Cover Story: A Ham Assists a Scientific Expedition on a Polar Ice Shelf Page 65

QST
DIGITAL EDITION

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DEVOTED ENTIRELY TO AMATEUR RADIO

Braving the Antarctic

QST Reviews

FlexRadio Systems FLEX-6400M HF and 6-Meter SDR Transceiver

HecKits FET DIP Meter Kit

RM Italy BLA600 500 W HF and 6-Meter Linear Amplifier

DIGITAL FEATURE

54 | See our Video Review of the **FlexRadio Systems** FLEX-6400M HF and 6-Meter SDR Transceiver.

The radio... YAESU

The Conclusive Choice

1- Pulling out weak signals during extremely harsh band conditions

Narrow Band SDR + Direct Sampling SDR

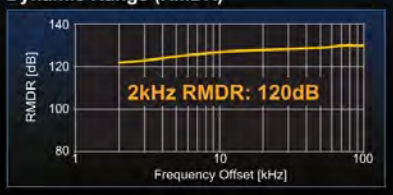
A unique Hybrid SDR Configuration utilizing YAESU's Legendary Powerful RF Front-End and improved local oscillator C/N characteristics combined with a Sharp Crystal Roofing Filter and 18-bit Narrow Band SDR produces unsurpassed critical receiver performance when faced with challenging on-the-air interference situations.

The Narrow Band SDR portion is combined with Direct Sampling SDR output on the LCD display. The operator enjoys an astounding visual awareness of activity across the entire band plus detailed activity focus in the immediate proximity of the selected operating frequency.

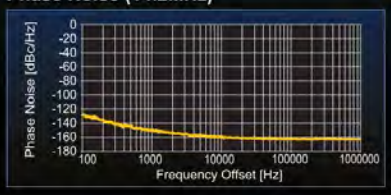
Hybrid SDR Configuration

14MHz Band Blocking Dynamic Range (BDR)

14MHz Band Reciprocal Mixing Dynamic Range (RMDR)



1st Local OSC Phase Noise (14.2MHz)



In Homage to the Founder of Yaesu – Sako Hasegawa JA1MP

FTDX101MP 200W

HF/50MHz TRANSCEIVER

The Ultimate

FTDX101D 100W

HF/50MHz TRANSCEIVER

This device has not been approved by the FCC. This device may not be offered for sale or lease or be sold or leased until approval of the FCC has been obtained. The information shown is preliminary and may be subject to change without notice or obligation.

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.

C4FM/FM 144/430 MHz
Dual Band 5W
Digital Transceiver

FT-70DR

《 700 mW Loud and Clear audio,
Commercial Grade Specifications 》

C4FM/FM 144/430 MHz
Dual Band 5 W
Digital Transceiver

FT2DR

《 Improved 66 ch
GPS receiver included 》

System Fusion II

C4FM Digital
Pursuing Advanced Communications

C4FM/FM 144/430 MHz Dual Band 50 W
Digital Transceiver

FTM-100DR

《 Improved 66 ch GPS receiver included 》

C4FM/FM 144/430 MHz
Dual Band Dual Receive Digital Repeater

DR-2X

C4FM/FM 144/430 MHz Dual Band 50 W
Digital Transceiver

FTM-400XDR

《 Improved 66 ch GPS receiver included 》

C4FM/FM 144/430 MHz Dual Band 50 W
Digital Transceiver

FTM-7250DR

《 Heavy Duty 50 Watts High Power 》

C4FM/FM 144 MHz 65 W
Digital Transceiver

FTM-3200DR

《 Genuine 65 Watts High Power 》

C4FM/FM 430 MHz 55 W
Digital Transceiver

FTM-3207DR

《 Heavy Duty 55 Watts High Power 》

CW/SSB/AM/FM/C4FM
HF/50/144/430 MHz Wide-Coverage
100 W All Mode Transceiver (144/430 MHz: 50 W)

FT-991A

《 Real-Time Spectrum Scope included 》

System Fusion II Supports All C4FM Portables and Mobiles

- Firmware updates will enable System Fusion II compatibility with all existing C4FM products.

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The radio

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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.

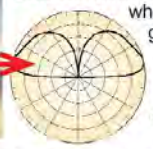
Cushcraft R9...80-6 Meters 80 Meters...No Radials...1500W

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.

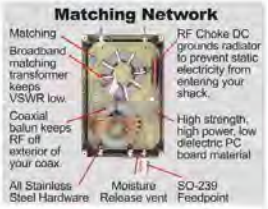
Use full 1500 Watts SSB/CW when the going gets tough to break through pileups/ poor band conditions.



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 broad-banded, 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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Add shipping. Prices and specifications subject to change. 2016 ©Cushcraft.

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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

❻ 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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www.arrl.org/qst-author-guide
email: **qst@arrl.org**

Our Cover

In this month's article, "Amateur Radio from Antarctica," journey to the bottom of the Earth with authors Reinhard E. Flick, PhD, K6REF, and Peter D. Bromirski, PhD. As part of a team conducting research on the Ross and Ronne-Filchner Ice Shelves, they installed more than 30 seismometer stations — and K6REF had the opportunity to get on the air. Pictured on our cover is the McMurdo Station ham shack, KC4USV, with its seven-element Yagi beam, on the southern tip of Ross Island. [Photo courtesy of Reinhard E. Flick, K6REF, and Peter D. Bromirski]

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AT-100PROII
- Dual Bargraph
- Auto / Semi-Auto Mode
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- RBA 4:1 BALUN
- RBA 1:1 BALUN
- 200W SSB

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Tuner dedicated to Icom radios with seamless integration.

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- AH-3 & AH-4 Compatible
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Designed for portable and low power applications - zero current draw once tuned.

Z-100 PLUS
- Low Cost
- Highly Portable
- 125W SSB/30W Digital

Z-11PROII
- LED SWR Indicator
- 10:1 SWR
- 125W SSB/30W Digital

Z-817
- FT-817/818 Compatible
- Operates on 4 AAs
- 20W SSB/5W Digital

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Tuner with built in Yaesu/antenna tuner interface.

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- 2000 Memories
- For FT-100, FT-857 and FT-897
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Remote tuners mounted at or near the feedpoint minimize coax SWR losses.

- Includes Controller/Bias T
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THE HEARING AIDS... FOR HAMS!

During a solar minimum, HF band conditions can be a challenge. Many hams are discouraged by this potential for reduced performance. Do not despair! A low sunspot period can be a great time to work rare DX, break into DX pileups and also win a contest or two, but it's critical to have the correct equipment – nothing is more important than having the ability to hear the signal you want to work.

SteppIR antenna products allow the user to remotely adjust each active antenna element to the exact length required, so the antenna is optimized at every single frequency within its range, including non-ham band frequencies. This significantly enhances the ability to HEAR the signal, which is why we call our products "The Hearing Aids, for Hams"!

Adam Blackmer
K7EDX

"When signals start to approach the noise floor – as they often do at a sunspot minima – SteppIR Yagis, with their support pattern and gain, allow users to hear and work stations that others cannot."
– Mike Mertel K7IR

An interlaced or trapped Yagi can't touch the performance of my tree mounted 3 element SteppIR Yagi – The odds are always in my favor to work the station in competitive situations.
– Michael Fischer K7XH

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DIAMOND ANTENNAS help you get the most out of your on-air experience.

For all your base station and repeater needs, DIAMOND has an antenna that will work for you.

You've tried the rest, now own the best!

X700HNA Special Features:

- Heavy duty fiberglass radomes
- Four section assembly
- Overlapping outer shells for added strength
- Stainless steel mounting hardware & radials
- Strong waterproof joint couplings
- Type-N cable connection
- Wideband performance
- Highest gain Dual-band Base Antenna!

Here is a small sample of our wide variety of antennas

Model	Bands	Length Ft.	Max Pwr. Rating	Conn.
Dualband Base Station/Repeater Antennas				
X700HNA (4 section)	2m/70cm	24	200	N
X510HD (3 Section)	2m/70cm	17.2	330/250	UHF or N
X300A (2 Section)	2m/70cm	10	200	UHF or N
X200A (2 Section)	2m/70cm	8.3	200	UHF
X50A (1 Section)	2m/70cm	5.6	200	UHF or N
X30A (1 Section)	2m/70cm	4.5	150	UHF
Monoband Base Station/Repeater Antennas				
F23H (3 Section)	144-174 MHz (W/ Cut Chart)	15	350	UHF
F22A (2 Section)	2m	10.5	200	UHF
CP22E (Aluminum)	2m	8.9	200	UHF
F718A (Coax Element)	70cm	15	250	N
Dualband Mobile Antennas				
SG7900A	2m/70cm	62.2 in.	150	UHF or NMO
SG7500A	2m/70cm	40.6 in.	150	UHF or NMO
NR770H Series	2m/70cm	38.2 in.	200	UHF or NMO
MR77 Series	2m/70cm	20 in.	70	Mag Combo
AZ504FXH	2m/70cm	15.5 in.	50	UHF
AZ504SP	2m/70cm	15.5 in.	50	UHF
NR7900A	2m/70cm	57 in.	300/250	UHF
Monoband Mobile Antennas				
NR22L	2m	96.8 in.	100	UHF
M285	2m	52.4 in.	200	UHF or NMO

The Standard By Which All Others Are Judged

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Howard E. Michel, WB2ITX, ARRL Chief Executive Officer, hmichel@arrl.org

Second Century

The Spectrum of Hams

"We have some data, albeit raw data at this time, that tells us where segments of ARRL members and non-member amateurs fall in terms of interests and priorities. ARRL needs to develop products and services for all these segments. In today's age, ARRL has the ability to customize our engagement with customers and members who expect this from us. ARRL has to do this, in order to remain relevant. One size no longer fits all."

Is your passion for Amateur Radio primarily about communications, or about technology? Do you consider Amateur Radio a hobby, or a service?

The answers to these questions are not either/or decisions. Most people do not fall to the extremes. Nearly everyone's pursuit of Amateur Radio falls somewhere along a spectrum between developing new technology and using existing technology to communicate, and along a spectrum between Amateur Radio as a hobby and Amateur Radio as a service.

A spectrum between hobby and service is easy to understand. Hobbies are undertaken in one's leisure time for pleasure. Service activities help someone else.

A spectrum between communications and technology might be more difficult to picture. At the technology end, you have researchers in government and industry labs advancing the state of the art, creating new devices, systems, and processes to move electrons and photons from one place to another. At the communications end, you have operators battling the elements, using whatever technology is available to exchange information. In the middle, you have people selecting the best commercial products that allow them to communicate efficiently.

Now imagine a two-dimensional grid, with hobby-to-service as the horizontal axis, and technology-to-communications as the vertical axis. Every ham can be aligned as a dot — or possibly several dots — on that grid. But interests and passions change over time, meaning that many hams are likely on a path through that grid.

Where do you see yourself on our two-dimensional grid? If you are a DXer or contester, you are watching sunspots, the diurnal cycle, and atmospheric conditions, using the technology in your shack to get through a pileup to make that contact. Perhaps you engage in these activities to hone your skills for use in the next disaster, or perhaps you enjoy the feeling of accomplishment in achieving the next level of recognition. Whatever the underlying reason, your ham radio hobby is primarily about communications. You are the "guardians" of ham radio — an ARRL term for "classic," "old-school" practitioners of the hobby. Your interests can be found on the left side of the grid, probably about midway up the technology-communication axis. ARRL is there for you with *QST*, DXCC, *NCJ*, product reviews, and daily bulletins.

If you are a ragchewer, perhaps with a regular chat schedule with a small group of longtime friends, or the adventurous type who wants to make new friends in other parts of the world, you too are a "guardian" of ham radio, though you are probably in the upper left quadrant of the grid. For this type of guardian, ham radio is all about communicating. Again, ARRL is there for you with local clubs, a Spectrum Defense fund, and articles on "good old-fashioned hamming."

Another segment of hams has been given the name "technologist." Technologists are interested in building radios, antennas, and accessories. They are intrigued by transmitting information by using as little power as possible, trying the latest form of digital communications, or trying to quantify the latest improvement they made in their antenna. Technologists occupy the lower left quadrant. ARRL is also there for them with *QEX*.

The upper right quadrant is occupied by radio amateurs who are interested in helping their community by providing communications during disasters, or just helping in civic events like road races. They are not particularly interested in developing new technology, but they are looking for ways to communicate when the infrastructure collapses. The Amateur Radio Emergency Service® (ARES) consists of licensed amateurs who have voluntarily registered their qualifications and equipment, with their local ARES leadership, for communications duty in the public service when disaster strikes. ARRL staff has begun calling these service-minded hams "the ready," for their commitment to helping others.

These are just my suggestions. There is no one right way to be a ham. We are all brothers and sisters bound together with a license we earned. I encourage you to discuss your view of Amateur Radio with your fellow hams, and I welcome your comments at **wb2itx@arrl.org**.

Howard E Michel WB2ITX

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TH-11DX	11			4000	10, 12, 15, 17, 20	12.5	100	24	37	22	88	1.9-2.5	T2X	$1199.95
TH-7DX	**7**	**For Gain and F/B ratio–See...**		**1500**	**10, 15, 20**	**9.4**	**100**	**24**	**31**	**20**	**75**	**1.5-2.5**	**HAM-IV**	**$899.95**
TH-5MK2	5			1500	10, 15, 20	7.4	100	19	31.5	18.42	57	1.5-2.5	HAM-IV	$789.95
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EXP-14	4			1500	10, 15, 20 opt.30/40	7.5	100	14	31.5	17.25	45	1.9-2.5	HAM-IV	$629.95

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SPIDERBEAM ROTATABLE ALUMINUM MASTS - support for 13 to 25 lbs antenna weight. 33 ft - $459 / $485, 41 ft $509, 47 ft $629, 49 ft $575, 60 ft $749. Guy hardware, rotator adapters, other accessories available. QST review: May 2015

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The INRAD Desk Microphone System is the new standard on HF. Find out what nearly 1000 other hams who have purchased one already know: INRAD means great audio doesn't have to cost hundreds of dollars. Priced at just $138 to $158. ARRL Product Review, January 2018.

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235-5X-3	3

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Custom lengths and Bulk available

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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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233/2-G4 Vehicle Ground Braid (PN:233/2-G4) 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 38x48x8/34 10ga 53 amps

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

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ABR600 (PN24600)	Attenuation per 100ft	Power Rating
Low Loss Gas Injected Foam (85% VP)	0.4dB @ 30MHz	5.51KW
95% Tin-Copper Braid 100% AL Foil	0.5dB @ 50 MHZ	4.24KW
UV Stabilized Jacket	1.0dB @ 150MHz	2.41KW
Available with PL259, SO239, N-Type, TNC and 7-16DIN connectors	1.7dB @ 450MHz	1.35KW
	2.5dB @ 900MHz	0.93KW
	2.9dB @ 1200MHz	0.79KW

ABR213 (PN:2213A) Mil-SPEC (.405" diameter) Stranded Center Conductor, 66% VP, 97% BC Braid. Type II Jkt (Direct Burial)Available in Bulk or with PL259s, BNCs, N Type, TNC, SMA, or 7-16 Din Connectors.

Attenuation per 100ft	Power Rating
0.6dB @ 10MHz	3.43kW
1.0dB @ 30MHz	1.95kW
1.4dB @ 50MHz	1.5kW
2.4dB @ 150MHz	0.83kW
4.5dB @ 450MHz	0.45kW

Stocked Lengths 1.5ft to 200ft
Custom assemblies and Testing services available.

ABR240-UF (PN:218XA) RG-8X size (.240") Stranded Center Conductor, 85% VP, 95% TC Braid / 100 Foil, Type II Jkt (Direct Burial)Available in Bulk, W/ PL259s, BNCs, N Type, TNC, SMA, or Reverse Polarity Connectors.

Attenuation per 100ft	Power Rating
0.9dB @ 10MHz	2.16kW
1.6dB @ 30MHz	1.24kW
2.1dB @ 50MHz	0.96kW
3.6dB @ 150MHz	0.55kW
6.3dB @ 450MHz	0.31kW

Stocked Lengths 1.5ft to150ft
Custom assemblies and Testing services available.

ABR316/U (PN:23316)
Available in standard configurations in 3ft, 6ft, 9ft, and 12ft.

Connector Options
N Male to N Male
SMA Male to SMA Male
SMA Male to SMA Female
SMA Male to SO239
SMA Male to PL259
SMA Female to SO239
SMA Female to PI259
Custom assemblies available

ABR400-UF (PN:24500F) RG-8/U size (.405") Stranded Center Conductor, 86% VP, 95% TC Braid / 100 Foil, Type II Jkt (Direct Burial) Available in Bulk, W/ PL259s, BNCs, N Type, TNC, SMA, or 7-16 Din Connectors.

Attenuation per 100ft	Power Rating
0.8dB @ 30MHz	2.77kW
1.1dB @ 50MHz	2.14kW
1.8dB @ 150MHz	1.22kW
3.3dB @ 450MHz	0.69kW

Stocked Lengths 1.5ft to 200ft
Custom assemblies and Testing services available.

ABR400 (PN:24400) RG-8/U size (.405") Solid Center Conductor, 86% VP, 95% TC Braid / 100 Foil, Type II Jkt (Direct Burial) Available in Bulk, W/ PL259s, BNCs, N Type, TNC, SMA, or 7-16 Din Connectors.

Attenuation per 100ft	Power Rating
0.7dB @ 30MHz	3.33kW
0.9dB @ 50MHz	2.57kW
1.5dB @ 150MHz	1.47kW
2.7dB @ 450MHz	0.83kW

Stocked Lengths 1.5ft to 200ft
Custom assemblies and Testing services available.

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Member Spotlight

Dave Cripe, NM0S

Dave Cripe, NM0S, makes his home in the small town of Mount Vernon, Iowa, which is also the home of Cornell College. Dave is employed at Rockwell Collins, working in research and development of advanced technology products.

"It's quite an honor to work in a place with such a great Amateur Radio heritage," Dave said. "Some say the ghost of Art Collins, W0CXX, still roams the hallways. I'm not sure if that is true in a literal sense, but his spirit of innovation and excellence lives on here."

Dave has been licensed since November 1981. He had wanted to get his license long before then, but it was not until Dave started college that he was able to make that happen. He recalled, "My roommate just happened to be Jeff Fisher, AB5E, and he coached me through 5 WPM CW, and administered my Novice exam. My first call was KA9MCV. I'm of the opinion that even though it's not a requirement, your call sign should reflect the district in which you live. As a result, I've changed call sign every time I've moved, and have held KC3ZQ, AI9E, NE4AM, AI9A, and now NM0S."

Four State QRP Group

Dave has had a long-standing relationship with the Four State QRP Group (**www.4sqrp.com**). It was originally a regional club encompassing Arkansas, Kansas, Oklahoma, and Missouri, but today its membership is global.

The club is well known for its collection of kits, which is what drew Dave into their circle. "I first ran into Terry Fletcher, WA0ITP, and Joe Porter, W0MQY, at the Four Days in May QRP conference in 2008. They were interested in my entry in the Homebrew Contest and asked if I would let the club make it into a kit."

According to Dave, the Four State group has an interesting business model. Club volunteers package and sell QRP kits, the proceeds of which go to finance their annual convention, OzarkCon. OzarkCon takes place the first weekend in April in Branson, Missouri.

Dave explained, "I think I have donated designs for about 20 kits at last count, and I have about 12 more in the works. Right now, I serve on their Board of Directors as Vice President and I chair their Technical Committee."

Scouting, Radio History, and Music

Dave works with Boy Scout Troop 40 in Mount Vernon to promote Amateur Radio. Thanks to his efforts, the troop has eight boys, and their parents, licensed. They've established their own radio club known as the Order of the Aerial, with the call sign WN0BSA.

"Most of my on-air activities involve helping the Troop get their station set up for ARRL Field Day or Jamboree on the Air (JOTA), and helping the kids with their first on-air experiences," Dave said. "In addition to working with the Four State QRP Group and the Boy Scouts, I love researching radio history and compiling presentations for ham radio club meetings and conventions. Our avocation has many fascinating stories, and we need to appreciate the amazing accomplishments of those who have gone before us."

Music is another passion. Dave says he plays almost anything with strings. "I'm definitely not alone in this," he said. "It seems like a disproportionate number of hams are musically inclined. It has made for some interesting jam sessions at ham radio events!"

Dave Cripe, NM0S, at the helm of N0CXX, the Collins Amateur Radio Club station.

With the resurgence of interest in vinyl LP records, Dave recently dusted off his record collection, set his stereo system back up, and has even gone on record-collecting expeditions. As he said, "Reading lyrics off an LP jacket is an experience that owners of digital music will never enjoy."

Thoughts of the Future

Regarding the future of ham radio, Dave said:

> If we want ham radio to continue, our generation needs to be more effective in our outreach. We just can't sit back and expect young people to accidentally stumble upon us. Unfortunately, most kids will never have exposure to ham radio unless somebody brings it to them and shows them the fun and excitement of it. I'd like to challenge my fellow amateurs to volunteer time at schools, scouts, and youth groups in our communities to help build those essential relationships that will allow us to encourage and mentor the next generation of radio hobbyists.

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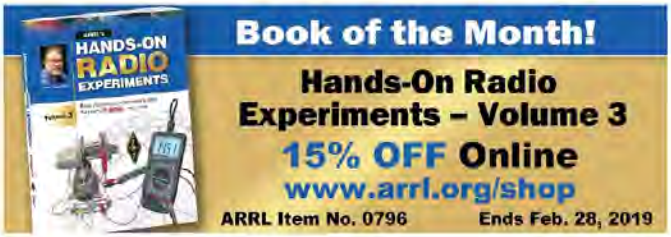

The American Radio Relay League, Inc.

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.

ARRL 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 06111-1400 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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Jay Bellows, K0QB
1925 Bidwell St., West St. Paul, MN 55118
(651-238-4444); **k0qb@arrl.org**

Chief Executive Officer*
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Secretary
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Treasurer
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Atlantic Division

www.atldiv.org
Tom Abernethy, W3TOM
P.O. Box 73, Accokeek, MD 20607
(301-257-6225); **w3tom@arrl.org**

Vice Director: **Riley Hollingsworth, K4ZDH**
580 Herrs Ridge Rd., Gettysburg, PA 17325
(717-476-7379); **k4zdh@arrl.org**

Central Division

www.central.arrl.org
Kermit Carlson, W9XA
1150 McKee St., Batavia, IL 60510
(630-879-0983); **w9xa@arrl.org**

Vice Director: **Carl Luetzelschwab, K9LA**
1227 Pion Rd., Fort Wayne, IN 46845
(260-637-6988); **k9la@arrl.org**

Dakota Division

www.arrldakota.org
Matt Holden, K0BBC*
8161 33rd Ave. S., Unit 706
Bloomington, MN 55425
(952-232-1984); **k0bbc@arrl.org**

Vice Director: **Lynn Nelson, W0ND**
3204 Willow Ln. SE, Minot, ND 58701
(701-833-1000); **w0nd@arrl.org**

Delta Division

arrldelta.org
David A. Norris, K5UZ*
907 Evening Sunset Cir., Redfield, AR 72132
(870-613-1606); **k5uz@arrl.org**

Vice Director: **Ed B. Hudgens, WB4RHQ**
1441 Wexford Downs Ln., Nashville, TN 37211
(615-333-9859); **wb4rhq@arrl.org**

Great Lakes Division

arrl-greatlakes.org
Dale Williams, WA8EFK*
291 Outer Dr., Dundee, MI 48131
(734-529-3232); **wa8efk@arrl.org**

Vice Director: **Thomas Delaney, W8WTD**
4632 Glenway Ave., Cincinnati, OH 45238
(513-921-7423); **w8wtd@arrl.org**

Hudson Division

www.hudson.arrl.org
Ria Jairam, N2RJ
P.O. Box 73, Sussex, NJ 07461
(973-594-6275); **n2rj@arrl.org**

Vice Director: **William Hudzik, W2UDT**
111 Preston Dr., Gillette, NJ 07933
(908-580-0493); **w2udt@arrl.org**

Midwest Division

www.arrlmidwest.org
Rod Blocksome, K0DAS
690 Eastview Dr., Robins, IA 52328-9768
(319-393-8022); **k0das@arrl.org**

Vice Director: **Art Zygielbaum, K0AIZ**
6601 Pinecrest Dr., Lincoln, NE 68516
(402-421-0839); **k0aiz@arrl.org**

How to Contact ARRL Staff

To send an email to any ARRL Headquarters staff member, put his or her call sign (or first initial and last name) in front of **@arrl.org**. For example, to send to Hiram Maxim, First President of the ARRL, use **w1aw@arrl.org**, or **hmaxim@arrl.org**.

