-902B Tiny Travel Tuner

Tiny 4½W x 2¼H x 3D inches, full 150 Watts, 80-6 Meters, has tuner bypass switch, for coax/random wire. **MFJ-904H, $149.95.** Same but adds Cross-needle SWR/ Wattmeter and 4:1 balun for balanced lines. 7¼W x 2¾H x 2¾D inches.

MFJ-902B $109.95

MFJ-16010 random wire Tuner

Operate all bands anywhere with MFJ's reversible L-network. Turns random wire into powerful transmitting antenna. 1.8-30 MHz. 200 Watts PEP. Tiny 4W x 2H x 3D in.

MFJ-16010 $69.95

MFJ-906/903 6 Meter Tuners

MFJ-906 has lighted Cross-Needle SWR/ Wattmeter, bypass switch. Handles 100 W FM, 200W SSB. **MFJ-903, $69.95,** Like MFJ-906, less SWR/Wattmeter, bypass switch.

MFJ-906 $99.95

MFJ-921/924 VHF/UHF Tuners

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8W x 2½H x 3D in.

MFJ-921/924 $89.95

MFJ-931 Artificial RF Ground

Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. Creates artificial RF ground or electrically places far away RF ground directly at rig. **MFJ-934, $209.95,** Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

MFJ-931 $109.95

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QST QuickStats

sta·tis·tics (stuh-tis-tiks) noun.
1. (used with a singular verb) The mathematics of the collection, organization, and interpretation of numerical data, especially the analysis of population characteristics by inference from sampling.
2. (used with a plural verb) Numerical data.

www.arrl.org/QuickStats

Online QuickStats Poll Results for November 1, 2017 through December 1, 2017.
Get on the web and vote today at **www.arrl.org/quickstats**!

Do you still exchange QSL Cards?

- Yes. **65%**
- Yes, but only if I need the other person's QSL for an award. **12%**
- Yes, but only if I receive a self-addressed, stamped envelope, or sufficient cash for the return postage. **7%**
- No. **16%**

On CW, do you prefer short contacts or longer conversations?

- Short contacts. **52%**
- Long chats. **18%**
- I don't operate CW. **30%**

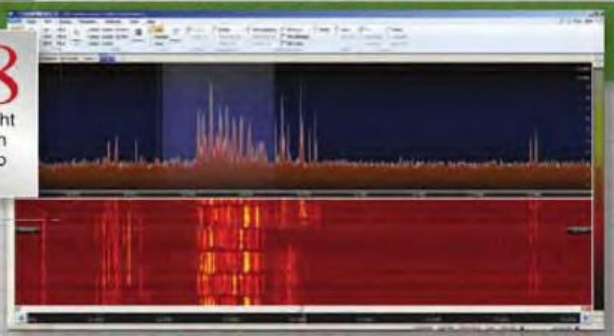
How have you coped with the declining propagation conditions on the HF bands?

- I've shifted to CW or digital modes. **21%**
- I now operate primarily on the lower bands such as 160, 80, 60, and 40 meters. **25%**
- I'm trying some different antenna designs. **4%**
- I bought an amplifier. **1%**
- All of the above. **12%**
- I've left HF for VHF. **3%**
- I haven't made any changes. **34%**

Have you tried the new FT8 digital mode?

- No. **37%**
- Yes. **50%**
- I've never heard of it. **4%**
- I don't operate digital. **9%**

FT8
The Latest Bright Shiny Object in Amateur Radio Digital World



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MFJ-4245MV Switching power supply gives 45A surge/40A continuous. 9-15 VDC out. 85-260 VAC in. Low ripple, highly regulated. 5-way posts, cig lighter, quick connects. 5 lbs., 7½W x 4¾H x 9D".

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35-Amps, $149.95

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MFJ-4128 switching power supply delivers 28A surge, 25A continuously at 13.8 VDC. Selectable AC input voltage 85-135 and 170-260 VAC. 5-way binding posts, cigarette lighter socket, fan "on" LED, 7W x 2¼H x 7½D", 4 lbs.

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MFJ-4225MV Switching power supply gives 25A surge, 22A continuous. Adjustable 9-15 VDC output, 85-260 AC input. Large 3" dual Amp/Volt meters, Binding posts, Cigarette lighter socket. 3.7 lbs. 5¼W x 4½H x 6D inches.