New England Division

Fred Hopengarten, K1VR
6 Willarch Rd., Lincoln, MA 01773
(781-259-0088); **k1vr@arrl.org**

Vice Director: **Mike Raisbeck, K1TWF**
85 High St., Chelmsford, MA 01824
(978-250-1235); **k1twf@arrl.org**

Northwestern Division

www.arrl.nwdiv.org
Mike Ritz, W7VO
33643 Burma Rd., Scappoose, OR 97056
(503-987-1269); **w7vo@arrl.org**

Vice Director: **Mark J. Tharp, KB7HDX**
P.O. Box 2222, Yakima, WA 98907
(509-952-5764); **kb7hdx@arrl.org**

Pacific Division

www.pdarrl.org
Jim Tiemstra, K6JAT
13450 Skyline Blvd., Oakland, CA 94619
(510-569-6963); **k6jat@arrl.org**

Vice Director: **Kristen McIntyre, K6WX**
40711 Witherspoon Ter., Fremont, CA 94538
(510-703-4942); **k6wx@arrl.org**

Roanoke Division

arrl-roanoke.com
George W. "Bud" Hippisley, W2RU
981 Circle Creek Rd., Penhook, VA 24137
(540-576-2527); **w2ru@arrl.org**

Vice Director: **Bill Morine, N2COP**
101 Windlass Dr., Wilmington, NC 28409
(910-452-1770); **n2cop@arrl.org**

Rocky Mountain Division

www.rockymountaindivision.org
Jeff Ryan, K0RM
9975 Wadsworth Pkwy. K2-275
Westminster, CO 80021
(303-432-2886); **k0rm@arrl.org**

Vice Director: **Robert Wareham, N0ESQ**
300 Plaza Dr., Suite 200
Highlands Ranch, CO 80129
(720-592-0394); **n0esq@arrl.org**

Southeastern Division

www.facebook.com/
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Greg Sarratt, W4OZK
321 Dupree Dr., Huntsville, AL 35806
(256-337-3636); **gsarratt@arrl.org**

Vice Director: **Joseph Tiritilli, N4ZUW**
4116 NW 1st St., Deerfield Beach, FL
33442-8033 (954-296-4234); **n4zuw@arrl.org**

Southwestern Division

www.kkn.net/n6aa
Richard J. Norton, N6AA
21290 West Hillside Dr., Topanga, CA 90290
(310-455-1138); **n6aa@arrl.org**

Vice Director: **Ned Stearns, AA7A**
7038 East Aster Dr., Scottsdale, AZ 85254
(480-948-5080); **aa7a@arrl.org**

West Gulf Division

arrlwgd.org
Dr. David Woolweaver, K5RAV
P.O. Box 531605, Harlingen, TX 78553
(956-425-3128); **k5rav@arrl.org**

Vice Director: **John Robert Stratton, N5AUS**
P.O. Box 2232, Austin, TX 78768-2232
(512-445-6262); **n5aus@n5aus.com**

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Delaware: Bill Duveneck, KB3KYH, 18682 Sunny Sky Blvd., Milton, DE 19968-2486 (302-537-4755); **kb3kyh@arrl.org**
Eastern Pennsylvania: George Miller, W3GWM, 293 Woods Rd., Wyalusing, PA 18853 (570-250-1007); **w3gwm@arrl.org**
Maryland-DC: Marty Pittinger, KB3MXM, 4 Pegram Rd., Owings Mills, MD 21117 (410-356-7899); **kb3mxm@arrl.org**
Northern New York: Thomas Dick, KF2GC, 11 Jenkins St., Saranac Lake, NY 12983 (518-891-0508); **kf2gc@arrl.org**
Southern New Jersey: Tom Preiser, N2XW, 177 Bowsprit Rd., Manahawkin, NJ, 08050-5001 (609-618-0224); **n2xw@arrl.org**
Western New York: Laura Mueller, N2LJM, 2011 E. Main St., Falconer, NY 14733 (716-338-3122); **n2ljm@arrl.org**
Western Pennsylvania: Joe Shupienis, W3BC, P.O. Box 73, Falls Creek, PA 15840-0322 (814-771-3804); **w3bc@arrl.org**

Central Division (IL, IN, WI)

Illinois: Ron Morgan, AD9I, 114 Herman St., East Peoria, IL 61611-4420 (309-397-9549); **ad9i@arrl.org**
Indiana: James Merry, Jr., KC9RPX, 7332 W. Mustang Dr., Ellettsville, IN 47429 (812-391-2661); **kc9rpx@arrl.org**
Wisconsin: Patrick Moretti, KA1RB, W349S3970 Waterville Rd., Dousman, WI 53118-9786 (262-354-2997); **ka1rb@arrl.org**

Dakota Division (MN, ND, SD)

Minnesota: Richard H. "Skip" Jackson, KS0J, 1835-63rd St. E, Inver Grove Heights, MN 55077 (651-260-4330); **ks0j@arrl.org**
North Dakota: Nancy Yoshida, KG0YL, 1079 Harvest Ln. NE, Thompson, ND 58278-9408 (218-779-6596); **kg0yl@arrl.org**
South Dakota: Chris Stallkamp, KI0D, P.O. Box 271, Selby, SD 57472-0271 (605-870-1784); **ki0d@arrl.org**

Delta Division (AR, LA, MS, TN)

Arkansas: James D. Ferguson, Jr., N5LKE, 1500 Lauren Dr., Searcy, AR 72143-8477 (501-593-5695); **n5lke@arrl.org**
Louisiana: John Mark Robertson, K5JMR, 201 Madewood Ct., Bossier City, LA 71111-6325 (318-572-7917); **k5jmr@arrl.org**
Mississippi: Malcolm Keown, W5XX, 64 Lake Cir. Dr., Vicksburg, MS 39180 (601-636-0827); **w5xx@arrl.org**
Tennessee: Keith E. Miller Sr., N9DGK, 1635 Jarratt Dr., Rockvale, TN 37135 (615-631-9952); **n9dgk@arrl.org**

Great Lakes Division (KY, MI, OH)

Kentucky: Steve Morgan, W4NHO, 1124 W. 12th St., Owensboro, KY 42301-2975 (270-926-4451); **w4nho@arrl.org**
Michigan: Jim Kvochick, K8JK, 10366 Greystone Ct., Brighton, MI 48114-7650 (810-229-5085); **k8jk@arrl.org**
Ohio: Scott D. Yonally, N8SY, 258 Valley Hi Dr., Mansfield, OH 44904-9792 (419-512-4445); **n8sy@arrl.org**

Hudson Division (ENY, NLI, NNJ)

Eastern New York: John K. Fritze, Jr., K2QY, 4 Normanskill Blvd., Delmar, NY 12054-1335(401-261-4996); **k2qy@arrl.org**
NYC-Long Island: Jim Mezey, W2KFV, 38 Appletree Ln., Carle Place, NY 11514-1336 (516-315-8608); **w2kfv@arrl.org**
Northern New Jersey: Rob Roschewsk, KA2PBT, 104 Buckhorn Dr., Washington, NJ 07882 (908-916-2570); **ka2pbt@arrl.org**

Midwest Division (IA, KS, MO, NE)

Iowa: Robert McCaffrey, K0CY, 1210 Noble Hills Pl., Boone, IA 50036 (515-432-2512); **k0cy@arrl.org**
Kansas: Ronald D. Cowan, KB0DTI, P.O. Box 36, LaCygne, KS 66040 (913-757-3758); **kb0dti@arrl.org**
Missouri: Cecil Higgins, AC0HA, 27995 County Rd. 220, Hermitage, MO 65668-8493 (417-399-5027); **ac0ha@arrl.org**
Nebraska: Matthew N. Anderson, KA0BOJ, 14300 NW 98th St., Raymond, NE 68428-4254 (402-480-5515); **ka0boj@arrl.org**

New England Division (CT, EMA, ME, NH, RI, VT, WMA)

Connecticut: Charles I. Motes, Jr., K1DFS, 22 Woodside Ln., Plainville, CT 06062 (860-747-6377); **k1dfs@arrl.org**
Eastern Massachusetts: Tom Walsh, K1TW, 9 Wildwood Dr., Bedford, MA 01730 (781-275-5882); **k1tw@arrl.org**
Maine: Bill Crowley, K1NIT, 150 Maple St., Farmingdale, ME 04344-4809 (207-623-9075); **k1nit@arrl.org**
New Hampshire: Peter Stohrer, K1PJS, 9 Gladstone St., Concord, NH 03301 (603-715-9539); **k1pjs@arrl.org**
Rhode Island: Bob Beaudet, W1YRC, 30 Rocky Crest Rd., Cumberland, RI 02864 (401-333-2129); **w1yrc@arrl.org**
Vermont: Paul N. Gayet, AA1SU, 11 Cherry St., Essex Junction, VT 05452 (802-878-2215); **aa1su@arrl.org**
Western Massachusetts: Raymond Lajoie, KB1LRL, 245 Leominster Rd., Lunenburg, MA 01462-2031 (978-549-5507); **kb1lrl@arrl.org**

Northwestern Division (AK, EWA, ID, MT, OR, WWA)

Alaska: Ray Hollenbeck, KL1IL, 1457 Pioneer Peak Dr., Wasilla, AK 99654 (907-373-6771); **kl1il@arrl.org**
Eastern Washington: Jack Tiley, AD7FO, 1806 S. Fawn Dr., Spokane Valley, WA 99206-3318 (509-951-7214); **ad7fo@arrl.org**
Idaho: Edward Stuckey, AI7H, 2300 W. Polo Green Ave., Post Falls, ID 83854-9680 (208-457-0354); **ai7h@arrl.org**
Montana: George Forsyth, AA7GS, 212 Skyline Dr. NE, Great Falls, MT 59404 (406-868-2212); **aa7gs@arrl.org**
Oregon: David Kidd, KA7OZO, 21760 S. Larkspur Ave., Oregon City, OR 97045-9164 (503-320-3484); **ka7ozo@arrl.org**
Western Washington: Monte L. Simpson, AF7PQ, P.O. Box 3008, Silverdale, WA 98383 (360-633-7665); **af7pq@arrl.org**

Pacific Division (EB, NV, PAC, SV, SF, SJV, SCV)

East Bay: Jim Siemons, W6LK, 2308 Lomond Ln., Walnut Creek, CA 94598-3705 (925-330-0049); **w6lk@arrl.org**
Nevada: John Bigley, N7UR, 2420 Palora Ave., Las Vegas, NV 89121-2157 (702-673-0904); **n7ur@arrl.org**
Pacific: Joe Speroni, AH0A, 278 Kapiolani Blvd. #502, Honolulu, HI 96826 (808-955-2496); **ah0a@arrl.org**
Sacramento Valley: Dr. Carol Milazzo, KP4MD, P.O. Box 665, Citrus Heights, CA 95611-0665 (916-879-7449); **kp4md@arrl.org**
San Francisco: Bill Hillendahl, KH6GJV, P.O. Box 4151, Santa Rosa, CA 95402-4151 (707-544-4944); **kh6gjv@arrl.org**
San Joaquin Valley: Dan Pruitt, AE6SX, 4834 N. Diana St., Fresno, CA 93726 (559-779-2974); **ae6sx@arrl.org**
Santa Clara Valley: Brandon Bianchi, NI6C, P.O. Box 60128, Palo Alto, CA 94306 (559-313-3373); **ni6c@arrl.org**

Roanoke Division (NC, SC, VA, WV)

North Carolina: Karl Bowman, W4CHX, 5509 Shimer Farm Ln., Raleigh, NC 27614-6301 (919-669-6068); **w4chx@arrl.org**
South Carolina: Marc Tarplee, N4UFP, 4406 Deer Run, Rock Hill, SC 29732-9258 (803-327-4978); **n4ufp@arrl.org**
Virginia: Joseph Palsa, K3WRY, 9101 Arch Hill Ct., Richmond, VA 23236-2725 (804-350-2665); **k3wry@arrl.org**
West Virginia: Dan Ringer, K8WV, 18 W. Front St., Morgantown, WV 26501-4507 (304-292-1999); **k8wv@arrl.org**

Rocky Mountain Division (CO, NM, UT, WY)

Colorado: Jack Ciaccia, WM0G, P.O. Box 21362, Boulder, CO 80308-4362 (303-587-0993); **wm0g@arrl.org**
New Mexico: Bill Mader, K8TE, 4701 Sombrerete Rd. SE, Rio Rancho, NM 87124 (505-250-8570); **k8te@arrl.org**
Utah: Mel Parkes, NM7P, 2166 E. 2100 North, Layton, UT 84040 (801-547-1753) **nm7p@arrl.org**
Wyoming: Jack Mitchell, N7MJ, 1141 Centennial Dr., Cheyenne, WY 82001-7405 (307-631-1456); **n7mj@arrl.org**

Southeastern Division (AL, GA, NFL, PR, SFL, VI, WCF)

Alabama: JVann Martin, W4JVM, 16 Baron Dr., Chelsea, AL 35043-6607 (205-281-4728); **w4jvm@arrl.org**
Georgia: David Benoist, AG4ZR, 190 Fox Hall Crossing East, Senoia, GA 30276 (404-290-0470); **ag4zr@arrl.org**
Northern Florida: Kevin J. Bess, KK4BFN, 908 Flagler Ave., Edgewater, FL 32132-2124 (386-547-2838); **kk4bfn@arrl.org**
Puerto Rico: Oscar Resto, KP4RF, HC 77 Box 8743, Vega Alta, PR 00692-9660 (787-883-6878); **kp4rf@arrl.org**
Southern Florida: Barry M. Porter, KB1PA, 13908 Via Nidia, Delray Beach, FL 33446 (561-499-8424); **kb1pa@arrl.org**
Virgin Islands: Fred Kleber, K9VV, P.O. Box 24275, Christiansted, VI 00824-0275 **k9vv@arrl.org**
West Central Florida: Darrell Davis, KT4WX, 6350 Mills Rd., Fort Meade, FL 33841 (863-245-9923); **kt4wx@arrl.org**

Southwestern Division (AZ, LAX, ORG, SDG, SB)

Arizona: Rick Paquette, W7RAP, 1600 W. Sunkist Rd., Tucson, AZ 85755-9561 (520-425-6877); **w7rap@arrl.org**
Los Angeles: Diana Feinberg, AI6DF, P.O. Box 4678, Palos Verdes Peninsula, CA 90274-9618 (310-544-2917); **ai6df@arrl.org**
Orange: Carl Gardenias, WU6D, 20902 Gardenias St., Perris, CA 92570 (951-490-2270); **wu6d@arrl.org**
San Diego: Dave Kaltenborn, N8KBC, 630 Alber St., Chula Vista, CA 91911 (619-616-8758); **n8kbc@arrl.org**
Santa Barbara: John Kitchens, NS6X, P.O. Box 178, Somis, CA 93066 (805-216-2569); **ns6x@arrl.org**

West Gulf Division (NTX, OK, STX, WTX)

North Texas: Jay T. Urish, W5GM, 1065 Overland Dr., Lowry Crossing, TX 75069-4727 (972-965-6229); **w5gm@arrl.org**
Oklahoma: Kevin O'Dell, N0IRW, 1718 South Fairgrounds, Stillwater, OK 74074 (580-220-9062); **n0irw@arrl.org**
South Texas: Paul Gilbert, KE5ZW, 1209 Doris Ln., Cedar Park, TX 78613-7067 (512-468-0792); **ke5zw@arrl.org**
West Texas: H. Dale Durham, W5WI, P.O. Box 375, Buffalo Gap, TX 79508 (830-719-9000); **w5wi@arrl.org**

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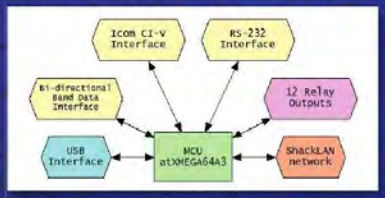

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OM2000+	Manual 160-6 m 2 kW
OM2000+ MARS	MARS and Commercial HF
OM2000A+	Automatic 160-6 m 2 kW
OM10C Combiner	Combiner for two OM amplfiiers
OM10C 4000HF MARS	Two OM4000HF manual tuned amps and combiner package
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OM4000A – OM4000HF OM2500A – OM2500HF

The A-series are automatic band change amplifiers.

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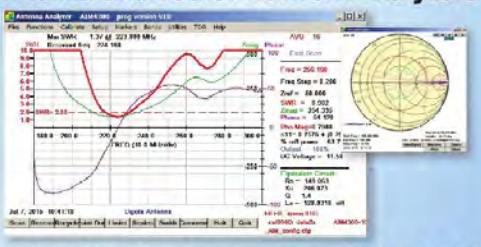

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The amplifier's rugged internal ATU can handle full power with load SWR up to 3:1, while a wider matching range is allowed at lower power, including up to 10:1 in standby mode.

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KPA1500 Features

- 1500 W
- Very compact design
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Up Front

Mr. Ambassador

Jean-Pierre Venembre, F6BGV (ex 7X0VP)

Jean-Pierre Venembre, F6BGV, as 7X0VP in Algeria in 1964.

Following Algeria's declaration of independence in 1962, I was among a few dozen French amateurs who remained in the country. I was just 19 years old when, on February 15, 1963, I called CQ and was answered by an amateur in Algeria who spoke with an American accent. He said his name was Bill, and he invited me to meet him the following Saturday at the American Embassy in the Colonne Voirol neighborhood of Algiers, where he said he worked.

I assumed that Bill was the embassy's resident radio operator. So, on that Saturday, I went to the American Embassy's main reception desk, and said I had an appointment with Bill. The receptionist smiled broadly and said Bill was expecting me, but as a security measure, I would need to follow two heavily armed Marines to his office.

US Ambassador William J. Porter.

To a 19-year-old boy, this escort was most impressive. I was led upstairs to a huge set of padded double doors and, to my great surprise, was shown into the vast office of William J. Porter, the American Ambassador to Algeria.

"Hello Jean-Pierre. How are things with you today?" William Porter asked, quickly putting me at ease, and we went on to have a long chat about Amateur Radio. He told me his home call sign was K1YPE, and he left me with the impression of being an extremely kind, down-to-earth man. It was a meeting I will never forget.

William Porter was later to head the US delegation that signed the peace agreements with North Vietnam in Paris in 1973. He passed away in 1988 at the age of 74. [Our thanks to Steve Wallis, F5VBB/G3YPK, for the translation from the original French.]

Visions of Young Amateurs in the Late '50s and Early '60s

Gary Tate was KN0BII back in 1960, when he was the proud owner of this Novice station. Today, he is K0GLT.

Andrew Freeman, W0AAA, is shown at his Novice station in 1962, when he was better known as WN0AAD. Recently, he called CQ and was answered by Hayden Bowers, K4TAG, whom he'd worked more than 56 years ago from this same station, when Hayden held the call sign WN4CXZ.

Bruce Lent, now K6HRU, strikes a casual pose at his station in 1957. The photo was taken by the late Larry Smith, WB6JIQ.

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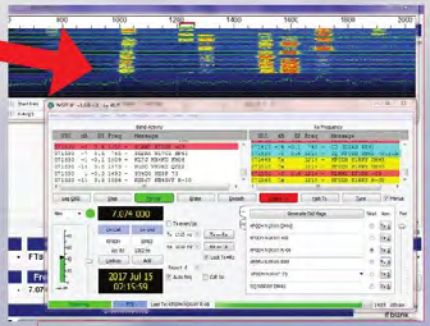

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Letters from Our Members

An Underestimated Public Service Necessity

I really enjoyed Rick Palm's, K1CE, article, "Event Operating: Top 20 Training Tips and Techniques," from the December 2018 issue of *QST*. As a race coordinator with our Pecos Valley Amateur Radio Club, I was pleased to know our club practiced most of the tips, and I was able to add a few to our list as well. However, I did notice the absence of one recommendation, which probably should be near the top of any list of public service assistance necessities, particularly those involving strenuous or outdoor activity.

At a recent full marathon event here in southeast New Mexico, those planning supplies for the water stations had apparently underestimated the amount of drinks needed for participants. I've always stressed to our monitors/operators the importance of carrying a cooler with at least half a dozen bottles of water in case a runner is in need. That importance was realized that day when the water stations' supply began to dwindle, and runners were passing our monitors complaining of needing water. The information was relayed to Net Control, who immediately advised race officials, who in turn were dispatched to the stations in need. In the meantime, our monitors were able to respond to the immediate need by supplying runners with water within seconds of the radio alert.

Dehydration is a threat, particularly here in our hot and dry southwestern desert climate, but one can also dehydrate in a humid climate or during winter months. It's my belief that keeping extra water handy should be toward the top of any radio club's logistics checklist.

Jim Tucker, KB0QNW
Roswell, New Mexico

Ham Radio's Worldwide Community

While on vacation this summer in Spain and Portugal, I decided to entertain my Facebook friends by posting a photo of a glass of sangria against the backdrop of my location in Frigiliana, Spain. I was setting up my shot from an elevated outdoor terrace, when I noticed what I thought was a hex beam antenna in the extreme distance. I was able to zoom in and capture a photo of the antenna array.

An internet search of "radio amateurs in Frigiliana, Spain" revealed the exact same antenna photo that I had just taken, and a call sign — EA7GT! **QRZ.com** provided an email address, so I wrote a note to Alejandro, EA7GT, relating my experience and our common interest. Amused and flattered, Alejandro responded and invited me to join himself and fellow hams Miguel, EA7ATJ, and Oscar, EA7ATA, for Friday evening drinks and fellowship at a pizzeria in nearby Nerja. Although faced with a bit of a language barrier, the use of my rudimentary Spanish, Alejandro's knowledge of English, and a helpful amount of Google Translate allowed us to enjoy discussing the typical topics regarding our fascinating hobby.

This experience is just one of many cases showing how ham radio is truly a unique community. I will forever treasure the hospitality offered by these fine gentlemen, and I look forward to continuing our friendship.

Doug Wilkerson, AA0DW
Loveland, Colorado

More Mesh Networks

I read "The Microwaves and a Mesh Mashup" by Rick Palm, K1CE, in the November 2018 issue of *QST*, and I wanted to let your readers know about another network now in operation. Amateurs JR Borsos, N8CAV; Doug Jarmuth N0DAJ, and Ron Miller, K7OPA, have been learning the ins and outs of mesh networking for the last couple of years in our small rural western town of Wickenburg, Arizona. During emergency drills in support of our local hospital, we have been able to demonstrate the advantages of high-speed mesh networks for transferring critical images and data for medical support, over and above the VHF/UHF radios we have installed at the hospital for voice and Winlink backup during communication outages.

With the assistance of Linda Brockwell, the hospital's Director of Nursing who is also a ham, we received funding to install the first link of what we hope to be a statewide medical mesh network. This link, using 3 GHz Ubiquiti Networks equipment and AREDN, connects Wickenburg Community Hospital with their clinic in the small town of Congress, some 18 miles north. We plan to connect the hospital to other rural clinics when they are opened, and to a larger regional network to include other medical facilities throughout the state.

We hope our network, called ERMMN (Emergency Rural Medical Mesh Network), will become the seed for growing advanced amateur microwave-based emergency communication services for the medical community in Arizona.

Ron Miller, K7OPA
Wickenburg, Arizona

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We've Been There, and Can Do That

Dave N8NB Tom KB8UUZ

George K3GP

Prepare Your Station to Work the World

Are you ready for DXpeditions to El Salvador, Macau and Central Kiribati in February?

Whether looking to fill bands or trying to score an All-Time New One, remember that the DX Engineering team is here to help. Why us? Because we've been there...and can do that. The T31T Central Kiribati 2016 QSL belongs to Tom KB8UUZ, staff technnical writer; George K3GP, customer/technical support specialist, worked the HU1M/3 El Salvador DXpedition in 2003; and Dave N8NB, technical support specialist and member of the DXCC Honor Roll, logged Macau XX9THX in 2012. When it's time to upgrade your DXing, contesting, EMCOMM, or rag chewing capabilities, turn to the team that speaks your language and shares your passion—DX Engineering. 73 and see you in the pileups!

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Change Audio Volume Using Keyboard Shortcuts

Kevin P. Chandler, AB1ZQ

I often switch between *fldigi* and *N1MM Logger* during a contest, but the required speaker and microphone volume settings aren't the same between the two programs. So my waterfall display is either too loud or too quiet, and I have to navigate several Windows dialog boxes to change both the speaker and microphone volume levels. Switching to CW requires even lower volume levels than other modes to reduce garbled decoding. Then, when I change a program or a mode again, the volume settings must be reset.

Because of the lost time and nuisance of these adjustments, I needed an application that would store the settings and easily retrieve them for the current scenario. Developing this application using *Microsoft Visual Studio*, plus learning the audio portion of the *.NET Framework*, seemed a bit daunting. There is a much simpler solution: AutoHotkey.

Explaining AutoHotkey

AutoHotkey is a broad and highly functional programming language, despite its relative simplicity. For volume control application, I used AutoHotkey's ability to create custom keyboard shortcuts — a "hotkey" in AutoHotkey-speak. Hotkeys can execute commands within a program, run other programs, or execute the commands built into AutoHotkey.

Assign hotkeys to PC audio settings.

I used the built-in AutoHotkey command **SOUNDSET** to adjust the volume level. **SOUNDSET** takes two parameters: the volume setting and the target device, which is either **MICROPHONE** or **SPEAKERS**.

SOUNDSET operates on the current default device of each type, so you don't need to be device-specific and you don't have to alter this application if your transceiver programs use different combinations of each device at different times.

Visit AutoHotkey's extensive online documentation by clicking the **DOCUMENTATION** link on their home web page (**https://autohotkey.com/**) for more information.

Shortcut Combinations and Assignments

I coded all of my hotkey volume control assignments into one AutoHotkey script file — which is a plain text file with an .ahk extension — and then ran the script. That script file is available on the "*QST* in Depth" web page, **www.arrl.org/qst-in-depth**. While the script is running, the volume control keyboard shortcuts are ready and waiting to be pressed.

For my needs, I created volume level shortcuts for use with *fldigi*, *N1MM Logger*, and CW. For ease in remembering, I assigned them as follows: **CTRL+ALT+**f, **CTRL+ALT+**n, and **CTRL+ALT+**c, respectively.

You don't need to stick with my setup, but by following along with my examples, you'll be able to create the keystrokes you wish to use with your own volume control scenarios.

Translating a Shortcut into Hotkey Language

AutoHotkey requires a very simple but specific syntax when creating a hotkey. The first three lines in the script listing are default setup commands. You can read their comments, but for now, it's not required to understand what these commands do. Comments begin with a semicolon, either at the beginning of a line or at the end of a line of commands. Comments are not executed when scripts are run. Following the setup

lines are the CW portion of the script:

```
;set levels for CW
!^c::
SoundSet, 10, MICROPHONE
SoundSet, 20, SPEAKERS
return
```

> *"Hotkeys can execute commands within a program, run other programs, or execute the commands built into AutoHotkey."*

The first line is a comment briefly describing this hotkey. The second line of !^c:: defines the hotkey keystroke, where ! means **ALT**, ^ means **CTRL**, and the **c** is a regular letter "c." The two colons define this keystroke combination as being a hotkey. So for the CW volume control, the assigned keystroke **CTRL**+**ALT**+c. **SHIFT** is also available using a +.

The !, ^, and + can be used by themselves or in any combination, and the order in which they are typed doesn't matter. Spaces are not allowed in a hotkey definition.

Note that AutoHotkey takes precedence, so its hotkeys will override any matching keystrokes used in other programs running at the same time. Because of this, I recommend selecting volume control keystroke combinations that don't conflict with keystrokes for any other programs that may being running while this volume control script is also running.

Following the hotkey definition is the **SOUNDSET** command. One line for the **MICROPHONE** volume, the other for the **SPEAKERS** volume (the order of these two lines doesn't matter). Adjust these numbers for each device to set your required sound level when you press the defined hotkey keystroke.

The last line is the **RETURN** command, which means that the hotkey has completed its tasks and control is returned to normal. The script remains running and is waiting to intercept any of its defined hotkeys.

The hotkey definitions for *fldigi* and *N1MM Logger* are identical to CW, except they have different keystroke letters — "f" and "n" respectively — and are defined with different volume level settings.

Additional Script Features

Several more hotkey definitions are shown following the *N1MM Logger* definition, including those to incrementally raise or lower the speaker or microphone volume level independently.

Panic Button

Another hotkey is **CTRL**+**ALT**+p, what I call the "Panic Hotkey." It turns off the speaker just in case of a transmit mishap. You can either mute the speakers or set the speaker volume to zero. The benefit of **MUTE** is that it maintains the current volume level. This option is commented out in the script listing. The "1" shown with the **MUTE** command option is required for command syntax, but the volume doesn't change to 1. With **MUTE**, you must specifically un-mute the speaker volume. Changing the speaker volume level by any method does not un-mute the speaker.

The benefit of zero volume is that the volume is restored by pressing one of the volume control Hotkeys, or any other speaker volume adjustment method, but the volume setting prior to the Panic is not maintained.

I suggest testing your Panic Hotkey definition, either with the **MUTE** or zero volume method. Whatever way you choose, be sure to comment out the other line.

Incremental Volume Adjustments

These hotkey definitions follow the same basic outline as the other definitions, with two differences. First, there are two new characters in these Hotkey definitions: < and >, where < dictates the left key only in the definition and > dictates the right key only. The < and > always apply to the key code assigned after it.

Since the **ALT** key tag **!** follows the < and > in all four definitions, the keystroke combinations are: left **ALT**+**CTRL**+m, left **ALT**+**CTRL**+s, right **ALT**+**CTRL**+m, and right **ALT**+**CTRL**+s. Use < (left) to decrease either volume level and > (right) to increase either volume level.

As defined, either **CTRL** key will work for these combinations, but if you edit the definitions to <^! or >^!, then the left/right key would apply to **CTRL** and not to **ALT**.

Another difference is there is a – or + in front of the volume level (without a separating space) in the **SOUNDSET** commands. This changes the volume setting from an absolute volume level as above, to an incremental value and as written, changes the volume ±2 from the current level. This allows for quick volume changes without having to edit the script, perhaps to respond to changes in propagation or to the signal strength of a particular contact.

Incremental volume changes are lost when you exit the script or when you press one of the regular volume control hotkeys. Incremental changes are also lost if you use zero volume for Panic and press the Panic buttons. Incremental changes are maintained if you implement **MUTE** for Panic until exit.

If you wish to edit the current volume increment, I suggest not making it too large, because you don't have to release all of the keys to repeatedly increment or decrement the volume. To demonstrate how quick increment or decrement currently is, hold down (left or right) **ALT** and **CTRL** and repeatedly tap "m" or "s." I made all of the increment/decrement values the same amount, but this is not required.

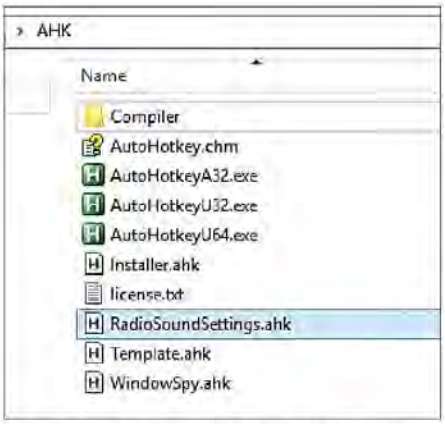

Figure 1 — Screenshot of the AHK folder.

Figure 2 — RadioSoundSetting.ahk showing an error.

Figure 3 — RadioSoundSetting.ahk shown running in the notification area.

Downloading AutoHotkey

To obtain AutoHotkey, click the **DOWNLOAD** button on their home page for a .zip file that has all that you need. You can run the installer if you wish, but if you prefer to test AutoHotkey and its scripts before installing any software, then download the .zip file.

Save the .zip file to your desktop for now and open it. Create a folder on your desktop — or some other location of your choosing — and name it, for example, "AHK." Extract all of the .zip files to this folder. Nothing is installed, and so nothing will need to be uninstalled later.

Open *Notepad* — or any plain-text editor — and enter the script listing as shown on the "*QST* in Depth" web page. Save the file with an appropriate file name and an .ahk extension, such as "RadioSoundSettings.ahk." Save the script file in the AHK folder along with the other AutoHotkey files, as shown in Figure 1.

To run the script, drag the file and drop it on AutoHotkeyU64.exe (or AutoHotkeyU32.exe for the 32-bit Windows systems). If there are any errors, a dialog box is displayed and the number of the offending line is indicated. In the error dialog screen shot (see Figure 2), there's a typo in "SoundSet" that needs correction. Fix any errors, save the script, and drop it again.

If the error dialog isn't displayed, then the script syntax is correct and the script is now running. Check your Windows notification area for a green icon with the letter "H" in it. Hover your cursor over the icon to display the script name (see Figure 3). The volume control hotkeys are now available. Press one or two of them to be sure they're changing the volume levels as defined.

Once it's confirmed the hotkeys are functioning as intended, connect your transceiver, start your radio software, and set them to one of your volume control scenarios.

Using the normal volume slide controls, set the microphone and speaker volumes as required and make a note of these two values. Right-click the script's green icon in the notification area and select **EDIT THIS SCRIPT**, as seen in the script right-click options shown in Figure 4.

Your script file is opened in your text editor. Locate the **SOUNDSET** volume values for the scenario you just tested and change these volume level numbers to the numbers you had written down. Save your changes and close the script file. Right-click the green icon again and select **RELOAD THIS SCRIPT**.

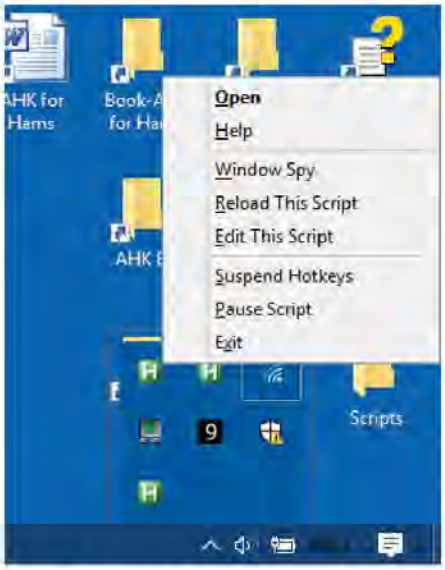

Figure 4 — Script right-click options.

Using the normal volume slide controls, change the volume settings to any value other than the script's values and then press the hotkey keystroke for this same scenario. Check the volume levels to be sure they are set to the values saved in the script. Repeat these steps to set the volume levels for each of your other volume control scenarios.

Test the Panic Hotkey to see if zero volume or muting satisfies a stop transmit situation. If required to switch the Panic method, or to comment out this entire hotkey for no Panic Hotkey, edit and reload the script as you did above and test any changes.

Next, test the volume increment/decrement hotkeys. If edits are required, or to comment out any or all of these hotkeys for no minor volume adjustments, edit and reload the script as you did above and test the changes.

To stop running the script, right-click as above and select **EXIT**. The icon will no longer be in the notification area and the hotkeys will no longer function.

For programs such as those from *DX Lab Suite*, you can add the script file or its .exe file to be shutdown on radio program exit. Barring this type of feature, the script will continue running until explicitly stopped using an **EXIT**.

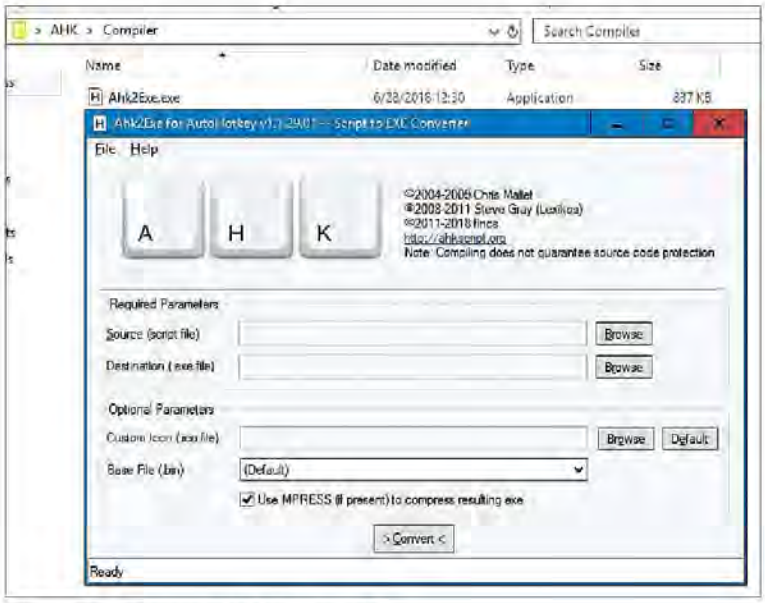

Figure 5 — Screenshot of the compiler.

The Volume Control Script is Ready

Now that your script is all set to your requirements, dragging and dropping the script to get it started each time will become rather irksome. If your radio software has provisions for auto-starting other programs like *fldigi* has, then it's best to take advantage of this feature. You can also start your script using a batch file or by double-clicking a shortcut. Whichever start method you choose, you have two approaches to set this up.

The first approach is starting AutoHotkeyUXX.exe with the script file as one command line:

C:\your path to\ AutoHotkeyUXX.exe C:\your path to\YourScriptFile.ahk

Then, edit to suit and add this line to a batch file, to an auto-start input, or to a shortcut.

The other option is compiling the script into an .exe executable file using AutoHotkey's included compiler, then adding the .exe path and file name to a batch file, an auto-start input, or a shortcut.

To compile your script into an .exe, open the "Compiler" subfolder located in your AHK folder and run the compiler file Ahk2Exe.exe (see Figure 5). Click **SOURCE BROWSE** to select your script file. By default, the .exe will be created in the same folder as the script, with the same file name as the script but with an .exe extension. If you want the file in some other destination, browse to it in **DESTINATION** or move it after compiling. Click **>CONVERT<** and, when complete, a dialog box announces your .exe file has been made.

Generally speaking, if a script file runs, it will compile. Once compiled, changes made to your script do not affect the .exe file. You must compile the script again to get any script changes into a new .exe file. Be forewarned that the compiler overwrites the existing .exe without any notification.

Once compiled, and you don't need to change your script again, you can delete all of the AutoHotkey files you downloaded and the .zip file. Save your script file just in case.

Single-Operator, Two-Radio Operation

This script, as written, will adjust the volume of only the default device, even if the default device has changed after the script started. Each hotkey operates on the device that's current when the keystroke is pressed.

If you are running more than one instance of a speaker device or a microphone device at one time — as in a single-operator, two-radio (SO2R) scenario — you may wish to use this script for volume control of all devices. The **SOUNDSET** command has an additional parameter called **DEVICE-NUMBER** that may make multiple-device volume control possible, although I haven't tested this parameter for use on multiple simultaneous devices. See the **SOUNDSET** command in the AutoHotkey online documentation for more information.

Conclusion

Now that you have a taste of AutoHotkey, you may want to install it for future projects of your own. When installed, the .ahk extension will be associated with AutoHotkey, so double-clicking an .ahk script file will default to running the script. Also, when you now right-click an .ahk file, you will have the options to run the script, edit the script, or compile it at the default compiler settings.

I hope you found this volume control application useful and that it's your springboard to many more fun and helpful projects using AutoHotkey.

Kevin Chandler, AB1ZQ, was first licensed in 2016 and has been an ARRL member since then. He enjoys building antennas and chasing DX. Kevin especially enjoys contesting, which helps him improve his skills and learn more about his equipment and signal propagation. He holds a BSME from the University of Vermont and is a registered professional engineer in Vermont. Kevin is a regular contributor to the SolidWorks forum where he has posted other AutoHotkey utilities that he has written. You can reach Kevin at **ab1zq@arrl.net**.

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

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The Basics of Fan Cooling

Fan cooling involves nonlinear trade-offs among fan noise, temperature rise, fan power consumption, airflow, air pressure, and single or multiple fans.

Al Rabassa, NW2M

We are all familiar with the heat produced by electrical and electronic devices, which results from inefficiencies in these devices. For example, if a transmitter is radiating 100 W from its antenna but consuming 276 W from a power supply (13.8 V at 20 A), it is producing 176 W of heat. In an electronic circuit, where cooling from radiation, heat spreading, and natural convection is inadequate to keep the electronic components below their rated temperatures, some form of forced air cooling may be required, which is often provided by a fan.

Fan-Assisted Cooling

Fans are rated by the volume of air they can move in a given time. This rating is known as CFM, which stands for cubic feet per minute. The key to fan specification is not to over-specify, which, while able to easily provide the necessary cooling, might take up too much space in a product, making it larger than necessary. On the other hand, under-specifying the fan might lead to continuous high-speed operation and objectionable noise.

The CFM rating for a fan is calculated as follows:

$$CFM = BTUs / (\Delta T \times 1.08)$$

where

BTUs = watts of heat × 3.412

ΔT = desired change in temperature in °F through the system

1.08 = the heating multiplier for air at sea level and room temperature. This factor is calculated as the weight of a cubic foot of air, times the specific heat of air, times the number of minutes per hour, or 0.075 × 0.24 × 60 = 1.08. The heating multiplier is sensitive to both air pressure and air temperature (note that reference books generally list the weight of a cubic foot of air at sea level as 0.0807 pounds, but this is at the "standard" temperature of 32 °F).

So, for example, the CFM rating for a fan allowing a 20 °F temperature rise in the air flowing through a transmitter creating 170 W of heat and operating at sea level would be calculated as CFM = (170 × 3.412) / (20 × 1.08), or roughly 27 CFM. Operating the same transmitter in Denver, a mile above sea level, would require a 34 CFM fan due to a smaller heating multiplier of approximately 0.86 as a result of the decreased air pressure at that altitude.

Fan Properties

Fan properties (also known as *affinity laws* or *fan laws*) in general are nonlinear (see Figure 1), with the excep-

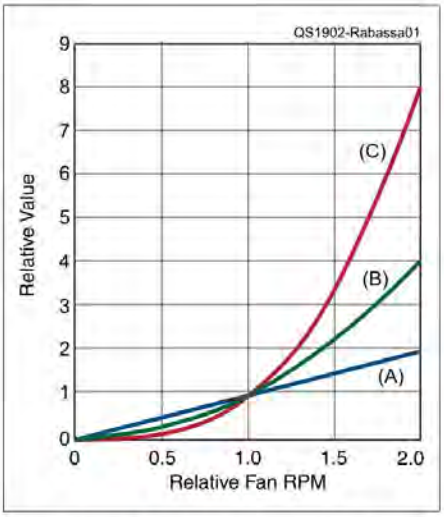

Figure 1 — Fan affinity laws: at (A), the airflow rate measured in cubic feet per minute is directly proportional to the fan RPM; at (B), the pressure produced by the fan is proportional to the square of the fan RPM, and at (C), the power consumed by the fan is proportional to the cube of the fan RPM.

> *"It is clear that reducing the speed of a fan can have a significant impact on reducing sound levels."*

tion of airflow, which is proportional to the fan speed — halving the fan revolutions per minute (RPM) halves the CFM. The air pressure produced by a fan is proportional to the square of the fan speed — halving the fan speed reduces the air pressure to ¼, while doubling the speed results in a quadrupled pressure increase. The power consumed by a fan is a cubic function — halving the fan speed reduces the power consumed to ⅛, while doubling it increases the power consumed by a factor of 8.

Fan noise is an important property and it varies according to the logarithmic function 50 $\log(s_2 / s_1)$, where (s_2 / s_1) defines the speed ratio. So, for example, reducing the fan speed by half will reduce its noise by about 15 dB, while increasing the speed by a factor of 2 will result in a 15 dB noise increase.

Multiple fans (see Figure 2) configured in series will increase the air pressure according to the number of fans while keeping the CFM constant. Conversely, multiple fans configured in parallel will multiply the CFM according to the number of fans while maintaining the air pressure of a single fan.

Fan System Optimization

First, the most critical factor must be identified — it could be the noise produced by the fan or fans, the required temperature drop, or the space allotted for fan cooling. Often, it is a combination of factors that must be prioritized. Also, reliability may be a factor for equipment remotely located, such as atop a tower where it might be desirable to have a multiple fan system that could endure the failure of one fan.

Conclusion

It is clear that reducing the speed of a fan can have a significant impact on reducing sound levels. Fans in series or parallel (or both) have other advantages over a single fan solution. Along with single versus multiple fan systems, there are many trade-off options possible. I hope this article will be useful in your next fan-based design.

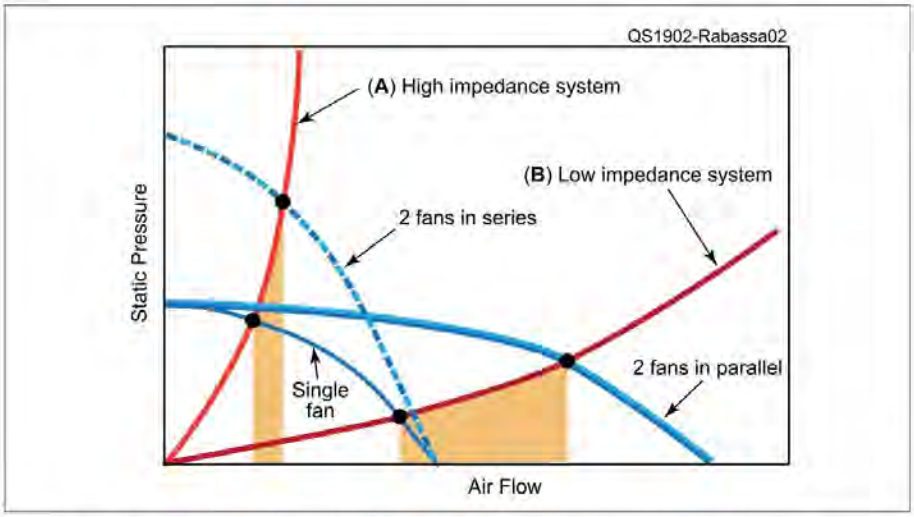

Figure 2 — Multiple fan options: at (A), a high-impedance physical system requires fans in series to increase the static pressure to overcome the high resistance to air flow and, thus, provide a higher volume of air for increased cooling; while at (B), a low-impedance system, which has less resistance to airflow, uses fans in parallel to increase the airflow for better cooling.

ARRL member Al Rabassa, NW2M, has held an Amateur Extra-class license since 1986. He was first licensed in 1985 as N2FPT (General class) in southern New Jersey and was taught by William Helmetag, WA2VQG, the 1990 ARRL Herb S. Brier Instructor of the Year. Al now lives in Rockville, Maryland, and is an active member of the Montgomery Amateur Radio Club, which has been an ARRL affiliated club since 1967. Al has advanced degrees from MIT, Johns Hopkins University, and Monmouth University, and he is an avid collector of the Yaesu FT-101 series radios. You can reach Al at **nw2m@arrl.net**.

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

Remotely Switched Directional FoG Array

Modify your flag-on-ground antenna to cover four points of the compass.

Jerome Kahn, AC0RL

I built (with some variations) the antenna that Charlie Kluttz, W4TMR, described in "The Flag on Ground (FoG) Antenna," in the September 2017 issue of *QST*, and it performed admirably.[1] My preamp circuit modification made Charlie's antenna receive from selectable opposite directions. I then nested a second modified directional FoG antenna rotated 90° so I could cover four compass directions (see Figure 1).

Modify the Preamp Circuit

Figure 2 shows the modifications I made to the original W4TMR preamp design to accommodate switching in the terminating resistor when the preamp was unpowered. Four units are needed for my array, and one is powered up at a time.

The dc power to operate the relay K1 is carried on the coax cable via L1. The normally closed contact connects R1 to the antenna termination resistor. When energized, the input of the existing preamp transformer connects to the antenna via the relay normally open contact. This modification allows a preamp/resistor to be on both sides of the FoG antenna to switch the receive direction by 180°.

[1]Charlie Kluttz, W4TMR, "The Flag on Ground (FoG) Antenna," *QST*, Sept. 2017, pp. 30 – 31.

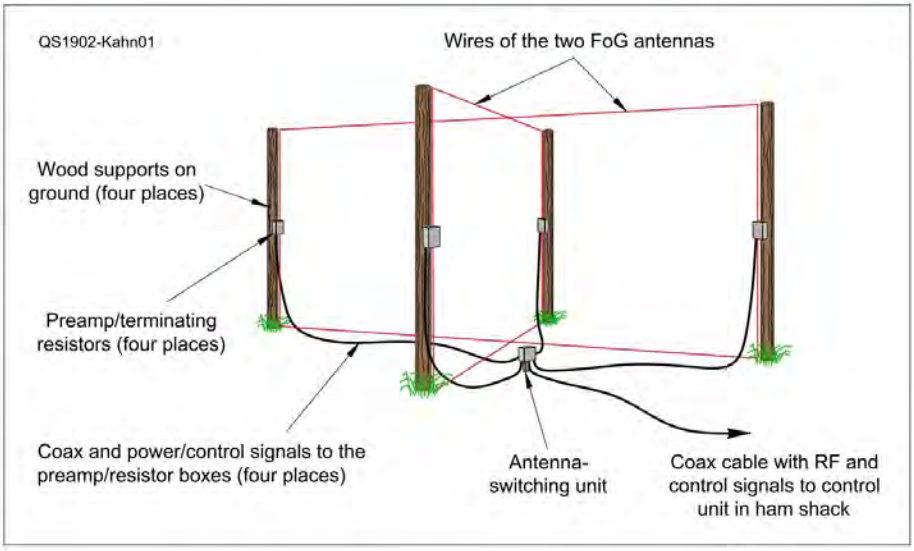

Figure 1 — This pair of reversible flag-on-ground antennas can be pointed in each of four compass directions.