25-Amps, $84.95

MFJ-4125 gives 25A surge, 22A continuous. 13.8 VDC switching power supply has 5-way binding posts on front panel and quick connects on back. 3.5 lbs. Super compact 5½W x 2½H x 5¾D inches fits anywhere.

25-Amps, $94.95

MFJ-4125P gives 25A surge, 22A continuous. 13.8 VDC switching power supply front has 2 pair of Anderson PowerPoles® and 5-way binding posts on front. Quick connects on back. 3.5 lbs. Super compact 5½W x 2½H x 5¾D".

18-Amps, $99.95

MFJ-4218MV ham radio's only adjustable 0-24 VDC output switching power supply! 18A at 13.8 VDC, 9A at 24 VDC. Backlighted Volt/Amp meters, 5-way binding posts outputs, LED load fault indicator. 6W x 2¼H x 6¾D", 2.2 lbs. 110/220 VAC input.

15-Amps, $69.95

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15-Amps, $69.95

MFJ-4115 Super-compact 3¾W x 2¼H x 7¾D", 1.5 lb. switcher. 17A surge, 15A cont. 13.8 VDC. 110/220 VAC. Fault LED, 5-way posts.

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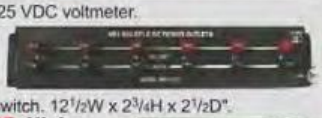

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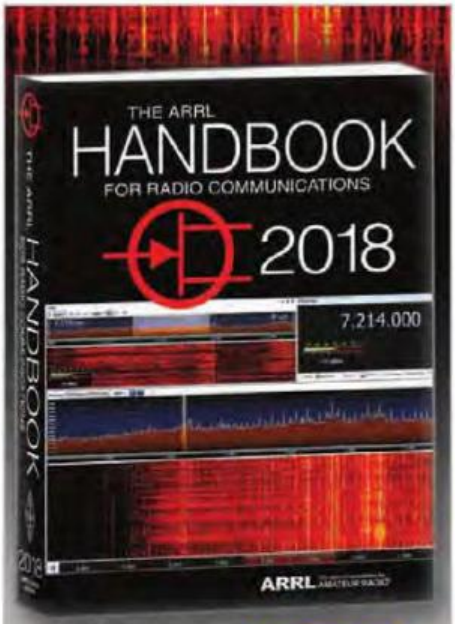

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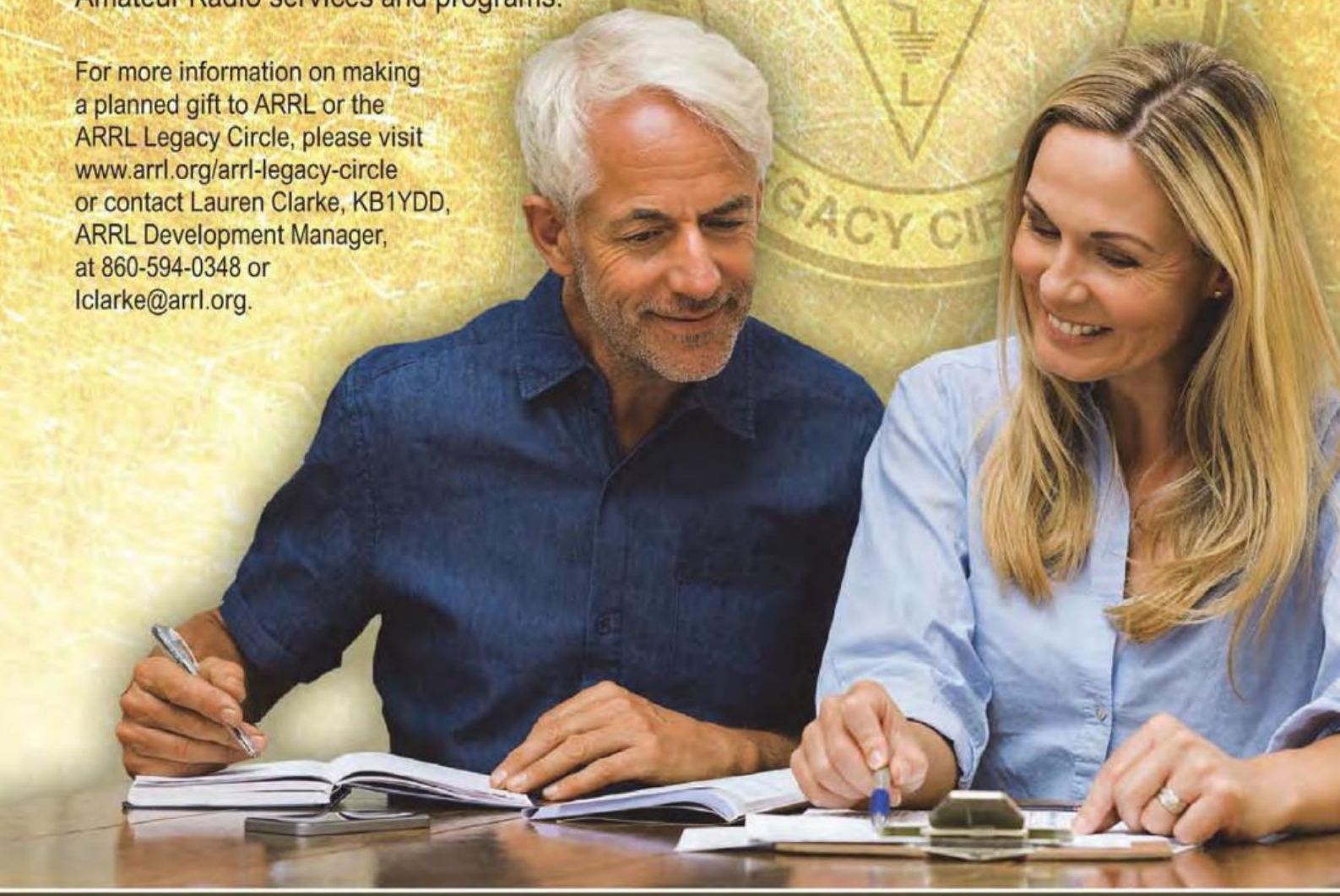