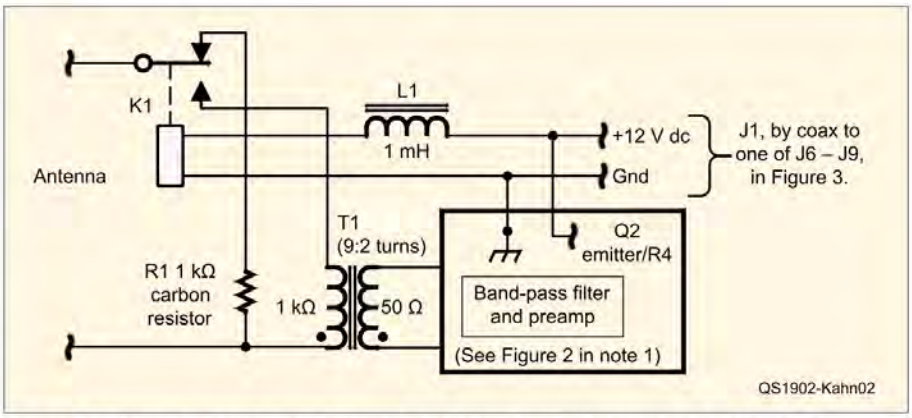

Figure 2 — Modifications to each antenna feed box can be selected as a preamp or terminating resistor.

K1 — SPDT 250 mA 12 V reed relay, PN: HE721C1210
L1 — 1 mH RF choke
R1 — 1 kΩ
T1 — RF transformer, 50 Ω to 1 kΩ, two turns to nine turns on Amidon BN73-202 core

Preamp Switching and the Control Unit

To avoid running additional control lines to the FoG array, I inject a dc voltage on coaxial cable connector J4 of the control unit (see Figure 3) via coax cable to J5 of the antenna-switching unit (see the "*QST* in Depth" web page, **www.arrl.org/qst-in-depth**), then to one of J6 to J9 in the antenna-switching unit to power one of the four preamplifiers via J1 (see Figure 2) and to provide switching. The control unit shown in Figure 3 resides in the ham shack. It injects the appropriate dc voltage to select and run a preamp. It also passes the RF with dc blocking to the receiver. U1, an LM317T adjustable regulator, provides the necessary control voltage steps to select the desired antenna pattern directions: 15 V for north, 20 V for east, 25 V for south, and 30 V for west.

Use a heatsink with the U1, and L1 should be capable of providing a few hundred milliamps without overheating. I used UHF connectors but you can use RF connectors of your choosing. The 0.1 µF, 500 V silver mica capacitor between J3 and J4 provides the dc blocking for the receiver.

The Switching Unit

The switching unit is located at the antenna site. The input is via coaxial connector J5. The RF from the selected preamp is routed via C7, a 0.1 µF, 500 V silver mica capacitor. The dc is passed through L1 to the switching chain and to U2, a 12 V regulator that powers the switching array and the preamps via L2. L1 and L2 must be able to pass up to 100 mA without overheating.

The switching chain works by a series of Zener diodes, D14 – D16, arranged so the base of Q6 is biased **ON** at any voltage above 12 V, Q4 above 17 V, Q2 above 22 V, and Q1 above 27 V. Transistors Q3, Q5, and Q7 are biased **OFF** if any of the transistors higher in the chain are biased **ON**. The 12 V, 250 mA single-pole

"To avoid running additional control lines to the FoG array, I inject a dc voltage on the coaxial cable to power the preamps and to provide switching."

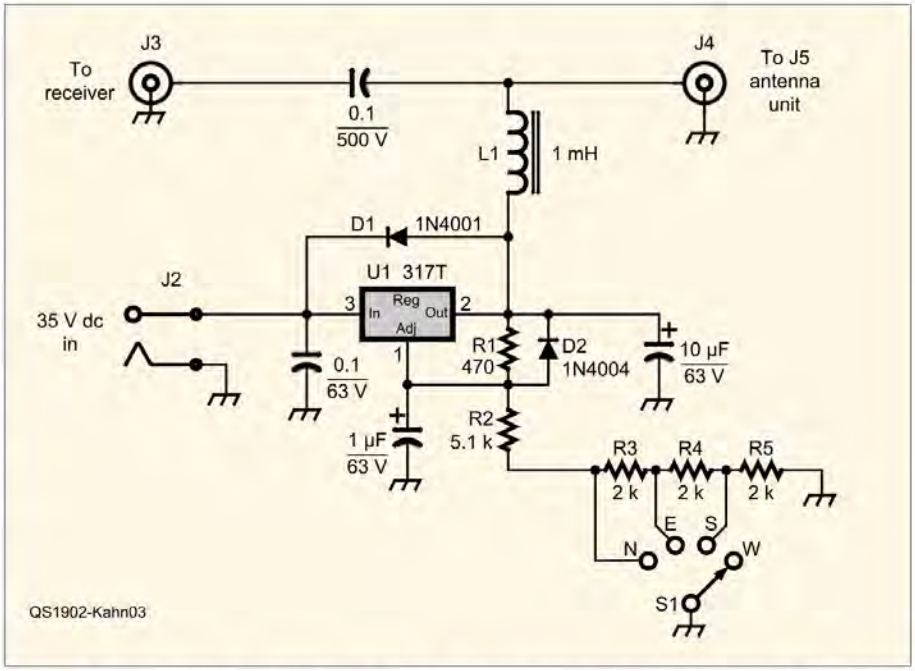

Figure 3 — The control unit resides in the ham shack and injects the appropriate dc voltage based on the position of switch S1 to select and run a preamp.

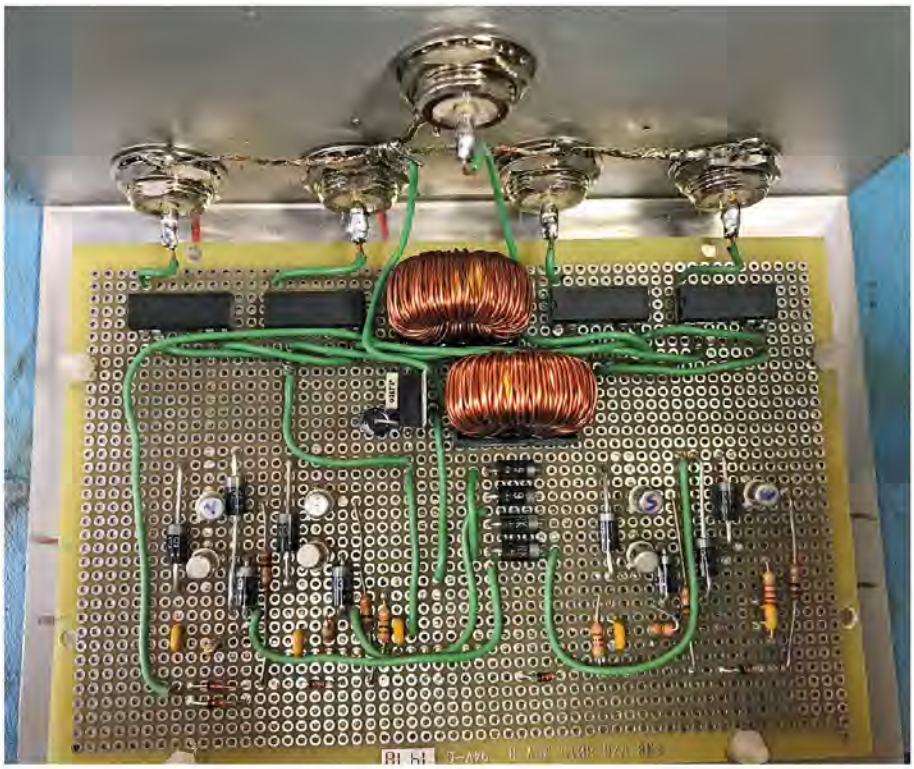

Figure 4 — The antenna-switching unit board layout.

Figure 5 — Front panel of the in-shack switching unit.

double-throw (SPDT) or single-pole single-throw (SPST) relays are energized when the appropriate transistor, or transistor pair, are biased **ON**. Only one of the four relays can be energized at a time. When a relay energizes, it connects the appropriate preamp and provides the required switching and power. All diodes D1 – D13 are Schottky type. C1 – C4 and C8 are 1 μF, 50 V and prevent oscillations induced during switching. Figure 4 shows the layout of my antenna-switching unit board and Figure 5 shows the front panel of the in-shack switching unit.

My tests have concluded that there is no degradation of performance or directivity when using this approach relative to a single-direction antenna. This is a small yet effective 160-meter antenna.

Photos by the author.

Jerome Kahn, AC0RL, is an Amateur Extra-class licensee and has been a ham since 1991. He also holds an FCC General Radiotelephone Operator License with Ship's Radar Endorsement. Jerry is a self-taught electronics engineer and software designer/developer. He holds an FAA Commercial Pilot certificate with single- and multi-engine authorization, and instrument ratings. He was an avionics technician in the US Navy for VA-15 from 1979 to 1983. Jerry's hobbies include motorcycling, flying, ham radio, vintage radio restoration, and inventing.

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

Coming up in the January/February 2019 and future *QEX* issues are a range of Amateur Radio articles and technical notes. These are at the top of the queue:

- David M. Collins, AD7JT, designs an innovative CW keyer.
- Bob Simmons, WB6EYV, introduces additional PIC programs for his VoIP board.
- Phil Salas, AD5X, builds a highly linear two-tone test generator for transceiver IMD testing.
- Paul Wade, W1GHZ, finds a range of measurement uses for an antenna analyzer.
- Virgil Leenerts, W0INK, describes an experimental impedance measuring instrument based on the Howland current source.
- Maynard Wright, W6PAP, revisits trimming the wire dipole antenna using remote measurements.
- Jan M. M. Simons, PA0SIM, uses two orthogonal antennas to extract signals from noise.
- Thomas M. Alldread, VA7TA, builds a portable, wide dynamic range RF field strength meter.
- Jim Koehler, VE5FP, automates a simple toaster oven for reflow soldering.
- Braddon Van Slyke, AC0ZJ, shows how to make a base-band quadrature modulator that operates over multiple bands.

QEX is edited by Kazimierz "Kai" Siwiak, KE4PT, (**ksiwiak@arrl.org**) and is published bimonthly. *QEX* is a forum for the free exchange of ideas among communications experimenters. The annual subscription rate (six issues per year) in the United States is $29. First Class delivery in the US is available at an annual rate of $40. For international subscribers, including those in Canada and Mexico, *QEX* can be delivered by airmail for $35 annually. Subscribe today at **www.arrl.org/qex**.

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Field Deployable Mini-K9AY Loop

This portable receiving loop is sized for the 30- and 40-meter bands.

Bob Lombardi, W4ATM

My interest is in improving 30-meter reception at my ham shack. I considered various vertical arrays and beam antenna options, but nothing seemed to work out for me in my limited space, and, at best, it looked like I could get about 3 dB improvement in some directions. That's when I began considering a receive-only loop. In the end, I scaled Gary Breed's, K9AY, 160-meter band loop antenna[1] to 40 meters for use on the 30- and 40-meter bands.

Receiving Loops

Receive performance is all about improving the signal-to-noise ratio (SNR) — if you can't get more signal, maybe you can reduce the noise level. That's where receiving loops come in. A small, steerable antenna might be able to improve SNR. A small loop will often receive less signal and less noise than a full-sized antenna, but the signal isn't always as reduced as much as the noise is. Noise arrives from different directions than the signal, and by steering the antenna, the noise can be decreased, thus improving the SNR. A small loop like this has a significant front-to-back ratio. [A small resistor-terminated loop is a non-resonant travelling-wave antenna that exhibits significant directionality for its size. — *Ed.*] Signals arriving from the feed-point side (from the left in Figure 1) add to the received signal, while signals arriving from the termination side cancel it. The result is a broad front lobe and reduced sensitivity off the back of the antenna. On 10 MHz WWV, I've experienced a front-to-back ratio of 20 dB, just as Gary's *EZNEC* simulations[2] suggest.

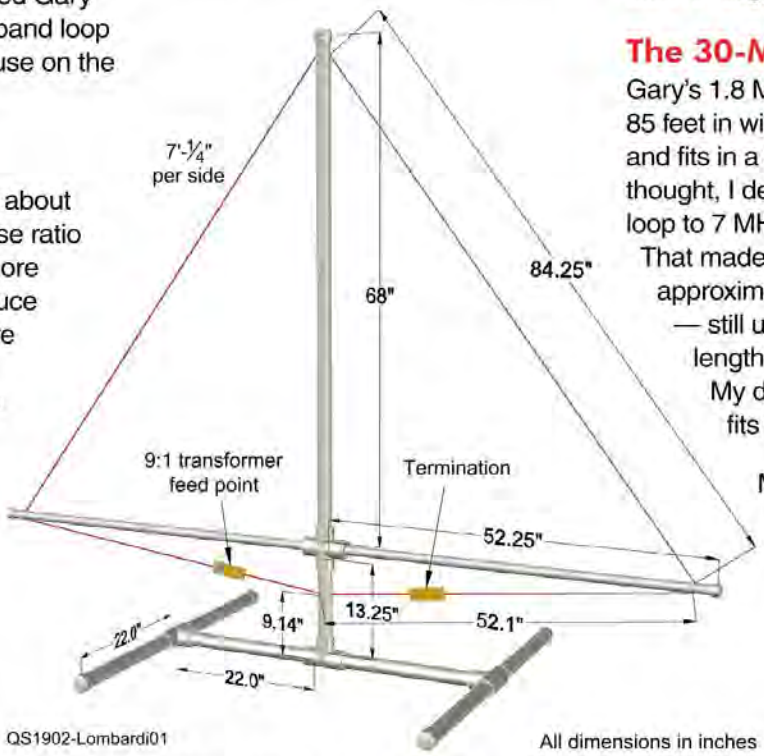

Figure 1 — A CAD rendering of the antenna structure showing the general layout of the antenna wires and the schedule 40 PVC pipe components. See the sidebar, "Antenna Components."

The 30-Meter Solution

Gary's 1.8 MHz loop uses a total of 85 feet in wire length, is 25 feet tall, and fits in a 30-foot circle. After some thought, I decided to scale Gary's loop to 7 MHz, a factor of 7/1.8 = 3.9. That made my loop wire length approximately 21 feet, 10 inches — still under a quarter-wavelength in the 30-meter band. My design is 8 feet tall and fits in a 9-foot circle.

My yard doesn't have trees for supports or much room for antennas, and because I live in

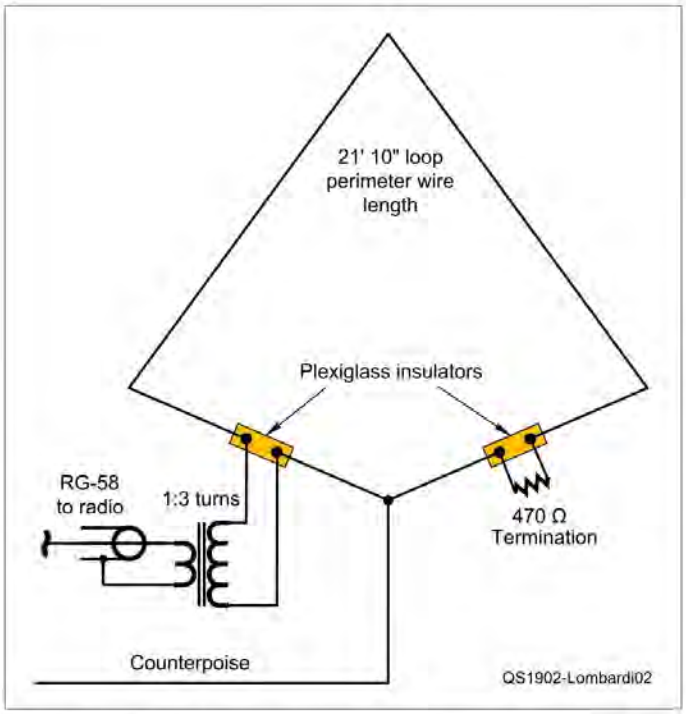

Figure 2 — The radio coax shield does not connect to a ground or counterpoise. My counterpoise actually connects to the 470 Ω resistor.

a hurricane-prone area, all antennas must be built for easy takedown. I decided against a permanent installation and instead made the antenna from PVC pipe and fittings. When I want to use it, I carry the antenna to my side yard, which is more than a half wavelength from the transmit antenna. When I need to clear that area, I carry it onto the back porch.

I modeled the mechanical design in *Rhinoceros 3D* computer-aided design (CAD) software[3] to get the dimensions for parts. The dimensions are shown in Figure 1.

Antenna Components

- 1 – 10-foot piece of 2-inch PVC pipe
- 1 – 10-foot piece of 1-inch PVC pipe
- 3 – 2-inch PVC crosses (Grainger 22FL05)
- 1 – 2-inch PVC **T** (Grainger 22FJ60)
- 2 – 2-inch PVC to 1-inch reducing adapters (Grainger 22FK63)
- 5 – 2-inch PVC pipe caps (Grainger 22FJ37)
- 2 – 1-inch PVC pipe caps (Grainger 22FJ32)
- 1 – 50-foot spool of #22 AWG stranded wire

Construction

The center upright is cut from a 10-foot piece of 2-inch schedule 40 PVC pipe. The cross arms are 1-inch PVC, and each is 4 feet, 4 inches long. The loop is made from #22 AWG wire, and small pieces of Plexiglas® hold the attachment points for the coax and for the 470 Ω terminating resistor. The **H** base uses six 22-inch sections of 2-inch PVC with three **T** joints holding them together. PVC caps are installed at the ends. Cement all joints and remember that PVC cement dries very quickly. Once the cement hardens, you can handle the assembly without waiting hours for it to cure.

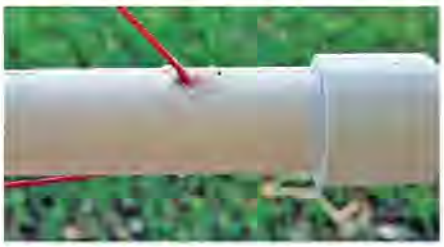

Figure 3 — Detail of wire hole through a cross arm.

Assembly:

1 Use a 2-inch PVC cross joint with two 2-inch to 1-inch adapters to connect the 2-inch vertical pipes to the 1-inch horizontal pipes. Cut one of the two 10-foot pieces of 2-inch PVC pipe to make a 13¼-inch-long piece. This fits between the PVC **T** at the base center and the cross you just cemented.

2 The remainder of the piece for the center support is now 106¾ inches, but is cut to a 68-inch length. Cut a 22-inch length from the remainder for the base (leaving 16 inches of scrap). That is one of six 22-inch pieces needed for the **H** base.

3 Cut the other 10-foot pipe into five 22-inch-long pieces. (I built the base as an assembly first, then added the 13¼-inch length upright, and cemented the cross to that so the 1-inch pipes were over the long middle section of the base **H**.)

4 Cement the 68-inch-long 2-inch pipe into the cross.

5 Three inches from the top end of the upright, and from the ends of the horizontal cross members, drill ¼-inch holes through the pipe to pass the wire through (see Figure 3).

6 Drill the bottom wire holes into the 2-inch pipe, 9 inches above the top of the 2-inch base pipes.

7 Using #22 AWG PVC insulated stranded hook-up wire, thread through one hole and out the opposite side. Tape the last inch of the

> *"Receive performance is all about improving the signal-to-noise ratio — if we can't get more signal, maybe we can reduce the noise level."*

wire to a 6-inch-long piece of solid #16 AWG wire used as a guide, rather like a sewing needle pulling the much more flexible wire. Unlike other antennas, the wire length isn't critical; there's no trimming the wire to null the VSWR because the antenna is non-resonant.

Once the wire is cut to length and the loop finished, use silicone sealant (RTV) to seal all of the wire holes.

Circuitry

Figure 4 shows the coax connected to the transformer, which has a 9:1 impedance ratio and 3:1 turns ratio. The transformer is wound on a binocular balun core (I used the Amidon BN-43-202 with #24 AWG enameled wire). Wind three turns for the 50 Ω side and nine turns for the 450 Ω side.

There is some discussion about the resistor value among K9AY loop users. Scaled to 10 MHz, my quarter-size version suggests a 470 Ω termination. The termination seen on the right side in Figure 4 is a 470 Ω, ¼ W carbon composition resistor. Anything between 390 Ω and 510 Ω would be okay.

Deployment

Gary's original design is placed in a fixed location. At the center of his array, there's a ground rod and a remotely controlled box to select the loops and the direction. My antenna is portable, so the ground rod and control box aren't used. It's one loop that I rotate manually to point in the direction of interest. Portable also means it can't be grounded with a ground rod. Instead, I made a counterpoise from about 35 feet of wire. It's rolled for storage onto a 1-foot piece of PVC pipe scrap, and I throw it across the yard to deploy it.

Figure 4 — A view near the base of the finished antenna shows the feed point across the Plexiglas insulator connecting the wire at the left, and the terminating resistor across the Plexiglas insulator connecting the wire at the right.

Without the control box, there is no preamplifier, but the preamplifier on my receiver seems an adequate substitute.

Performance

On 10.1 MHz (30 meters), the targeted band, signals seem a little weaker than on my reference vertical antenna. Switching between the loop and my vertical with the high-gain preamp in my Icom 7600, I watched several FT8-mode exchanges on the 30-meter band. I find the loop is slightly weaker in signal strength. I get similar results with WWV on 10 MHz and used that signal to measure a 20 dB front-to-back ratio. Signals appear weaker on 40 meters compared to 30 meters, but SNR is sometimes better. My loop also works fairly well on 80 meters, where both signal and noise are drastically reduced. Everything I hear on the vertical is also heard on the loop.

Overall, this loop has been a worthwhile addition to my station.

Notes

[1]G. Breed, "The K9AY Terminated Loop – A Compact, Directional Receiving Antenna," *QST*, Sept. 1997, pp. 43 – 46.
[2]G. Breed, "How to Build the K9AY Loop Receiving Antenna," AY Technologies, **www.aytechnologies.com**.
[3]*Rhino3D*, Robert McNeel & Associates, **https://www.rhino3d.com/**.

Bob Lombardi, W4ATM, became interested in radio as a child in first grade when a cousin let him listen to shortwave radio. He built his first Heathkit shortwave receiver in seventh grade and eventually received his Novice-class license, WN4EHS, the week of Novice Roundup 1976. His main interest has always been stalking new DX stations. He upgraded to Advanced class in 1976 and, soon after, to Amateur Extra. He obtained the vanity call W4ATM, short for "Amateur Telescope Maker," in 1997. Bob's interest in radio eventually led to a career in RF design. He retired in 2015.

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A Force-Sensing CW Paddle

Art Heft, K8CIT

An easy-to-build, inexpensive paddle that has no moving parts and no contacts.

This paddle works on the principle of the force that your fingers apply, and it costs less than $30 to build. The sensitivity to force is electronically adjustable from a low of about 0.7 ounces to more than 4 pounds. It is the smoothest operating paddle that I have ever used in my 61 years on the air. There are no moving parts to get out of adjustment, and no contacts to get dirty.

The Force Sensor

Force sensors come in various sizes. My paddle uses a large 1¾ × 1¾ inch force sensor (the gold-colored square under my thumb in the lead photo). I had built another paddle using a ½-inch-diameter sensor, but I discovered that it was too small, causing my fingers to drift off target while sending. This article describes the paddle with the larger sensor.

The force sensor is a variable resistor that changes value depending on the applied force. With no force applied, the resistance is about 10 MΩ. With medium force applied, it reads about 1 kΩ. This is sufficient difference for an op-amp to act upon.

The circuit is very simple and comprises one force sensor, one op-amp, two quarter-watt resistors, and a trim pot for each of the *dit* and *dah* channels. My op-amp package U1 contains four op-amps, but we use just two of them (see Figure 1).