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MFJ...the World Leader in Ham Radio Accessories!

MFJ – Wipe Out RFI!

Wipe out RFI, noise, interference from any direction at any frequency with a 60 dB notch before it gets into your receiver!

Eliminate severe power line noise from arcing transformers and insulators, fluorescent lamps, light dimmers, touch controlled lamps, computers, TV birdies, lightning crashes from distant thunderstorms, electric drills, motors, industrial processes -- before it gets into your receiver.

It's more effective than a noise blanker! Interference much stronger than your desired signal can be completely removed without affecting your signal. Works on all modes -- SSB, AM, CW, FM, digital -- and from BCB to lower VHF.

MFJ-281, $12.95. Clearest speech you ever heard! 3" speaker, 8W, 8 Ohms, 6' cord, 3.5 mm plug.

Null out strong QRM on top of weak rare DX and work him! Null out strong local ham or AM broadcast station to prevent receiver overload.

The MFJ-1026 is an adjustable phasing network that combines two antenna signals to give you various directional patterns. Null out a strong interfering signal or peak a weak signal at a push of a button.

Use external or built-in active noise antenna. RF sense T/R switch bypasses your transceiver. Plugs between antenna and transceiver. 12 VDC, 110 VAC with MFJ-1312D, $15.95. 6½ x 1½ x 6¼".

MFJ-1026
$199.95

MFJ-1025, $179.95. Like MFJ-1026 less active antenna, use external noise antenna.

MFJ Morse Code Reader and Keyer Combo

Plug in this MFJ Morse Code Reader with built-in keyer and watch CW turn into solid text messages as they scroll across an easy-to-read LCD

MFJ-464
$199.95
(Keyboard, paddles not included)

Built-in keyer makes working high speed CW a breeze. Type-ahead buffer, message memories and adjustable speed lets you compete with the best high speed CW operators – they won't even know you never passed a code test!

Everything you need for ultimate CW: sends/reads 5-99 WPM, automatic speed tracking, large 2-line LCD shows send/receive messages, use single, iambic paddle or computer keyboard, front panel speed, volume controls, 4 message memories, type ahead buffer, read again buffer, adjustable weight & sidetone, RFI proof, easy menu operation, more!

MFJ-551, $39.95. RFI suppressed keyboard.

MFJ-564/B, $69.95. MFJ Iambic paddles, chrome/black.

MFJ Contest Voice Keyer

Makes contesting easy -- Calls CQ, sends your call, does contest exchanges -- in your own natural voice

MFJ-434B
$199.95

MFJ Contest Voice Keyer™ makes contesting easy! Calls CQ, sends your call and does contest exchanges for you in your own natural voice!