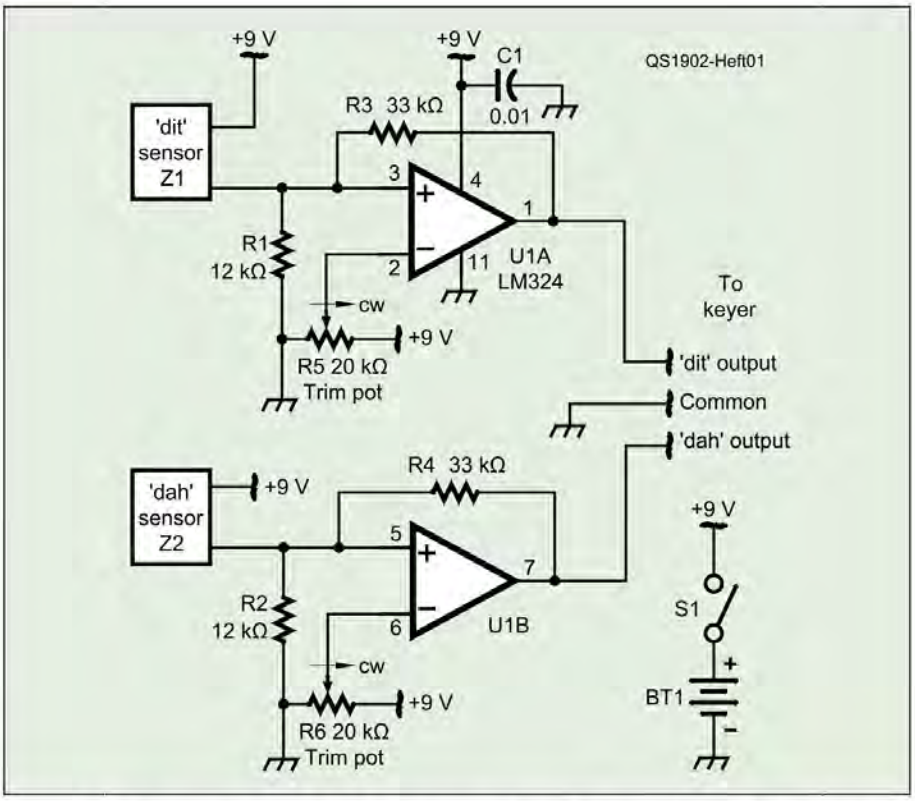

Figure 1 — Schematic diagram of the force-sensor key (all part numbers are Digi-Key).

B1 — six AAA cells wired in series
C1 — 0.01 µF, 50 V (1103PHTR-ND, $0.32)
R1, R2 — 12 kΩ ¼ W (CF14JT12K0CT-ND, $0.10 ea)
R3, R4 — 33 kΩ ¼ W (CF14JT33K0CT-ND, $0.10 ea)
R5, R6 — 20 kΩ trim pot (3362P-203CF-ND, $1.02 ea)
S1 — single-pole single-throw toggle switch
U1 — op-amp, LM324N (LM324NFS-ND, $0.54)
Z1, Z2 — 1.75 × 1.75 inch force sensor, (1027-1002-ND, $12.40 ea)
Misc. — circuit board (SBB1005-1-ND, $1.59)
Misc. — IC socket (AE9989-ND, $0.22)

"The force sensor is a variable resistor that changes value depending on the applied force."

Assembly Details

This is an example of how I assembled my paddle, but parts are adaptable to what you have available.

I used a scrap of 7/16-inch-thick plastic from my junk box and sawed and filed it into a 1¾-inch square paddle with a 1-inch-tall tail, extending back 3 or 4 inches (see Figure 2).

Then, I bonded the force sensors to the plastic paddle using RTV silicone adhesive. I found a 4 × 5 × 1¼ inch cast aluminum project box and used it as the housing for the paddle.

The black object to the right of the paddle in Figure 2 is a battery pack of 6 AAA cells wrapped in black electrical tape and wired in series to produce 9 V. The current draw is just 12 to 13 mA key down, so the battery will last a long time if you remember to turn the power off when the unit is not in use. The power toggle switch is on the rear of the box.

I wrapped the sensors and paddle lever with clear packing tape to keep the sensors from getting worn in use. The op-amp can directly drive most any modern transceiver or outboard keyers. I use this paddle to drive the keyer inside my Elecraft K3 or QRP Labs radios.

Final Adjustment

Adjustment is fast and easy. With the paddle connected to your keyer (use dummy load if the keyer is connected to a transmitter), apply power to the paddle and adjust one of the trim pots counterclockwise until you hear dits or dahs. Then, turn the trim pot back clockwise, just past the point where the dits or dahs stop. The more clockwise you go, the higher the required forces. I like mine adjusted very low. Repeat for the other side of the circuit, and you are done. Happy and smooth keying!

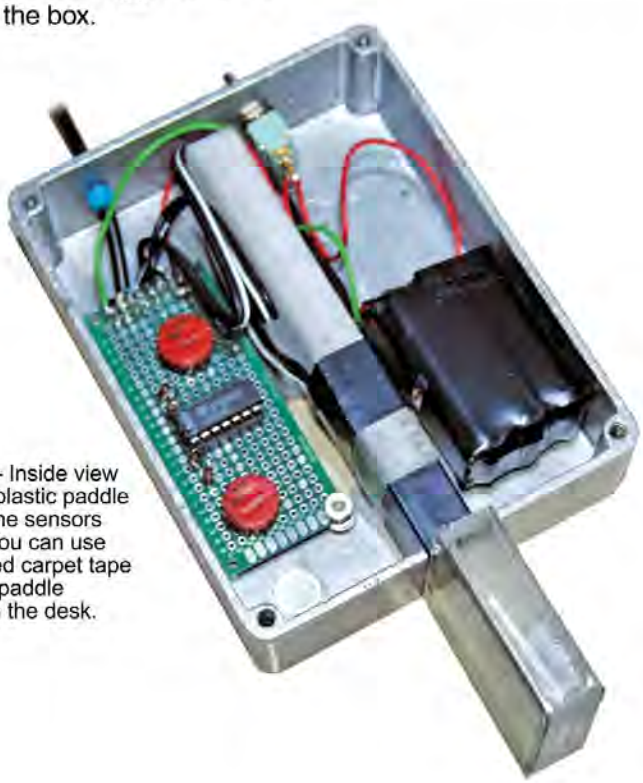

Figure 2 — Inside view shows the plastic paddle lever with the sensors attached. You can use double-sided carpet tape to hold the paddle securely on the desk.

Art Heft, K8CIT, has been an ARRL member for many years and has held an Amateur Extra-class license since 1972. He was first licensed in 1956 as KN8CIT while in the 7th grade.

Art is active on CW and AM on 160 meters through 20 meters, including low-power operations. He's even participated in the US Islands On The Air program. Lately, he operates HF CW ragchewing on 80, 40, and 30 meters, and, most recently, AM on 75 meters. His main loves in Amateur Radio are CW and antennas.

Art was an electronics technician in the auto industry, working with anti-lock brakes for 30 years. After retiring in 1999, he owned and ran a powder-coating shop until his wife Karen, KB8CZL, retired and they moved.

He spends time on the air with his many CW friends, and has refurbished some classic radios. Living in the country means he has plenty of room to string antennas in the trees.

You can find Art around 7.023 to 7.028 MHz in the early mornings, on 3.880 MHz AM in the late mornings, or by email at **artandkaren@gmail.com**.

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New Products

NEX-GEN Plug-and-Play Hot Spot

Digital ham radio Hot Spots are now available as fully "plug and play" machines, custom programmed to match the operator's transceiver directly by the manufacturer, NEX-GEN. This line includes the Rugged Spot, built on a Raspberry Pi 3B motherboard with 1 GB of RAM.

Call 858-568-6673 or visit **www.HamRadio1.com** to see the full line of plug-and-play Hot Spots available.

Installing Coax Crimp Connectors

Dino Papas, KL0S

I have never liked installing coax connectors. I think this was due to the fact that I did it so infrequently, each time seemed like the first time — and we all know what *that* is like. Finally, I broke down and bought some specialty tools and coax crimp connectors, and I haven't looked back since.

Tools

I find that a ratcheting crimping tool with a set of interchangeable dies is essential for this task. The ratcheting action is necessary to apply the proper crimping force, and a selection of die sizes ensures the proper amount of crimp for a chosen connector. The tool is also useful for Anderson Powerpole connectors and wire terminals. My ratcheting crimper is part of the Andy-Crimp Pro set sold by Quicksilver Radio. The set also includes cable cutters and strippers.

Rounding out my coax tool set is DX Engineering's Coaxial Cable Tool Kit that, while intended for preparing coax for solder connectors, also makes easy work of preparing coax for crimp connectors. They also sell a ratcheting crimp tool set (DXE-UT-KIT-CRMP2) for use with Amphenol Connex crimp-on connectors.

Crimping tool photo courtesy of Appaloosa, Wikimedia Commons.

The right tools make this task a cinch.

Step-by-Step Process

I'll illustrate the crimping process with two differently sized type N connectors (see Figure 1) and attach them to both the LMR-400 cables and the thinner LMR-240 cables.

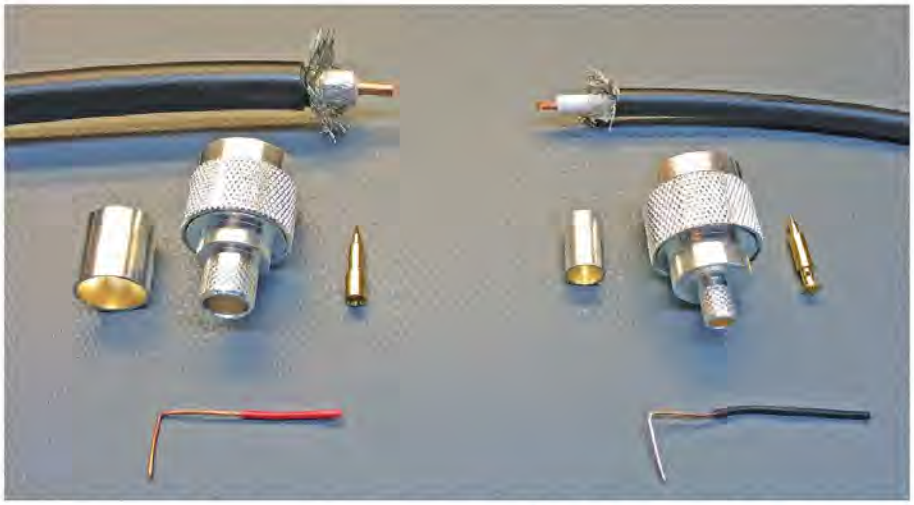

Figure 1 — On the left, a type N crimp connector for LMR-400 coax cable and, on the right, a type N crimp connector for the thinner LMR-240 coax cable. The two **L**-shaped wires at the bottom are homemade stripping gauges made by inserting a piece of wire into the connector body and bending it where it stops.

Step 1: Square the end. Cut a small piece from the cable end with a large, sharp cable cutter to get a straight, flush cut across the end. If the cutter is dull or too small, it will deform the end of the cable. Now, slip the ferrule and a length of heat-shrink tubing onto the cable (see Figure 2).

Figure 2 — Start with a square cut across the cable end and slide on the ferrule and a piece of heat-shrink tubing.

Step 2: Expose the braid. For LMR-240 cable, I use the DX Engineering green coax prep tool's **1ST CUT** opening to expose ⅝ inch of braid and aluminum shield. For LMR-400 cable, I use the similar red coax prep tool's **2ND CUT** opening to expose ¾ inch of braid and shield. Both tools make a spiral cut that proceeds until the wire end hits a stop (see Figure 3). A rubber jar-opening pad helps to grip the wire.

Figure 3 — The cable's outer covering is removed to expose the braid or shield.

Step 3: Prepare the braid. Slide the ferrule up to the braid and pull the braid back and down tight over it. Use a sharp pick to pull the braid outwards and perpendicular to the cable. Then, use a very sharp set of cutters to trim the exposed braid length by roughly half (see Figure 4). Before crimping, the ferrule must slip over and cover the braid, so it's best not to trim the braid too short at this point. With LMR-240 cable, I carefully slice the foil shield lengthwise along the dielectric on the opposite side of where the foil is split. Then, peel the cuts down to create two strips of foil and trim them to match the length of the trimmed braid. With the thicker LMR-400 cable, you can simply leave the foil in place around the dielectric.

Figure 4 — The cable braid shown trimmed and folded back.

Step 4: Prepare the exposed dielectric. Once the center insulating dielectric has been exposed, use a purpose-made measuring gauge to mark how much dielectric to remove to expose the center conductor. Make a new gauge for each type of connector by inserting piece of scrap wire into the end of the connector body until it stops. Then, bend it over the edge of the connector into an **L** shape, with the bottom leg of the **L** representing the reference length. After marking the cut position, use a conventional "finger twirl" coax stripping tool to cut the dielectric (see Figure 5). Make sure the end of the dielectric is a clean square cut.

Figure 5 — The measured amount of dielectric is marked and then removed.

Step 5: Prepare the center pin. Use the center pin to mark the depth of the center conductor necessary to have the pin sit flush to the dielectric, and then clip the center conductor at this point (see Figure 6). Before crimping or soldering the pin to the center conductor, test fit the connection to ensure the center pin comes up flush with the end of the connector by dragging your fingertip across the top and feeling for the tip's sharp point.

Figure 6 — The center pin being fitted.

Step 6: Prepare the connector. First, make sure that there is no short from the braid or shield to the center conductor, and then firmly push the connector onto the coax (see Figure 7). Next, slide the ferrule over the braid or shield until it's flush with the connector body and trim off any protruding braid strands. The connector is now ready for crimping.

Figure 7 — The connector must be firmly pushed onto the coax.

Step 7: Crimp the connector. Select the proper die and place it over the ferrule, flush against the connector body, and then squeeze the ratcheting crimp tool handles until they automatically release, indicating the completion of the operation. Figure 8 shows an unmounted die positioned properly on a ferrule for an LMR-240 connector.

Figure 8 — An unmounted die, illustrating proper placement of ferrule for crimping.

Step 8: Finishing. Slide the heat-shrink tubing over the ferrule, flush with the connector body, and set it with a heat gun. Finally, add an ID label for a professional touch (see Figure 9).

Figure 9 — LMR-400 cable with type N crimping connector, finished with heat-shrink tubing and an ID label.

Conclusion

Learning to crimp coax cable connectors will definitely take some practice. You can cut some scrap pieces of coax and prepare the ends for a crimp-on connector. As long as you don't solder or crimp the center conductor pin or crimp the ferrule, you can use the components over and over again until you get the hang of it. Alan Wolke, W2AEW, has an excellent YouTube instructional video about crimping that is worth watching.[1]

[1]A. Wolke, W2AEW, **www.youtube.com/watch?v=ktQVwfo-s9w**.

Photos by the author.

Amateur Extra-class licensee and ARRL Life Member Dino Papas, KL0S, has been an Amateur Radio operator for almost 50 years. He holds a BSEE degree from the University of California at Davis and a Masters of Engineering Management from George Washington University. Dino retired as a colonel after 26 years of active duty in the US Army. He now resides with his wife Toby, KL0SS, an Amateur Radio operator and ARRL Life Member, in Williamsburg, Virginia, where he is president of the Williamsburg Area Amateur Radio Club. Dino and his wife host the club's Ham Radio Makerspace that was described in the February 2015 issue of *QST*. You can contact Dino at **kl0s@arrl.net**.

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New Products

The bhi GroundBreaker

The bhi GroundBreaker isolates the grounds of external audio equipment from those of the radio system and prevents ground loops and associated RFI problems from getting into the audio. Six versions of mono or stereo 3.5-millimeter connections are available to match most impedances. For more information or to order, US customers can visit **www.dxengineering.com** or **www.gigaparts.com**. Customers in the UK can order at **www.bhi-ltd.com/noise-cancelling/accessories/groundbreaker.html**.

Product Review

FlexRadio Systems FLEX-6400M HF and 6-Meter SDR Transceiver

Reviewed by Joel Hallas, W1ZR
QST *Contributing Editor*
w1zr@arrl.org

The FLEX-6400M is a 100 W nominal SSB, CW, AM, FM, and digital-mode transceiver for 160 to 6 meters. Unlike previous FlexRadio SDR transceivers, the FLEX-6400M can be operated as a standalone radio that doesn't require a computer or separate control head for operation. Thus the FLEX-6400M — with its front panel that includes switches, knobs, and a high-definition color display — can fit into the traditional transceiver spot in a ham shack.

FlexRadio Signature Series Transceivers

Martin Ewing, AA6E, reviewed earlier versions of the direct-sampling Signature Series transceivers in *QST*.[1, 2] The FLEX-6400 is now the entry point instead of the FLEX-6300, while the middle ground includes the new FLEX-6600 rather than the FLEX-6500. The FLEX-6700 is still at the top of the lineup. The FLEX-6400 and FLEX-6600 are available in two configurations — a standalone model as in the FLEX-6400M reviewed here, and a blank front-panel model (without the M suffix) that requires an external control system. As with the earlier FlexRadio models, the control system can be a Windows-based PC, iPad, or iPhone running the appropriate *SmartSDR* software, or FlexRadio's Maestro control panel.

The Maestro is a thin front panel that looks very much like the front of the FLEX-6400M, but it can be mounted separately from the FLEX-6400 and interconnected via a built-in wireless link or via an ethernet cable. The Maestro can also be used for remote operation of the FLEX-6400 or FLEX-6400M over the internet, should you want to have a similar-looking front panel from a remote location. It provides the functionality of a PC running *SmartSDR*, but is independent of the PC. The price of the base FLEX-6400 starts at $1,999. With the Maestro, it is $199 more than the standalone FLEX-6400M.

Bottom Line

The FLEX-6400M expands FlexRadio's line of high-performance, direct-sampling transceivers to include a traditional front panel, allowing operation without the need for a computer for control and display. It can also be controlled locally or remotely from a Windows-based PC, iPad, or iPhone running the appropriate *SmartSDR* software, or from FlexRadio's Maestro control panel — perhaps offering the best of both worlds.

Other options for the FLEX-6400 include an internal automatic antenna tuner at $299 and a GPS-based frequency standard that will control the radio's frequency, as well as provide an accurate 10 MHz reference for other station and test equipment at $699. The review radio included the antenna tuner.

How It Works

As with the other *Signature Series* transceivers, this transceiver is based on a direct digital-sampling architecture with no conversion steps in front of the analog-to-digital converter (ADC). The radio samples and digitizes the entire spectrum from 0.03 to 55 MHz, thus information from any frequency range is immediately available. As shown in Table 1, the FLEX-6400M's performance is right up in the top tier of current HF transceivers.

The selected portion to be decoded is called a *slice*, and the FLEX-6400M can process two such slices from anywhere within the received spectrum, but both slices must come from the same antenna port. The

FlexRadio FLEX-6400M Key Measurements Summary

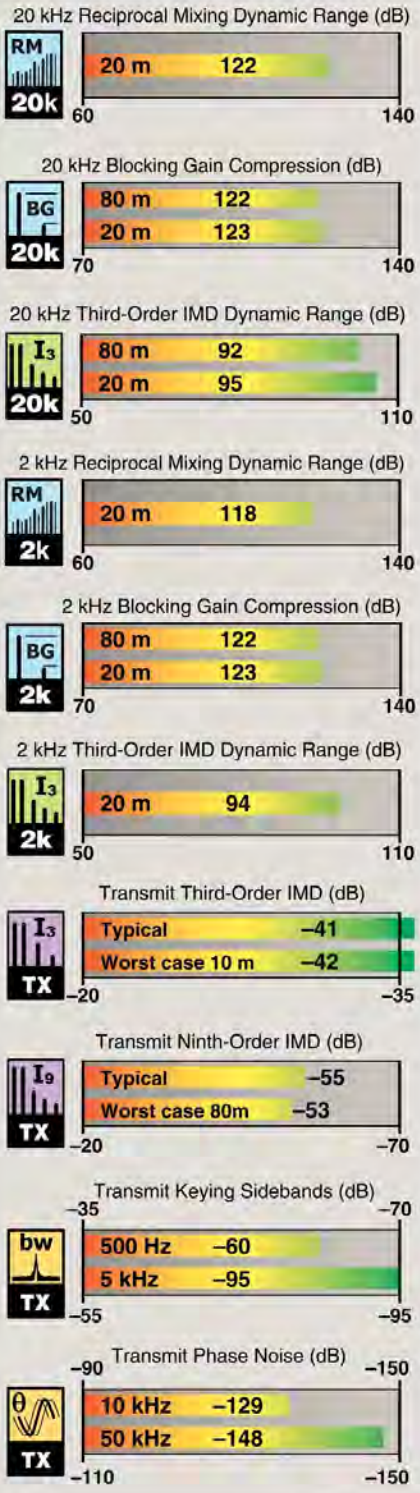

Table 1
FlexRadio Systems 6400M, serial number 1618-2097-6401-2120, v2.3.9

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: Receive, 0.03 – 54 MHz. Transmit, 160 – 6 meter amateur bands only.	Receive, 0.03 – 55 MHz. Transmit, 160 – 6 meter amateur bands including five 60-meter channels.
Power requirement: Transmit, 23 A (maximum). Receive, 1.7 A (typical) at 13.8 V dc (±15%).	At 13.8 V dc: Transmit, 22 A (typical), 12 A (AM) at maximum RF power output; 6.0 A at minimum RF output. Receive, 2.16 A (maximum backlight), 2.10 A (minimum backlight). Power off, 25 mA.
Modes of operation: SSB, CW, AM, FM, RTTY, digital.	As specified.

Receiver	Receiver Dynamic Testing
SSB/CW sensitivity: Not specified.	Noise floor (MDS), 400 Hz bandwidth, AGCT = 60:

Preamp	*0*	*+16*	*+32 dB*
0.137 MHz	–115	–104	–98 dBm
0.475 MHz	–117	–113	–115 dBm
1.0 MHz	–115	–130	–127 dBm
3.5 MHz	–113	–127	–132 dBm
14 MHz	–114	–129	–138 dBm
50 MHz	–115	–131	–138 dBm

Noise figure: Not specified.	Preamp 0/16/32 dB: 14 MHz: 33/18/9 dB; 50 MHz, 31/16/9 dB.
AM sensitivity: Not specified.	10 dB (S+N)/N, 1 kHz tone, 30% modulation, 6 kHz BW:

Preamp	*0*	*+16*	*+32 dB*
1.0 MHz	10.0	2.63	3.39 µV
3.88 MHz	18.0	3.46	2.11 µV
29.0 MHz	21.9	3.16	0.59 µV
50.4 MHz	14.8	2.21	0.81 µV

FM sensitivity: Not specified.	For 12 dB SINAD, 3 kHz deviation, 15 kHz BW:

Preamp	*0*	*+16*	*+32 dB*
29 MHz	21.9	3.16	0.59 µV
52 MHz	0.59	0.26	0.20 µV

Spectral sensitivity: Not specified.	Panadapter display, preamp 0/16/32 dB: 14 MHz, –127/–141/–149 dBm 50 MHz, –123/–139/–147 dBm Waterfall display, preamp 0/16/32 dB: 14 MHz, –130/–144/–154 dBm 50 MHz, –126/–142/–151 dBm
Blocking gain compression dynamic range: Not specified.	Blocking gain compression dynamic range, 400 Hz BW:

	20 kHz offset *Preamp 0/16/32*	*5/2 kHz offset* *Preamp 0 dB*
3.5 MHz	122/120/110	122/122 dB
14 MHz	123/122/115	123/123 dB
50 MHz	121/123/118	121/121 dB

Reciprocal mixing dynamic range: 115 dB at 2 kHz.	14 MHz, 20/5/2 kHz offset: 122/120/118 dB.