Save your voice! Record and play back frequently used phrases like "CQ Contest this is KF5C", "You're 59", "Qth is Mississippi".

Repeat messages continuously. Vary repeat delay 3-500 seconds. Makes a great voice beacon and calling CQ easy.

Record and play back off-the-air signals -- great help if you didn't get it right the first time!

A playing message can be halted by the Stop Button, your microphone's PTT/VOX, remote control or computer.

All audio lines are RF filtered to eliminate RFI, audio feedback and distortion. Audio isolation transformer totally eliminates hum and distortion caused by ground loops.

Five messages, 75 seconds total. Use your mic or built-in mic for recording. Can be remote or computer controlled.

Works with 8 pin round or modular mics. Built-in Speaker amplifier.

External speaker, phone jack. 9V battery, 12 VDC or 110 VAC with MFJ-1312D, $15.95. 6½W x 2½H x 6½D".

MFJ-73, $34.95. MFJ-434B Remote Control with cable.

MFJ SDR T/R Protection Switch

New!

MFJ-1708SDR, $79.95. An inexpensive wideband SDR receiver presents *everything* on a band like a panadapter! If you want to know where the activity is, who's generating splatter, what's in the DX window, how wide your audio is or what frequencies are clear, it's all right there! During receive the MFJ- 1708SDR switches your SDR to your antenna letting you see the entire band on your display. On transmit your SDR is switched out and grounded to protect your SDR. PTT and a failsafe RF sense circuit switches MFJ-1708SDR. For HF/VHF/UHF.

MFJ-1270X TNC for VHF Packet/APRS

MFJ-1270X, $129.95. A universal self-contained KISS mode TNC that works with every Packet software program that supports KISS mode -- just connect your FM transceiver and plug into your computer USB port. Natural for emergency communications. Perfect for APRS. Fully compatible with WinLink 2000. Works with Windows, Mac OS X and Linux. Active audio filter cleans up analog signals. Uses less than 25 mA.

MFJ-1270DG, $29.95. X-digi board converts MFJ-1270X into a remotely configureable digipeater.

MFJ Giant SWR/WattMeter

MFJ-868B, $159.95. World's largest 1.8-54 MHz SWR/Wattmeter has giant 6½ inch meter! True active peak/average forward/reflected power. 20/200/2000 Watt ranges.

MFJ Desk Microphones

MFJ-299, $99.95. Tailored for SSB. Adjustable 11" boom. Silibant sound shield, graphic equalizer, compressor, VU meter, on-air indicator, PTT/lock switch.

MFJ-297, $69.95. SSB Boom Mic, PTT switch.

MFJ Boom-Microphone/Headset

MFJ-393 (K,I,Y), $69.95. **Professional** Boom-Mic headphones for contesting, DXing, traffic nets. Comfortable padding lets you operate for hours, seals out noise. Frequency-tailored Mic busts thru noise/QRM. Adjustable boom.

MFJ 24/12 Desk Clock

MFJ-108B, $21.95. **Read** both UTC and local time simultaneously. BIG 5/8 inch digits! Solid brushed aluminum frame. 4¼W x 2H x 1D

Mic Control Center

MFJ-1263, $119.95. **Instantly** switch ragchewing to DX mic to any two transceivers. Use PTT foot switch, boom mic/headset, phones, speaker, audio-in jack.

MFJ Dry Dummy Load

MFJ-260C, $39.95. **300 Watts**. SWR below 1.1:1 to 30 MHz. 1.5:1 from 30-650 MHz. **MFJ-264, $74.95.** 1.5kW load.

MFJ AC Line Filter

MFJ-1164B, $79.95. **Filters** AC line RFI, surges, noise, transients, hash 30 dB, 60-80 dB with ground. Four 15A/120 VAC outlets.

MFJ Enterprises, Inc. 300 Industrial Pk Rd, Starkville, MS 39759
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Escape with the TM-281A

On or off the road, Kenwood's TM-281A is a mobile radio you can always count on.

As tough as nails, this MIL-STD-compliant transceiver delivers powerful performance, excellent audio clarity, and a host of advanced features. It offers superb operating ease day or night thanks to the large backlit LCD and illuminated keys. So the next time you take off, take the TM-281A.

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