ARRL Lab Two-Tone IMD Testing (400 Hz bandwidth), AGCT = 60:

Band/Preamp	*Spacing*	*Measured IMD Level*	*Measured Input Level*	*IMD DR*
3.5 MHz/0	20 kHz	–113 dBm –97 dBm	–21 dBm –8 dBm	92 dB
14 MHz/0	20 kHz	–114 dBm –97 dBm	–19 dBm –6 dBm	95 dB
14 MHz/+16	20 kHz	–129 dBm –97 dBm	–33 dBm –15 dBm	96 dB
14 MHz/+32	20 kHz	–138 dBm –97 dBm	–44 dBm –29 dBm	94 dB
14 MHz/0	5 kHz	–114 dBm –97 dBm	–19 dBm –6 dBm	95 dB
14 MHz/0	2 kHz	–114 dBm –97 dBm	–20 dBm –6 dBm	94 dB

Band/Preamp	Spacing	Measured IMD Level	Measured Input Level	IMD DR
50 MHz/0	20 kHz	–115 dBm –97 dBm	–20 dBm –10 dBm	95 dB
50 MHz/+32	20 kHz	–138 dBm –97 dBm	–42 dBm –15 dBm	96 dB

Second-order intercept point: Not specified.	Preamp 0/16/32 dB: 14 MHz, +71/+71/+71 dBm 21 MHz, +71/+71/+69 dBm 50 MHz, +83/+83/+71 dBm
DSP noise reduction: Not specified.	12 dB.
FM adjacent channel rejection: Not specified.	Preamp +32 dB: 29 MHz, 97 dB; 52 MHz, 95 dB.
FM two-tone third-order IMD dynamic: range: Not specified.	20 kHz offset, preamp +32 dB: 29 MHz, 84 dB; 52 MHz, 90 dB; 10 MHz spacing, preamp +32 dB: 29 MHz, 86 dB; 52 MHz, 99 dB.
Squelch sensitivity: Not specified.	FM, preamp +32 dB: 29 MHz, 0.32 µV to 1.58 µV; 52 MHz, 0.14 µV to 0.71 µV.
S-meter sensitivity: Not specified.	S-9 signal, preamp 0/16/32 dB: 14 MHz, 38.4/38.4/36.3 µV 50 MHz, 26.3/23.4/23.4 µV Scaling: 6 dB per S-unit.
Notch filter depth: Not specified.	Tunable notch filter: normal, 29 dB; deep, 61 dB; very deep, >70 dB.
IF/audio response: Not specified.	Range at –6 dB points:‡ CW (400 Hz BW): 400 – 800 Hz; Equivalent Rectangular BW: 402 Hz; USB (2.4 kHz BW): 90 – 2,500 Hz; LSB (2.4 kHz BW): 90 – 2,500 Hz; AM (6 kHz BW): 31 – 5,491 Hz.
Receive processing delay time: Not specified.	165 ms.

Transmitter	Transmitter Dynamic Testing
Power output: 1 – 100 W (SSB, CW, FM), 1 – 25 W (AM).	SSB, CW, FM: 1.8 – 30 MHz, 0.9 – 100 W; 50 MHz, 0.6 – 85 W. AM: 1.8 – 30 MHz, 0.17– 23 W; 50.4 MHz, 0.1 – 17 W.
RF power output at minimum specified operating voltage: Not specified.	At 11.7 V dc: 14 MHz, 92 W; 50 MHz, 77 W.
Spurious-signal and harmonic suppression: 55 dB (HF); 65 dB (50 MHz).	HF, >68 dB typical; 61 dB worst case (5.330 MHz); 50 MHz, 73 dB. Complies with FCC emission standards.
Third-order intermodulation distortion (IMD) products: Not specified.	3rd/5th/7th/9th order, 100 W PEP: –41/–40/–49/–55 dB (HF typical) –42/–39/–46/–53 dB (worst case, 10 m) –42/–37/–46/–55 dB (50 MHz) At 50 W RF output: –35/–43/–50/–55 dB (14 MHz) –32/–40/–50/–55 dB (50 MHz)
CW keyer speed range: Not specified.	5.5 to 100 WPM, iambic mode A & B.
CW keying characteristics: Not specified.	See Figures 1 and 2.
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	S-9 signal, AGC fast, SSB, 200 ms; CW (full break-in), 186 ms.*
Receive-transmit turnaround time (TX delay): Not specified.	SSB, 47 ms; FM, 26 ms (29 MHz), 25 ms (52 MHz).
Transmit phase noise: Not specified.	See Figure 3.
Amplifier key line closure to RF output: Selectable, 0 to 30 ms.	As specified. RF off to key line open, variable, 0 to 3 seconds.

Size (height, width, depth, including protrusions): 7.0 × 14.0 × 12.9 inches; weight, 10.5 lbs.

Second-order intercept points were determined using S-5 reference.

‡Default values; bandwidth is adjustable.

*Default settings. Turnaround time is affected by the Filter Options menu to optimize filter sharpness versus turnaround time.

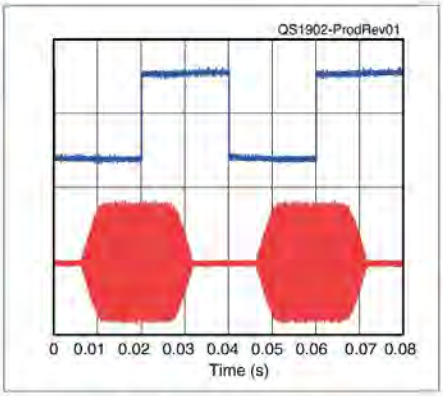

Figure 1 — The CW keying waveform for the FlexRadio FLEX-6400M, showing the first two dits in full-break-in (QSK) mode using external keying and the default rise time setting. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure, and the lower trace is the RF envelope. (Note that the first key closure starts at the left edge of the figure.) Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output on the 14 MHz band.

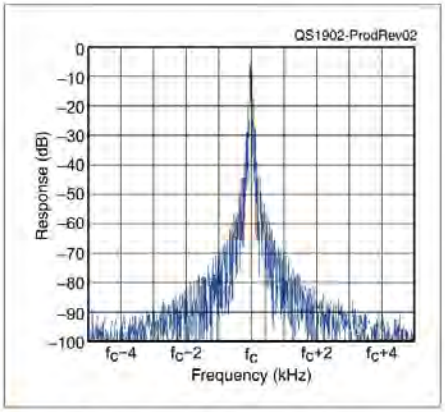

Figure 2 — The spectral display of the FlexRadio FLEX-6400M transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying and the default rise time setting. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 100 W PEP output on the 14 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in decibels.

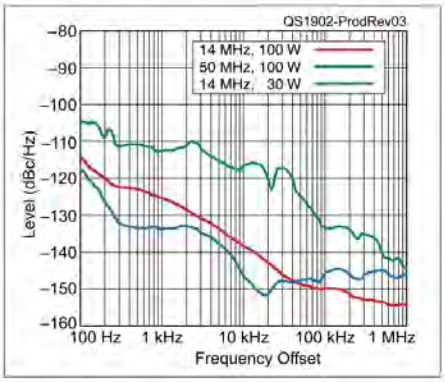

Figure 3 — The spectral display of the FlexRadio FLEX-6400M transmitter output during phase-noise testing. Power output is 100 W on the 14 MHz band (red trace), 30 W on the 14 MHz band (blue trace), and 100 W on the 50 MHz band (green trace). The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 100 Hz to 1 MHz from the carrier. The reference level is –80 dBc/Hz, and the vertical scale is 10 dB per division.

higher-featured FLEX-6600M operates in a similar way, but has the capability to process a total of four slices. Any of the four slices can be pointed to any two antenna ports for receive, and each has independent transmit antenna selection, thus supporting fully independent dual-receive systems.

Computer Connectivity

The transceiver interconnects with your PC via its CAT 6 ethernet port. While a computer connection is not necessary to operate the FLEX-6400M, it is needed to exchange digital information with the PC (such as for a logging program), or to use transceiver audio to operate via sound-card digital modes, such as FT8. The ethernet connection can be direct to the PC or over your LAN, or even a remote connection to another location (more on this later).

While the direct connection to the FLEX-6400M must be to a device with a CAT 6 port and connected via an eight-wire CAT 6 cable in order to operate, the rest of the station or home network can be older technology.

In order to connect to my antiquated household LAN (which can transfer data at up to 50 Mbps), I found that using an inexpensive five-port gigabit switch with CAT 6 connectors and CAT 6-wired jumpers (one is provided with the FLEX-6400M) allowed my PC and the FLEX-6400M to connect together at high speed, as well as to interface with my LAN.[3] USB ports on the radio can be used to interface with other radio hardware, such as an amplifier or automatic antenna switch.

The FlexRadio *SmartSDR* software includes three major functions, each accessible through its own desktop icon. We were working with version 2.3.9 at the start of the review, and it included *SmartSDR v2.3.9*, *DAX*, and *CAT*. The *DAX* software is the *digital audio exchange* that can connect to your Windows PC's audio system, either for remote operation or to run sound-card digital modes using software on your PC. The *CAT* software can support computer automated radio operation for interfacing with logging software and other applications independent of other *SmartSDR* functions. The *DAX* and *CAT* modules can be brought up independently of *SmartSDR* if you are operating from the FLEX-6400M front panel.

If you bring up the full *SmartSDR* program, it allows your local or remote PC to take over the complete functioning of your transceiver and brings up the *CAT* and *DAX* modules as part of the process. Your PC first indicates that the radio is in use, then you tell it to turn off that user (the local FLEX-6400M display) and connect. The local FLEX-6400M screen is then replaced by an indication that the radio is in use by your PC.

SmartSDR shows the full pan-adapter and waterfall displays, along with all the other transceiver functions, although operation is slightly different from the transceiver front panel. For example, the radio's touchscreen functions are operated by the PC mouse, and some other controls are different in appearance and position.

To operate your FLEX-6400M from *SmartSDR* remotely, you will need to set up an account with the *SmartLink* software from FlexRadio. This software is available from the *SmartSDR* startup page. Registering as a *SmartLink* user provides you with security and authentication so that only a *SmartSDR* user with knowledge of your email address and password can access your FLEX-6400M remotely.

Note that *SmartSDR* requires a license to operate. Purchase of the radio includes a license for a single copy of *SmartSDR* that is assigned to the particular radio and goes with it if sold. The original license includes access to any minor updates, but a fee is required to obtain a new license for a major update.

During the review period, the radio indicated that v2.4.9 had become available, so I selected that and let it download and upgrade. After indicating that it was downloading properly, as shown on the progress indicators, it seemed to hang during the update phase. After a couple of restarts, it eventually came up in v2.4.9, with all memorized conditions still intact.

On the Air

I enjoyed using the FLEX-6400M as my main station transceiver for more than a month and had an opportunity to test it in most modes. While getting started was simple, as with most full-featured radios, expect to spend some time with the manuals to be able to fully appreciate and learn to operate all the advanced features. You can assume that any feature or function you've encountered on any transceiver is also supported on this radio.

This radio is a bit different from other transceivers I have used in some minor ways that struck me as I was getting started. While the radio includes a single small front-facing speaker, it has lower audio output than I am used to. The rear stereo speaker jack is designed to drive powered computer-type speakers. I found suitable speakers in my bottomless basement, and even found a wall transformer that could run them.

The other unusual item is that there are no front-panel jacks on the FLEX-6400M. This may be a blessing for those who like to hide all of their station wiring, but because there is only one **KEY** jack, and one **MIC** jack, I found the arrangement a bit cumbersome at times while trying different accessories.

Figure 4 — A screenshot of the FLEX-6400M display showing a single panadapter display, with waterfall below, including the frequency tuned by VFO A.

Figure 5 — Same as in Figure 4, except a second spectrum and waterfall display are added below the first. Note that the second is on a different band, bandwidth, and mode. Either can be anywhere within the FLEX-6400M's tuning range, but both must be from the same antenna.

Frequency memories also store the mode, selectivity choice, and other mode-specific parameters, such as repeater offset and CTCSS tones needed for FM. The memories are added, loaded, or deleted from the main menu, with each selected from the list by a push on the touchscreen. To eliminate the two pushes needed to get to the memory list, I set the **F1** function button to **OPEN MEMORY**, which made memories easier to use.

The spectrum scope is quite useful and flexible. It can observe a portion of the spectrum near the tuned frequency, as shown in Figure 4. If set to cover a particular portion of a band that includes both the A and B receiver channels, they are both shown on the same scan. Alternately, the B channel could be on a different portion of the band, or even a different band and mode, and can be shown on a separate span below the first — each with its own width and tuning rate, as shown in Figure 5. The width can be adjusted from 6 kHz to 7 MHz, either by using the + and – buttons that appear when the display is tapped, or by squeezing or stretching the screen with your fingers. The display is crisp and sharp, and it offers a high enough resolution that the use of a larger display (available via an HDMI connection) might be useful.

The front panel also shows two bar graph meters, one for each VFO, as shown in Figures 4 and 5. The default settings are transmit power and receive signal strength, but each can be cycled through a number of other indications by pushing the scale that you would like to change. Push the **METERS** tag on the screen, and all the meters are presented.

The internal antenna tuner quickly tunes an antenna system with up to a specified 3:1 SWR to near 1:1, and it remembers the tuner settings for that frequency. I found that it could tune some antennas with a higher SWR, but the internal SWR meter only shows up to a 3:1 value, so it can be hard to tell. Attempting to use an antenna with more than the specified mismatch can be risky. While the radio cuts back to 10 W out during tuning (adjustable in the **TRANSMIT** menu), if you try to operate with full power, you could damage tuner components if ratings are exceeded.

Voice Operation

Voice modes all worked well, with good audio reports received on SSB and AM. Conditions did not allow me to make any FM contacts on 10 or 6 meters — not unusual here. The transceiver is supplied with a handheld FHM-2 PTT electret microphone that plugs into the 3.5-millimeter, rear-panel jack. The jack can supply electret bias voltage on the **MIC** line, or it can be set to **OFF** by a menu item in order to use dynamic microphones or electrets that require bias on a separate pin. In addition to the supplied hand mic, I tried a professional-quality dynamic and an amateur electret desk mic and received good reports on all.

For 10- or 6-meter FM operation, the FLEX-6400M provides easy split-frequency offsets, as well as CTCSS tone encoding for repeater access. The repeater frequency offset is displayed in MHz, with a decimal point, rather than kHz (for example, 0.1 MHz rather than 100 kHz on 10 meters). Note that the frequency offset shown does not change after pushing the **PTT** button, continuing to show the receive frequency.

On SSB, the transmit voice bandwidth can be set from 1,600 to 4,000 Hz in eight steps using touchscreen buttons. The selection can be immediately overridden by using **BW SELECT** knobs, either by setting the **LOW – HIGH** or **SHIFT – WIDTH** choices. The transmit and receive audio response can be set via separate eight-channel equalizers with octave frequency bins starting with one centered at 63 Hz and going to 8 kHz, each adjustable for 10 dB cut or boost. The transmit equalizer settings are used for all voice modes.

For AM, the receive bandwidth can be set from 5.6 to 20 kHz in eight steps, again overridden by the front-panel **BW SELECT** knob set, if desired. In addition, synchronous AM reception (**SAM**) can be selected. That mode provides better reception during fades by using an internally generated carrier instead of the one received over the air, which will not always stay constant in amplitude.

Voice-operated transmit control (**VOX**) worked flawlessly, as did the anti-VOX function, which kept the VOX from triggering off loud received stations, even with the mic pointed at the speakers. Adjusting VOX parameters is accomplished via the **TX MENU**, not to be confused with the **TRANSMIT** menu. This took a bit of study, but the documentation does refer to them differently.

For split-frequency operation, pressing the **TX** button for slice B can initiate split-frequency mode. In order to have the two audio channels appear on separate sides, it is also necessary to adjust the unidentified **L – R** slider to the right of the **AGC** selector on each **SLICE** menu (initiated by tapping the receive frequency), one to the right, one to the left. Remember to move the slice A slider back to the middle if not running in split mode.

A monitor function is provided, along with a recording function that can be used to record and playback audio signals. It can be used to record either transmitted audio or received signals, depending on the state of the transceiver when the red button on the **SLICE** menu is engaged. You can listen to the audio recording offline, or you can transmit it on the air. You can also integrate the radio with voice messaging from third-party software, such as *N1MM Logger+*.

CW Operation

The FLEX-6400M includes many useful features for the CW operator, like full break-in (QSK) or adjustable delay, and semi-break-in operation is supported with the transmit-receive switchover noise, just barely audible with my ear on the cabinet top. A single 3.5-millimeter stereo jack in the rear can be used for paddles, a straight key, or connections to an external keyer. In addition, Pin 4 of the rear-panel **ACCESSORY** connector provides another input for a straight key, external keyer, or computer-generated keying interface. The built-in iambic (mode A or B) electronic keyer can be adjusted from 5 to 100 words per minute. CW messages can be programmed with CWX in *SmartSDR* for Windows, and function keys of the FLEX-6400M front panel can be used to send canned messages.

Activating the **TX MENU** (by pushing the **MIC/SPEED** button) while in **CW** mode opens the **CW TRANSMIT** menu. Here, you can set a slider to change from 0 to 2,000 milliseconds of transmit-receive delay, with 0 resulting in full break-in, so you can receive between transmitted code elements.

The two receivers can be set independently to default CW bandwidths of 50, 100, 250, 400, 500, 800, 1,000,

Lab Notes: FlexRadio Systems FLEX-6400M

Bob Allison, WB1GCM, ARRL Assistant Laboratory Manager

Some HF transceivers, such as this FLEX-6400M, are a joy to test, with predictably good performance. The receiver test results are presented a little differently from our usual format. FlexRadio Systems provides several sensitivity settings, and for test purposes, we chose three: 0, +16, and +32 dB. With an antenna hooked up, the 0 dB gain setting provides enough sensitivity to match the background noise floor in a relatively quiet location. Much of the time on HF, adding more sensitivity simply makes the background noise higher and does not increase the signal-to-noise ratio for the listener, so it's important to match the gain setting to band conditions.

The FLEX-6400M's dynamic ranges are quite good overall. Third-order IMD dynamic range is about 95 dB, regardless of gain settings. Signal blocking is excellent, and reciprocal mixing is kept to a minimum — both of these dynamic ranges are excellent. Second-order IMD products are very low with the gain settings to either +16 or +32 dB. This type of performance is most welcome to those who live in close proximity to strong shortwave broadcast stations, where the mixing of strong 6 and 15 MHz signals can create phantom 21 MHz signals.

On 6 meters, where the noise floor is typically much lower, users of the FLEX-6400M will enjoy using the very sensitive spectral display, with a waterfall that can detect very weak signals on a quiet band. Though AM sensitivity could be better on HF, it is quite adequate for the 6-meter AM crowd on 50.4 MHz. FM sensitivity on 6 meters is also good.

On the transmit side, initially our FLEX-6400M greatly exceeded the FCC requirements for harmonic and spurious emission suppression on most bands, except for a spurious emission when transmitting on 6 meters. FlexRadio fixed that under warranty. Transmit IMD exhibits very low third-order products, desirable for good transmit audio quality. The seventh- and ninth-order products are about average, compared to other transceivers tested at the ARRL Lab. The FLEX-6400M has excellent keying characteristics, with complementary excellent keying sidebands. Low transmit phase noise makes this transceiver a friendly neighbor to others operating on nearby frequencies.

Note that with the power switched off, the FLEX-6400M draws 25 mA — a consideration if a battery is used for the supply voltage.

or 3,000 Hz. As with other modes, both the filter width and center frequency can be adjusted using the front panel concentric knobs, independent of the menu starting point. I heard just the slightest trace of ringing at the 50 Hz setting.

Data Modes

The FLEX-6400M has a number of options for data mode operation. The ethernet connection to my PC can use the FlexRadio *DAX* software to interchange data between PC and radio, without any additional audio interconnections. Of course, the **MIC** and **SPKR** connections could also be used, with extra cables to a physical sound card, but it's not worth bothering.

There is no capability for direct frequency-shift keying (FSK) for RTTY, but audio frequency-shift keying (AFSK) works fine. There are multiple other ways to do any of the popular computer-based digital modes. All the selectivity and audio-filtering options are available in data modes.

DSP Noise Reduction

The FlexRadio designers worked hard on the various noise reduction processes. The first thing I noticed is that instead of an **RF GAIN** control, the FLEX-6400M offers a front panel receive AGC threshold (**AGCT**) that is on the same concentric shaft as the **AF GAIN** control. The **AGCT** sets the maximum gain available so that signals will not have excessive loudness. By setting the threshold to just below the point at which the background noise starts to decrease, strong signals will be limited, with a reduction in noise, while weak signals will still be heard. The AGC attack/release time can be set to fast, medium, slow, or off, with separate settings for each slice receiver. The threshold should be adjusted for band changes or changes in noise level.

The FLEX-6400M has two different noise blankers. A wideband blanker (**WNB**) is designed to eliminate pulse-type noise and is applied before any selectivity that would tend to stretch out the noise pulses. This blanker is applied to any signals within the panadapter width. A separate noise blanker (**NB**) is applied to each slice separately. Both blankers are available and adjustable on each **SLICE** menu.

Noise reduction processing can reduce background "white" noise. Engaging and advancing the slider results in a dramatic improvement in signal-to-noise ratio, with minimum distortion until set to the highest level.

An effective automatic notch filter (**ANF**) is provided for use in voice modes. The button changes to a narrow audio peaking filter (**APF**) in CW mode, so you won't inadvertently notch out your desired CW signal.

An interesting feature is engaged by pressing the panadapter or waterfall screen, near where you would like to eliminate a carrier. A menu appears with a choice to **CREATE TNF**, which will enable a tracking notch filter that can be moved to the offending carrier. Unlike the usual **ANF**, it will stay at that frequency even as you tune up and down the band. Additional tracking filters can be established if there are multiple carriers. This is very slick and well described in the manual.

Operating Impressions

This radio has a lot going for it. The large, high-resolution display is helpful, particularly while using the spectrum scope, and the controls are easy to reach and operate. If you need an even larger display, the HDMI video connector on the rear can be used to drive a compatible monitor or even a TV set, so you can monitor band activity from across the room — or just impress visitors.

It did take me a while to get used to the concentric front-panel knobs. They turn easily, and initially, I sometimes turned both while attempting to turn just one. The large and small **FREQUENCY** tuning knobs are easy to operate and nicely weighted, so you can easily spin across large segments of the band. The tuning step is adjustable, with a separate button for each slice. A short tap advances the step size, while a longer push reduces it — easy to deal with.

My amplified computer speakers worked nicely during receive, but I suspect they were not designed to operate in an RF environment and made a lot of noise while transmitting on some bands. This is not a fault of the radio, but is something to be aware of as you set up your FlexRadio station. At least one manufacturer offers a pair of reasonably priced amplified computer speakers that are designed to minimize RF pickup.[4] Usually, such problems can be resolved by wrapping the speaker wires around some ferrite toroid cores, but I didn't bother for this temporary test. Just moving the wires away from my linear amplifier helped quite a bit.

I was operating the FLEX-6400M with my 500 W linear amplifier and auto tuner, just using the radio's **TX1** keying-out connection. There are actually three such dedicated connections that key upon the FLEX-6400M's switchover to transmit. Thus, for example, in addition to keying an amplifier, you could have connections in place for your transverter and mast preamp sequencer — a helpful arrangement. My amplifier requires just 20 to 30 W drive, depending on the band. The FLEX-6400M also thoughtfully remembers the power out setting for each band, so you don't need to tweak it as you change bands, or risk driving your amplifier into alarm, or worse. Changing bands also goes back to the mode, frequency, and bandwidth selected when you were last there.

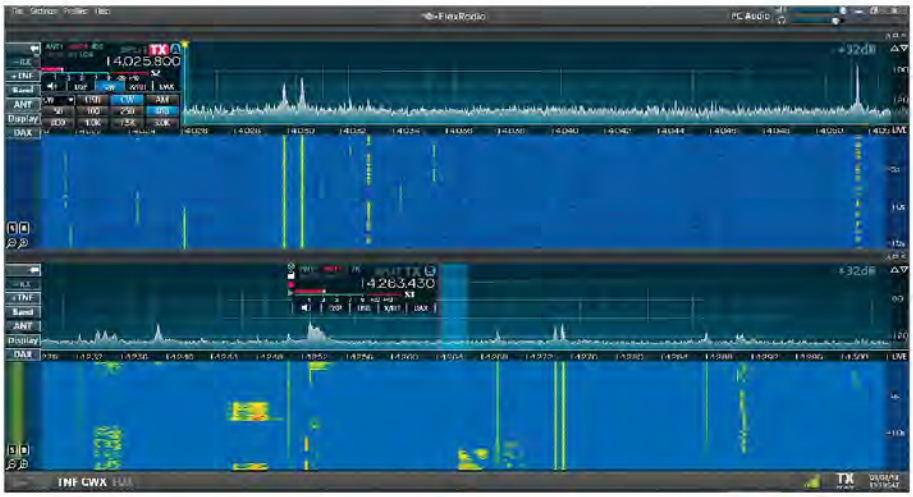

Figure 6 — *SmartSDR* on a locally connected PC running the FLEX-6400M. The setup menus are closed, and we are looking at signals on 20-meter CW and SSB.

Remote Operation

The FlexRadio Signature Series transceivers are a natural for remote operation. While the built-in display on the FLEX-6400M becomes redundant if you are operating from elsewhere, it doesn't cause any problems, and it allows an easy return to local operation if desired. I think that if I expected to do a lot of remote operation, I would be more inclined to go with the base FLEX-6400 and the Maestro separate front panel, which allows remote operation without the need of a PC. A typical *SmartSDR* screen on my locally connected PC is shown in Figure 6.

While attending the New England Division Convention in Boxborough, Massachusetts, I visited a booth operating with a Maestro onsite. The operation was sponsored by the Nashua (New Hampshire) Area Radio Society with Donald Bartlett, N1OKD, operating as N1T via a remote internet link to the station of Fred Kemmerer, AB1OC, in Hollis, New Hampshire. It was very impressive — especially considering how busy the shared internet connection must have been at the show venue. I couldn't tell the difference between the remote operation and operation locally at the show — except the antennas were a lot better from the remote site.

Documentation

Our FLEX-6400M did not include a printed manual, but two versions are provided on the FlexRadio website. One is a 165-page *FLEX-6400M / FLEX-6600M Users Guide*, while the other is a 218-page *SmartSDR Software User Guide*. While you might think that the software guide would only be needed for remote operation, the standalone version operates with the same software, so some operational details are described more fully in the software manual. The FlexRadio Customer Service support function via their website was responsive any time I struggled while becoming familiar with this transceiver. There's also a very active online community of FLEX users to answer questions and offer advice.

Wrapping Up

The FLEX-6400M is a very effective, full-featured transceiver that would work well in most stations, whether at home or operated from a remote location with internet connectivity. It provides all the advantages and capabilities of the traditional "blank-panel" SDR, but adds a serious front panel with all needed controls, indicators, and a stunning panadapter/waterfall display.

Manufacturer: FlexRadio, 4616 W. Howard Lane, Suite 1-150, Austin, TX, 78728; **www.flexradio.com**. Price: FLEX-6400M, $2,999; internal automatic antenna tuner, $299; GPS-synchronized 10 MHz oscillator, $699.

Notes

[1]M. Ewing, AA6E, "FlexRadio Systems FLEX-6300 Transceiver, FLEX-6700 Transceiver, and *SmartSDR for Windows* Software," Product Review, *QST*, April 2015, pp. 47 – 58.

[2]M. Ewing, AA6E, "FlexRadio Systems FLEX-6500 SDR Transceiver and Updated *SmartSDR for Windows* Software," Product Review, *QST*, Feb. 2017, pp. 53 – 59.

[3]I used a Linksys LGS105 unmanaged five-port gigabit switch. This compact unit, not much bigger than a deck of cards, is available for about $25 from a number of online retailers. It came up without any hassle, connecting to the FLEX-6400M, my PC, and my old LAN, and it made everything work together.

[4]West Mountain Radio COMspkr Computer Speaker System, **www.westmountainradio.com**.

Visit https://youtu.be/VKOYSQx-ESE to see our review of the FlexRadio Systems FLEX-6400M HF and 6-Meter SDR Transceiver on YouTube.

HecKits FET DIP Meter Kit

Reviewed by Paul Danzer, N1II
n1ii@arrl.net

Some years ago, no ham shack was complete without two test instruments: a volt-ohm meter and a *grid-dip meter* — sometimes called a *GDO* or *grid-dip oscillator*. The grid-dip meter was based on vacuum-tube technology and acted as a signal generator, a field strength meter, a resonance checker for measuring inductors and capacitors, an antenna tuning meter, and many other things.

Prices ranged from $20 to $350, primarily as a function of the oscillator stability and calibration. Today, solid-state devices, integrated circuits, and digital microprocessors long ago replaced tubes in new equipment. It is no surprise that the grid-dip oscillator has been replaced by a similar device using a field-effect transistor-based (FET-based) oscillator and digital counter to measure its frequency. The modern device is simply called a *dip meter*.

In its usual form, the dip meter consists of an oscillator and calibrated dial or frequency counter. In addition, there is a circuit that measures the amplitude of the oscillations. The tuning coil is outside of the case, and when the tuning coil comes close to a resonant circuit at the oscillator frequency (perhaps an inductor and capacitor in parallel), a certain amount of the oscillator energy is absorbed by the tuned circuit. At this point, the oscillator amplitude is pulled down, or dips, and a meter shows this dip.

The HecKits FET Dip Meter kit is a combination dip meter and frequency counter. It covers about 1.5 to 30 MHz, using five plug-in coils to cover frequencies in the HF ham bands. It's got a small meter on the front panel to indicate dips. The unit is housed in a plastic case that measures 5.5 × 2.5 × 1.1 inches and comfortably fits in the hand. It's powered from a standard 9 V battery.

Construction and Components

The assembly manual provided is easy to follow. Good quality components are included, and components mount on a printed circuit board. The kit includes a miniature socket wrench to fit mounting nuts that are smaller than the smallest size hardware compatible with a typical set of spin-tight sockets. As usual with small kits, a 20 to 40 W soldering iron, good light, and some sort of magnifier is needed.

There were a few typos in the assembly manual, which by this time, have probably been corrected. To assemble the completed unit, components on the PC board (see Figure 7) must be as tight to the board as possible to close the case.

Operation and Test

The eight-character by two-line LCD screen for the frequency display assembly comes preassembled and offers reasonable brightness and contrast. One knob controls the frequency, which can be set from 1.5 to 33 MHz on the varactor-controlled oscillator. There are five plug-in coils to match this range. One coil comes pre-wound, and you must wind the other four coils yourself.

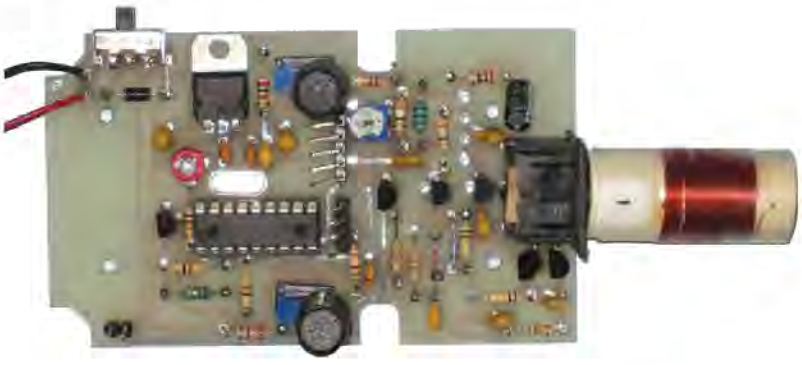

Figure 7 — The 10 MHz crystal on the lower center of the board controls the 18-pin integrated circuit — the LCD screen processor. The RF components are at the top of the board. One of the five coils is pictured plugged into the socket at the top.

Bottom Line

The HecKits Dip Meter Kit goes together easily, but its usefulness is hampered somewhat by lack of a pronounced dip, especially at the lower end of the frequency range.

The remaining front-panel knob sets the mid-range of the indicating dip meter.

Unfortunately, despite the clever oscillator and counter design, the dip displayed on the meter is often not pronounced enough. You may try to closely couple the object under test to the plug-in coil, but this is not always successful. The lack of a really pronounced dip is especially obvious at the lower end of the frequency range and with low-Q circuit applications. This meter would be more useful if the dip were more pronounced and easier to see.

Manufacturer: HecKits, Darrel Heckendorf, WA7OIB, Austin, TX; email **darrelheck@icloud.com**; **www.heckits.com**. Price: $85 plus shipping.

RM Italy BLA600 500 W HF and 6-Meter Linear Amplifier

Reviewed by Joel R. Hallas, W1ZR
QST *Contributing Editor*
w1zr@arrl.org

The RM Italy BLA600 is a compact, solid-state desktop linear amplifier that puts out 500 W on all amateur bands from 160 to 6 meters, except for the 60-meter channels. The amplifier uses an NXP/Freescale MRF6VP5600H 50 V LDMOS device and will deliver full output with 25 W or less drive on the HF bands, and 40 W or less on 160 and 6 meters. Its internal linear power supply can operate from a 120, 230, or 240 V ac line.

The BLA600 is highly automated, including near-instantaneous automatic band switching, based on the measured exciter frequency. Transmit-receive switching makes use of PIN diodes, resulting in near-instantaneous and quiet switchover that is able to support high-speed CW break-in. A nice feature is that it has three antenna outputs that can be selected manually or memorized on a band-by-band basis.

Hooking It Up

The BLA600 is very straightforward to interconnect to your station. All that is required is to connect the **GROUND** terminal to your station ground; the RF input (**RTX**) to your transceiver's output; a keying cable with a phono plug to the **PTT** socket, and up to three antennas (**ANT1**, **ANT2**, **ANT3**). Another phono jack is provided for the optional **ALC** output, which can be used as a safety measure to prevent overdriving.

The amplifier comes with an ac line cord, but you must provide and install a connector that matches your station outlet. The amplifier is shipped configured for 120 V ac operation, but the DX Engineering website offers detailed downloadable instructions for setting the line voltage to 230 or 240 V ac. It involves removing a plate on the rear panel and connecting a number of wires to the appropriate push-on terminals. Also, make sure that the fuse matches your ac supply voltage.

There is no provision to make use of the band data available from many transceivers, but the amplifier will respond to a single CW dit or voice syllable of output from the transceiver, measuring the input frequency and switching the band (and antenna, if memorized). The band (and antenna) can also be set manually using front-panel buttons. Plan your installation carefully, and have a friend available — although it's compact, this amplifier weighs 47 pounds.

Bottom Line

The RM Italy BLA600 is a competent, medium-power, 160- to 6-meter, solid-state linear amplifier that can provide a significant boost to the typical 100 W (or even lower-powered) HF transceiver. It is easy to install and interface with most any equipment.

Navigating the Front Panel

The attractive black front panel of the BLA600 has grilles for ventilation on either side with a row of buttons

Table 2
RM Italy BLA600, Rev 1.94, serial number 0090917

Manufacturer's Specifications	Measured in ARRL Lab
Frequency range: 1.8 to 54 MHz.	160-, 80-, 40-, 30-, 20-, 17-, 15-, 12-, 10-, 6-meter amateur bands.
Power output: 500 W PEP ±1dB.	HF, as specified; 50 MHz, 480 W.
Driving power required: 80 – 10 meters, 20 – 25 W; 160 and 6 meters, 30 – 40 W.	As specified.
Spurious and harmonic suppression: HF, >45 dB; 6 meters, >60 dB.	HF: 60 dB (typical); 56 dB worst case (10.1 MHz). 50 MHz, 67 dB. Meets FCC requirements.
Third-order intermodulation distortion (IMD): Not specified.	3rd/5th/7th/9th order products, dB below PEP at full output: 14 MHz, –30/–36/–53/–59 dB. 50 MHz, –30/–37/–53/–60 dB.
Transmit-receive switching time: Not specified.	Unkey to key, 4 ms; key to unkey, 3 ms.
Primary power requirements: 120 V ac, 10 A; 230 V ac, 6 A; or 240 V ac, 5 A.	
Size (HWD): 5.5 × 12.9 × 17 inches (including protrusions); weight, 47.5 lbs.	

along the bottom. The right end of the row has a power **ON/OFF** button, with the **STANDBY/OPERATE** button on the left end. In between are individual buttons for each band, with illuminated green band indicators above each button. Above the row of buttons on the left is an LCD multimeter with four menu-selectable indicators and two large bar graph indicators for relative power output (**POWER**) and standing-wave ratio (**SWR**).

Just below the multimeter are its controls, an **ENTER** (right arrow) key, + and – keys, and a **NAVIGATE** (down arrow) key. The two rows of 16 characters default into four info blocks. In the default mode, with the amplifier in **STANDBY** mode, the top row indicates mode (**STANDBY** or **OPERATE**) and antenna number (**ANT:#**). The bottom row shows drive power (**PIN:**), and transistor heatsink (**T1**) or exhaust (**T2**) temperature (**T1: ##°C**). With the amplifier in **OPERATE** mode, the lower line can also display drain current and voltage.

Meter selections are made using the four buttons below the display, which can also be used to make other set-and-forget selections, such as setting of ALC parameters, temperature units (°C or °F), display brightness and contrast, break-in on or off, and meter displays during **STANDBY** mode. In between, on the left side are an error/fault indicator (**!** in a roadside triangle) and a transmit indicator (**TX**), both of which are illuminated red if active.

Operating Impressions

I used the BLA600 with a FLEX-6400M (also reviewed this month) and my usual Elecraft K3/100. Both provide phono jacks with a **PTT** output signal, making interfacing easy. For my antennas, I had a dummy load in position one, my triband plus 6-meter Yagi in position two, and an Elecraft KAT500 500 W automatic antenna tuner with my remaining antennas in position three. After making a few simple connections, I was on the air with 500 W.

This setup worked well and was easy to use. Both transceivers can remember power output settings on each band, so I didn't have many overdrive fault problems. The amplifier only went into alarm if I was using the antenna tuner and didn't remember to set the tuning first at low power. The amplifier followed my keying in both voice and CW modes flawlessly.

The manual does not indicate any limits on duty cycle, so I had to see what it would do. With the amplifier connected to my trusty old Heathkit Cantenna high-power dummy load, I fed it a RTTY signal on 12 meters, while monitoring the heatsink temperature and listening for the fan to change intensity. I set the **POWER** indicator to the top of the green range. It started with the lowest transmitting fan speed and a temperature of 27 °C. At 3 minutes of continuous operation, the fan went up a notch and the temperature indicated 42 °C. After another few minutes, we were at 46 °C and the fan went up another notch. After 10 minutes of key-down, the temperature hit 55 °C, and I don't believe the fan increased any further. I stopped at that point, thinking that 10 minutes would be a long transmission, even for a RTTY ragchew.

At no time was the fan noise objectionable, and it stayed well below the high speed that it demonstrates during its self-test at turn-on. After 10 minutes of not transmitting, the heatsink temperature was down to 28 °C, and the fan was running at its usual minimum transmit speed. In another 7 minutes, the temperature was back to its starting point of 27 °C, and the fan went back to its usual **STANDBY** mode. Based on this exercise, I would have no qualms about pushing this amplifier for digital modes, contesting, or any other typical high duty-cycle Amateur Radio application.

There were a few things that I had to get used to working around. The instructions said that to memorize an antenna setting for a band, "press the **NAVIGATE** key for 3 seconds." At first, I thought that this function didn't work, but eventually, I found that it required a press of 30 seconds, not 3 seconds, to engage. Not a big deal, but DX Engineering indicates that RM Italy has fixed this in firmware in current production units. (There is no mention in the manual of a process

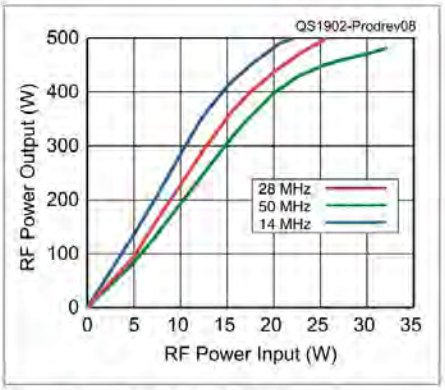

Figure 8 — RM Italy BLA600 input power versus output power.

Rear panel of the BLA600, showing available connections. See text for details.

for owners to update firmware in the field, nor is there a USB or serial jack on the rear panel.)

The **POWER** indicator, a colorful bar graph that is the dramatic focus of the display, shows an informative green/yellow/red of increasing height as the power output increases — but there is no indication of actual power output, nor an indication in the manual of what the target should be. After a bit in the red, the amplifier goes into **FAULT** mode and a cycle of the **OPERATE/STANDBY** switch is required to reset to normal operation.

Without an accurate external power meter, there is no way to know if 500 W is the top of the green, the middle of the yellow, or the bottom of the red. Also, say you want to use the BLA600 to increase your power on 30 meters to the 200 W maximum. It's difficult to know where 200 W is on this scale.

The manual suggests that while the output can be pushed beyond 500 W, it will have less distortion if kept at 500 W or below. That's borne out in ARRL Lab testing, as the linearity starts to fall off between 400 and 500 W (see Figure 8).

The SWR bar graph display doesn't seem to indicate the same SWR level at different power outputs, so it may be more of a reflected power indicator. The amplifier will go into fault mode if the SWR reaches about 2.5:1 to 3:1, but I found the trip point to be dependent on what the power is set to. It makes it a bit tough to check your antenna tuner settings, especially because the display does not indicate power or SWR while in **STANDBY** mode.

Neither of these concerns are really show-stoppers for me, but I would be more comfortable if the multimeter selections provided for numerical values of output power and SWR.

In terms of acoustic output, while the amplifier is not quite silent, it isn't very noisy. There is a constant just-audible noise level while the power is on. A variable-speed cooling fan comes on (and off) at a low level with keying. It is not terribly loud, and can almost be used as a sidetone monitor while operating CW. The fan can get much louder — it goes through each step as part of the start-up self-test — but I never heard it go above the low level during my normal operations.

The amplifier switches the output to Antenna 1 at power-off. This provides a nice safety feature if Antenna 1 is used for a dummy load — helping with lightning protection and my usual arrangement for that reason. The only problem with this approach is that if you want to listen to see if the bands are open, you can't tell unless the amplifier is turned on. (I'm used to an amplifier with a single output and external antenna switching that can be used with the amplifier or just the transceiver by itself.) Having multiple antenna outputs is a useful feature, but it's worth thinking about as you arrange your antennas.

Documentation

The BLA600 comes with a well-written, 27-page *User Manual*. It provides clear instruction on how to set up and interconnect the amplifier to your station equipment and describes all the options and metering choices. It even includes a section on using non-matched antennas with an antenna tuner (not supplied, nor available from RM Italy). Along with the well-illustrated line voltage adjustment instructions from DX Engineering, it provides everything you need to move up a notch to 500 W operation.

The one thing not included in the manual is a schematic diagram. Arguably, it is certainly not needed in order to set up and run the amplifier, but I still find it nice to know what's in the box — and it certainly can be helpful if troubleshooting is required.

Manufacturer: RM Italy Costruzioni Elettroniche. US distributor: DX Engineering, 1200 Southeast Ave., Tallmadge, OH 44278, **www.dxengineering.com**. Price: $2,499.99.

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

The Doctor is In

Antenna Performance Depends on Surroundings

Q Roxie, K1AUS, asks: I was looking at my off-center-fed 40-meter dipole the other day and I noticed that it is almost centered with the aluminum gutter on the apartment building I live in. The gutter is about 10% longer than the antenna and is about 12 feet to the east of, and about 4 or 5 feet higher than, the antenna. I wonder if it may be acting as a reflector, essentially making my antenna a two-element beam facing west. Would that explain why I can work the west coast, Hawaii, and Japan easier than I can work the US midwest and east coast?

A There could be many reasons for your experience, especially terrain. However, it is indeed the case that nearby metal objects can result in changes to your antenna pattern. If your gutter is seamless and not excessively connected to the building or metal downspouts, it could be acting as a reflector, making a two-element Yagi, and perhaps into an array of four half-wave elements on 20 meters, as well.

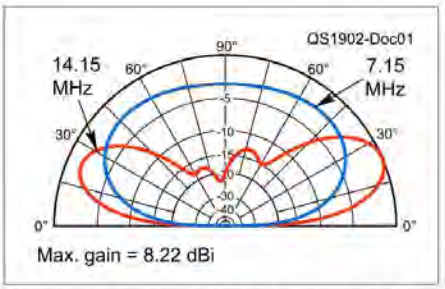

Figure 1 — *EZNEC* elevation pattern of a 40-meter off-center-fed dipole at a height of 40 feet above medium ground (conductivity 0.005 S/m, dielectric constant 13). The blue trace is on 40 meters, and the red is on 20 meters.

Figure 1 shows the *EZNEC* predicted elevation patterns of a 40-meter off-center-fed dipole on 40 and 20 meters at a height of 40 feet without anything else around, except for an *EZNEC* medium ground (conductivity 0.005 S/m, dielectric constant 13).[1] Figure 2 shows the elevation patterns with an ideal seamless gutter positioned as you described it. Figure 3 shows the azimuth patterns in the peak of the elevation patterns. West is to the left in all cases.

[1]Several versions of *EZNEC* antenna modeling software are available from developer Roy Lewallen, W7EL, at **www.eznec.com**.

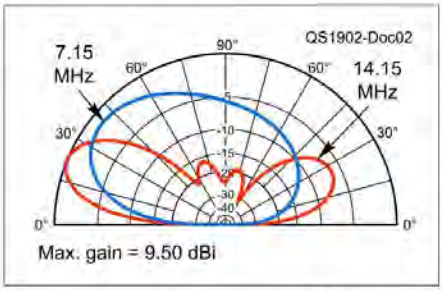

Figure 2 — Elevation pattern of the antenna of Figure 1 with an ideal metal gutter 10% longer than the dipole, 12 feet to the east and 5 feet above the dipole.

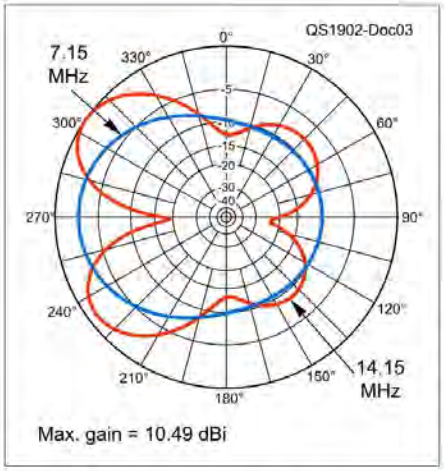

Figure 3 — Azimuth pattern of the antenna of Figure 2. Note that the peak response of the antenna on 20 meters is not perpendicular to the dipole. The elevation patterns on 20 meters (Figures 1 and 2) are at the strongest azimuth peak direction.

So, assuming nothing else is going on, it will indeed work as a Yagi, although it could likely be a bit better if you could shorten the gutter a bit.

Q Tom, W8AAZ, asks: I own a current model HF transceiver with a panoramic spectrum display that I use to spot activity on the bands. It reveals, to my dismay, that many operators have issues with their SSB transmitted signals. I can hear splatter as I always could, but now I can see it, and see that some of these hams appear to be spreading out as far as 10 kHz. Is it the result of old flaky radios, or improperly tuned linears?

Modern HF rigs are not tunable, so I suspect there is little transmitter mistuning going on. Some modern rigs include the capability to select SSB transmit bandwidth, but it is generally still within 4 kHz. The dirty signals often have a center that is within the 2 to 3 kHz normal width, but taper off on both sides over a wider bandwidth, often with irregularities visible. So what is going on with these spectrum hogs?

A In my experience, the majority of *splattery* SSB signals are caused by people who overdrive their transmitters or linear amplifiers.

Clipping results from overdriving and generates spurious signals.

I think much of the problem is that some operators don't understand that the analog meters on their transmitters and amplifiers don't respond to voice peaks during normal speech, but tend to display the average power. A 100 W PEP fully modulated SSB transmitter's power indicator will typically indicate 15 to 20 W average power output, depending on voice characteristics and the compression setting. Some folks figure that they paid for a 100 W transceiver, or 1,500 W amplifier, and aren't satisfied if their meters read any less. The best transmitters include the capability to show PEP output, potentially helping the problem go away. In the absence of such metering, an outboard PEP power meter would likely solve most of this problem.

Looking down a layer, real transmitters are not quite linear either and, as shown in *QST* product reviews, generate third-order (and higher) intermodulation-distortion (IMD) products. Those from low-frequency voice components will tend to stay largely in the channel, but will distort the voice response. Those from higher-frequency components will end up in adjacent channels. These products are typically at least 30 dB down from the original signals, so are usually a problem only from nearby stations, but can still be an issue.

"Some operators don't understand that the analog meters on their transmitters and amplifiers don't respond to voice peaks during normal speech."

Figure 4 — The extension cable made for my Icom speaker/mic. This allows mobile or portable operation using the built-in (or an external) speaker and the mic portion of the speaker mic, kept comfortably separate from the radio.

Your spectrum analyzer can probably see down 60 dB or more, so even weak splatter will be evident, even though it may not be noticeable to a listener on a busy band. This kind of wideband signal is built into most current transmitters, even if properly adjusted and operated. Usually, the worst transmit IMD is from 100 W transceivers running on 13.8 V supplies at full power. Reducing the power by 50% will often make a significant improvement. My 100 W transceiver only needs to put out about 25 W to fully drive my 500 W amplifier, so my spurious responses are actually relatively further down at 500 W than at 100 W PEP.

Q Ken, WO6Z, asks: I would like to use only the microphone portion of my speaker-microphone for my Icom ID-51A handheld transceiver and have a separate external speaker plugged into the transceiver. Any suggestions?

A This can be done, but there are (at least) two configurations that you may encounter:

- My Icom speaker/mic has a double plug, with one side for the mic (3/32-inch) and one for the speaker (1/8-inch). Rather than destroying the connector, I just made up a short extension cable with matching jack and plug for the **MIC** side, and it works fine for home or mobile use, including the mic's PTT. I can still plug both in if I want to use it in the usual way. See Figure 4.
- Some speaker mics may have combined functions onto one plug that requires a bit of detective work to separate the mic function, especially the PTT.

In looking at the ID-51A manual, it looks like your speaker/mic is of the same form as mine, with two plugs. On mine, they are both single-circuit (mono) types and the mic function is on the thinner plug. You can confirm that by plugging a speaker into the 1/8-inch jack. So if you make a simple extension, it should work fine (if it is like mine, which seems to be fairly standard, and even works with another brand of handheld transceiver here). To use a different PTT mic will require a bit more looking on how to hook up the PTT, but is surely possible.

Do you have a question? Ask the Doctor! Send your questions to "The Doctor," ARRL, 225 Main St., Newington, CT 06111, or email 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**.

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Hints & Hacks

Racks to Transport Gear and a Simple Way to Cut Light-Gauge Aluminum Sheet

Portable Racks for Radio Gear

For me, constructing a go-box and other radio projects calls for a lightweight, rigid rack to hold equipment. As I built my latest portable equipment rack, my goals included the ability to operate HF, VHF, and UHF, in addition to voice and HF digital; being able to immediately connect to antennas; 120 V power and battery power (with easy access to plug these in); the ability to remove the rack for operation, and a lightweight but rugged structure.

My solution came in the form of several interesting products, including:

- The Spud 7 Utility Dry Box from MTM Molded Products Company (**www.mtmcase-gard.com**).
- Six cooling racks for cooking, purchased from a department store. They were lightweight, strong, and could be trimmed to size and bent into broad U shapes for shelves.
- Wire cage clips, designed for a rabbit hutch (model ACC1, **www.miller-mfg.com**), allowed for joining wires in parallel to build the rack. Needle-nose pliers work, but you could also use Pet Lodge pliers, designed specifically for these clips.
- Soft wire ties — flexible wire covered in soft rubber — were perfect for organizing radio wires (see Figure 1). They're sold by Miracle-Gro or your local gardening store.
- Industrial-strength Scotch Bundling Wrap (a type of hook-and-loop fastener tape) mounted all components on the rack.

Figure 1 — On the left are the cage clips that attached the shelves to the walls. On the right are the soft wire ties used to organize any loose antenna or radio wires in the go-box. [Jim Halfpenny, K9YNP, photo]

My go-box included a Yaesu FT-857 radio; my Samsung Galaxy Note 3 cell phone; *DroidPSK* software (Wolphi LLC); a WolphiLink Smartphone-to-Ham Radio Interface; wires to connect instruments; an antenna tuner; antenna extension wires (two 9-foot SO-239 male-to-male extension wires — one for HF and one for VHF/UHF); a Bioenno Power 12 V, 12 Ah LFP battery; a Bioenno 14.6 V, 2 A ac-to-dc charger, and a Powerwerx Switching Power Supply.

Construction

To build the rack, I started by measuring the Spud 7 box. I had to shorten the walls of the rack by cutting material from the back. The Spud 7 is larger at the top and smaller at the bottom, so one edge of each wall must be clipped to create a sloping polygon. The clipped edge would be the top. Also, the two walls are mirror images that are reversed. I placed the wall "feet" on the bottom of the cooling rack away from the walls of the Spud 7, as this would facilitate connecting the walls to the shelves later. On the bottom edge, I cut a corner notch to accommodate antenna wires (see Figure 2). Sharp edges were later filed smooth and covered with electrical tape. This way, the HF antenna wire could be directed out under the corner on one side, while the VHF/UHF wire runs out the other side.

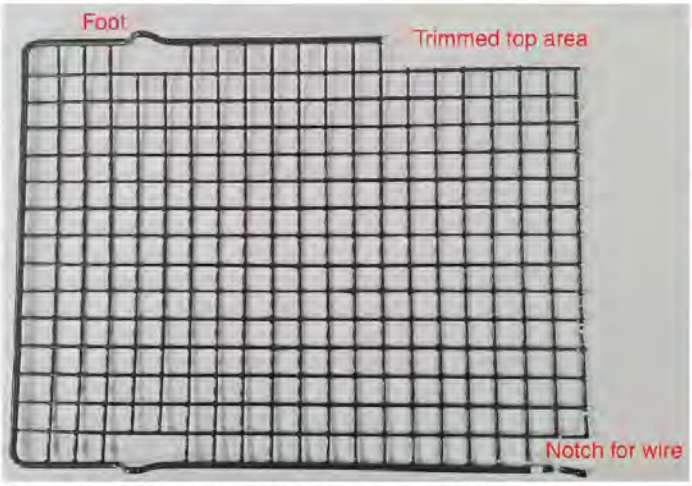

Figure 2 — The modified cooling rack, cut to make room for wires and to fit into the Spud 7 utility box. [Jim Halfpenny, K9YNP, photo]

Figure 4 — All the components in place for operating outside the Spud 7 utility box in which the rack will be stored and transported. There is room to the right and left of the rack to store 9-foot antenna extension cords, and my manual and papers can be stored on top of the rack. [Jim Halfpenny, K9YNP, photo]

The cooling racks were longer than the width of the Spud 7 and had to be bent at both ends for the shelves to fit. The bent ends provided additional support and facilitated binding the shelves to the walls. While each wire could be bent with pliers, there were many wires to bend. If you build this rack, I suggest using a bending break to make all bends at once.

I attached the shelves to the walls using the wire cage clips. For the bottom shelf, I made sure the cooling rack feet pointed up. For the other shelves, the feet pointed down. The top shelf sloped down to the back to match the slope of the Spud 7. The bottom edge of the walls sat flat on the bottom of the Spud 7, while the top shelf edge sloped down.

For the FT-857 shelf spacing, I wanted the bottom space to have 3 inches between shelves, with the middle space being 3½ inches. The remaining space was allocated to the top space. More space was needed in the middle to allow for attaching the FT-857 to the shelf. The rack for the FT-857 was mounted with bolts from the bottom. Because the open rectangles in the cooling rack are large, you may not have washers large enough for bolts. I made square

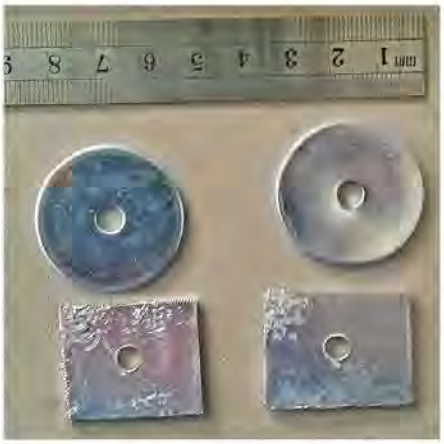

Figure 3 — The open rectangles in the cooling rack are large, so I cut pieces of aluminum to make square washers large enough to cover the holes. Washers could also be constructed out of hard balsam wood as a lightweight option. [Jim Halfpenny, K9YNP, photo]

washers by cutting pieces of aluminum large enough to cover the holes (see Figure 3). Also, for saving weight, the "washer" can be a cut piece of hard balsam wood.

I used the bundling tape to mount the components into the completed rack. From outside the rack, I stuck the bundling tape through the wire shelf and wrapped it around the component, then back to the outside. Then, holding the component against the shelf and holding one end of the tape, I pulled the tape tight across the shelf before sticking it.

Components on the bottom shelf (in the bottom space) had the tape cinched tight on the bottom of the rack, while those in the top space had it cinched on the top of the rack. This allowed plenty of space to work in while placing and securing the components.

Once components were placed in the rack, I used the soft wire ties to secure loose wires in place. I ran antenna extension wires out the back lower corners. Power wires from the battery charger and for Powerwerx could also run out under the lower back corners or the front, as I did for the battery charger (see Figure 4).
— *73, Jim Halfpenny, K9YNP,*
trackdoctor@tracknature.com

Cutting Light-Gauge Aluminum Sheet

Occasionally, my homebrew projects involve cutting light-gauge (16 AG) aluminum sheet for building enclosures or enclosure panels. Because the cost of a metal shear is too expensive for my limited use, I developed a simple and inexpensive cutting fixture using a few pieces of wood, an aluminum angle, and a hacksaw blade. The fixture consists of two parts: a base and a cutting tool (see Figure 5).

Figure 5 — The cutting fixture base (top) and the hacksaw cutting tool (bottom). The arrow on the cutting tool indicates the direction of the cut. [Stan Ekiert, K3KKH, photo]

Figure 6 — The **T** nuts were mounted on the underside of the base plate in 1-inch diameter, 1/4-inch deep counterbore to make them flush with the base plate. [Stan Ekiert, K3KKH, photo]

The base consists of a base plate and two parallel guides that form a ¾-inch-wide channel for the cutting tool. The aluminum sheet to be cut is inserted between the base plate and the guides, then bolted the assembly together using 1½-inch-long ¼-20 screws. I secured the screws to the underside of the base plate with ¼-20, three-prong **T** nuts. On the underside of the base plate, I counterbore holes for the mounting screws to a depth of ¼ inch to mount the **T** nuts flush with the base plate (see Figure 6).

I made the base plate and channel guides from ¾-inch plywood. The base plate was 4½ × 23 × ¾ inches, while the guides were 18 × 1 × ¾ inches. The center-to-center spacing of the screws was 16 inches and could accommodate a 15¾-inch-wide sheet. A ½ × ¾ inch aluminum angle bracket was added to the left channel guide to minimize bowing of the guide when cutting narrow sheets.

The cutting tool consists of a 10-inch, 32 teeth-per-inch (TPI) hardened carbon steel hacksaw blade mounted to a 12¾ × 1½ × ¾ inch pine support. A 32 TPI blade was selected because its small kerf produces a narrow cut approximately 3/32 inches wide. I cut a 5/16 × ⅛ inch deep notch along one side of the support to accommodate the hacksaw blade and the 4-40 mounting screws and nuts. The hacksaw blade teeth extended approximately ⅛ inch beyond the support. I screwed and glued two handles fashioned from scrap wood to each end of the support, so the cutting tool could be pushed in a forward and backward motion within the channel to generate a cut.

I used the cutting tool to cut a 1/16-inch-wide slot in the top side of the base plate when the fixture was assembled. The slot can be used to align a scribe line (the cut line) on the aluminum sheet to the slot. If the piece to be used is to the right of the slot, then the scribe line should be aligned with the right side of the slot; otherwise, it should be aligned to the left side.

After the sheet was aligned and bolted to the fixture, I **C**-clamped the entire assembly to a bench top and began to cut. Because the cutting occurs on a horizontal surface, debris accumulates along the cut site and needs to be manually cleared every 10 to 12 cutting cycles (more frequently for long cuts). I used an old toothbrush to remove the debris.

I have also used this fixture to cut circuit boards. When cutting circuit boards and brushing away debris, take care to minimize any airborne dust and wear a surgical-type face mask. — *73, Stan Ekiert, K3KKH,* **roadspyder@msn.com**

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QST QuickStats
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Steve Ford, WB8IMY, wb8imy@arrl.org

Eclectic Technology

The "Loon" Project

Providing wireless internet access in rural areas has always been problematic. One solution is satellite internet, which has seen some penetration in the US market and elsewhere. But satellites are extremely expensive to deploy and costly to maintain.

The idea of providing a "lower" alternative to satellite technology with high-altitude balloons isn't new. Technology companies have been exploring this for at least the last 10 years. If you float a balloon 20 kilometers above the Earth and dangle a wireless access point beneath it, you can provide about 80 kilometers of ground coverage using a high-speed LTE connection.

Of course, the balloon needs a wireless backhaul connection to the nearest high-speed internet access point on the ground. If you try to expand the coverage area with more balloons, you'll need to set up "ground stations" — with the attendant costs — for each floating platform.

Or would you?

Loon, the former Google X project and now independent Alphabet Inc. company, has developed a system that creates greater ground coverage than previously possible, and accomplishes it with far fewer ground stations. Many amateurs will recognize the Loon solution to the backhaul problem (and I suspect some readers are already well ahead of me): *mesh networking*.

Rather than single Loon balloons communicating with individual ground stations, multiple balloons can overlap coverage areas and act as relays via a mesh system. In a mesh network, each balloon functions as a network node, relaying data at high speeds from one balloon to another as needed. Should one balloon go offline, the mesh network automatically compensates by reconfiguring the relay paths. Because all balloons share data, only one ground station is necessary to serve the entire network.

A Loon balloon being prepared for deployment. At an altitude of 20 kilometers, the balloons carry wireless networking gear that can provide high-speed internet access over wide areas.

The Clever Flexibility of Mesh

Hams were among the early adopters of mesh networking technology. Today we have groups such as AREDN (the Amateur Radio Emergency Data Network; **www.arednmesh.org**) using mesh networking to provide high-speed wireless communication for public service applications.

The flexibility of a mesh network makes it ideal for public service. Even in the worst disasters, there will still be a point outside the affected area where internet access is available. With a mesh network, amateurs can quickly deploy wireless nodes from the point of access all the way into the disaster area.

For example, nodes equipped with high-gain antennas and bidirectional RF amplifiers can establish the backhaul link to the access point, and then connect to a distributed mesh network within the disaster area. Within hours, the public service volunteers and their served agencies will have wireless internet access, all without the expense of a satellite link. Again, should one mesh node go offline, the rest will automatically compensate.

We may soon see the day when hams go into disaster areas not with handheld transceivers and portable repeaters, but instead with collections of mesh nodes, push-up masts, and antennas.

Amateur Radio from Antarctica

Reinhard E. Flick, PhD, K6REF, and Peter D. Bromirski, PhD

When Peter Bromirski asked me to spend 5 weeks in Antarctica to help install seismometers while camping on the Ross Ice Shelf, I immediately replied, "Can I bring my ham radio?"

He'd asked a year before the October 2014 departure, giving my 66-year-old brain time to overcome my concerns about the polar conditions and my camping inexperience. Despite my doubt and anxiety, I was excited about the rare opportunity to assist on an Antarctica research expedition and to operate from McMurdo Station, KC4USV, and Yesterday Camp on the Ross Ice Shelf (RIS) as KC4/K6REF, which would check off my seventh continent. I was pleased that ham radio could provide public outreach for the National Science Foundation (NSF) Polar Programs-sponsored research project (**https://scripps.ucsd.edu/centers/iceshelfvibes**).

A ham is asked to be part of a scientific expedition to the bottom of the world.

A typical seismic station during installation with the battery and data logger box, the "lampshade" solar panel array, and the connecting cables. [Reinhard Flick, K6REF, photo]

Science in Brief

The Ross and Ronne-Filchner Ice Shelves in West Antarctica — each almost the size of Texas — are the two largest floating ice masses in the world (see Figure 1). They are 600 – 2,000 feet thick and slow the discharge of the 2-mile-thick West Antarctic ice sheet flowing downhill toward the Pacific and Atlantic oceans like frozen rivers. Because ice shelves float, their mass has already made its contribution to sea level rise. However, they are a crucial impediment to the flow of land-bound ice that does raise sea level. If all West Antarctica ice wound up in the ocean, global sea level would rise 11 – 16 feet. This makes the evolution of ice shelves a focus of oceanographic and polar research.

Several smaller shelves along the Antarctic Peninsula (see Figure 1) have already partly or wholly disintegrated. The Larsen C Iceberg made news in 2017, when a 70-mile-long fracture led to calving of a Delaware-sized iceberg. Meanwhile, the more southern RIS is relatively healthy and stable, making this a good time to make baseline measurements.

Our mission was to install 34 high-data-rate broadband seismometer stations over the 500-mile-wide RIS (see lead photo and Figure 2). The central portion was log-periodic.[1]

These measurements provide the first comprehensive data on spatial, mechanical, and elastic response of ice shelves to wave forcing, crucial to understanding ice-shelf evolution and fragmentation processes. We reached station locations on snowmobiles with sled trailers for distances less than 15 miles and Twin Otter aircraft for longer hauls.

Logistics

The US Antarctic Program outfitting occurs in Christchurch, New Zealand, where the most important business is obtaining personal "extreme cold weather" (ECW) gear. This includes overalls, hats, gloves, socks, boots, goggles, balaclavas, and the ubiquitous Canada Goose "Big Red" jacket. There is also training, especially for first-timers on the ice, including the requirement to wear your ECW gear on the ice flight from Christchurch to McMurdo.

[1]Seismologists use log-periodic arrays for noise reduction and beam forming, which are the same reasons they are popular in acoustics and radio.

Figure 1 — Map of Antarctica. Gray shading delineates floating ice shelves. [Graphic courtesy of Wikimedia]

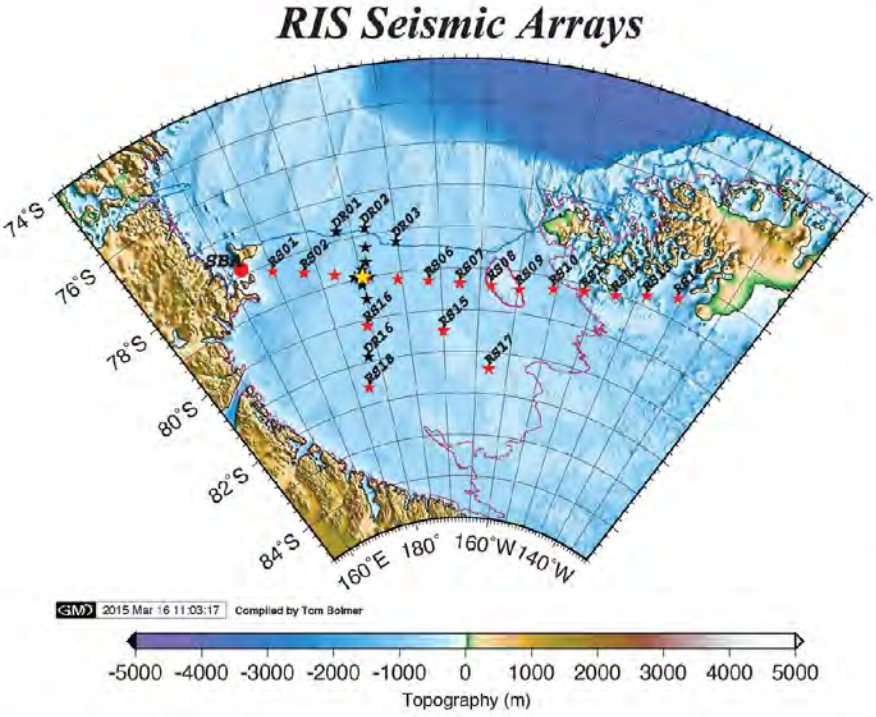

Figure 2 — An array of 34 seismometer stations (red stars) across the Ross Ice Shelf, with McMurdo Station on Ross Island ("SBA," left). Yesterday Camp is at the array center (gold star). The blue line indicates the approximate ice shelf edge, with the grounding line in red. [Tom Bolmer, graphic]

McMurdo sits on a narrow peninsula at the southern tip of Ross Island by the western edge of the RIS, just over 800 miles from the South Pole (see Figure 1). The fact that it's on an island is generally not obvious, being surrounded by permanent ice shelf and seasonal sea ice until February or March, when large ships dock to resupply. Camping and safety gear are issued at McMurdo, where days are spent acclimating to cold, preparing equipment, training in preventing and recognizing frostbite, and learning about snowmobile operation and precision recycling.

KC4USV McMurdo Operations

The McMurdo ham shack is a small, red-and-white-checkered shipping container, probably salvaged from a nearby airfield, but now situated in a large service yard. Like most structures in Antarctica, it has a vestibule forming the double-door entrance. The inside entry is a conventional freezer door mounted backwards keeping cold out, not in. Ross Island is designated IOTA AN-011, grid square RB32, with shack coordinates 77.855° S, 166.678° E.

The cozy shack has good heat, a telephone, internet connection, and a spectacular view of the Transantarctic Mountains. The main rig is a 150 W Kenwood TS-480. I also made contacts with my 100 W Yaesu FT-847. I operated without an amplifier through a Hy-Gain TH-7DX beam. Unfortunately, the Yagi was bolted in place, oriented east-west, after the rotor was damaged by extreme winds in a previous winter.

McMurdo Communications Operations (MAC-OPS) controls all communications, including Amateur Radio, which uses call sign KC4USV. MAC-OPS houses high-skill, dedicated professionals, several of whom are also hams. Jakob Conner, AK4NP, held the shack keys during the 2014 – 2015 season.

I operated KC4USV from November 5 – 13, 2014, logging 427 contacts. Of these, 401 were unique, including 330 from 42 US states and St. Croix. The other 71 were from 21 countries, including seven Canadian provinces, and counting Asiatic and European Russia as two countries. Contacts were from every continent, except Africa, and included Mike Fokin operating RI1ANT from the Russian Mirny Base, which was 1,600 miles away on the Indian Ocean side of Antarctica. Other highlights involved three QRP contacts: AE9F in California and WA2TP in Massachusetts, both transmitting 5 W, and W8FHF from Ohio, who was transmitting 1 W. Also notable was the contact with Lilly and Tom Service, KG4SNA, operating maritime mobile on their 44-foot sailing vessel *Tiger Lilly* near Tonga. All QSLs for McMurdo were efficiently handled by Larry Skilton, K1IED (SK).

Amateur Radio operations have occurred since the first days the US Navy opened McMurdo base, KC4USV, in February 1956. Hams provided crucial communication links, especially phone patches to the US for decades before reliable satellite links were available. Unfortunately, ham operations at McMurdo apparently stopped for a time after Christmas 2014, but *DX News* reported that it was back on the air in October 2017, with W2EMT, AF7DJ, and WY7AA operating, and as of December 2017, the station is on ARRL's Logbook of The World (LOTW).

KC4/K6REF Yesterday Camp Operations

On November 15, 2014, we departed McMurdo's Willy Field skiway (planes have skis, not tires, in Antarctica) in an LC-130 and arrived at Yesterday Camp (78° 57.35 S, 179° 53.19 W) in the middle of the RIS, which is a huge, flat, and cold stretch of ice. The site is about 1.5 miles from the International Dateline, so a moderate walk takes you into "yesterday." Actually, to avoid confusion, all of Antarctica maintains New Zealand time by international convention.

Figure 3 — Yesterday Camp's science tent and ham shack, with a 20-meter dipole strung between three poles in the background. [Reinhard Flick, K6REF, photo]

We slept at Yesterday Camp in cozy mountain tents and "50-below" sleeping bags for 19 days. Nights were spent watching the sun — which never set — travel in an ellipse above the horizon. We had several larger tents for working, cooking, and eating. These were warmed with propane stoves to about 40 °F — the temperature inside a normal refrigerator. The outside temperature was –13 °F when we arrived, gradually warming to a balmy 14 °F as we left on December 4, 2014.

I operated from the science tent (see Figure 3) at Yesterday Camp as KC4/K6REF from November 18 – 30, and from my mountain tent on December 3, 2014, making about 150 contacts in 27 countries and 23 US states. My Yaesu FT-847 was on the ice with a simple wire dipole mounted on three 8-foot bamboo flag poles. The operation was powered with a 12 V golf cart battery and a small battery charger hooked to a Honda generator. Unfortunately, it produced so much RF interference that reception was not possible while it was running. Operating from my mountain tent was less than ideal because it was too low for me to sit up.

Conditions at camp were often frustrating because propagation was commonly one-way. Still, there were pileups, especially from European stations eager to log a once-only Antarctica ice shelf contact.

We packed up and departed Yesterday Camp in a great flurry of snow, spent 2 nights in McMurdo (in actual beds), then flew back to Christchurch to drop off gear. We headed home on December 7, 2014, and arrived 23 hours later the same day, after crossing the dateline once more.

Acknowledgments

Many thanks to Bill Erhardt, K7MT; Bob Hines, K4MZU; Bob Matusiak, KK4KT; Roy Gallagher, KR6RG, and to the hams who spotted KC4/K6REF. Special recognition for Joe Garza, AB6RM (SK), for years of encouragement, cheer, and goodwill.

Reinhard E. Flick, PhD, K6REF, is an oceanographer for the California Department of Parks and Recreation, Division of Boating and Waterways, and he is a Research Associate for the Scripps Institution of Oceanography/UCSD.

Peter D. Bromirski, PhD, is a Research Oceanographer for the Scripps Institution of Oceanography/UCSD, with an expertise in oceanography, seismology, and sea level variability.

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A New Mentor Makes a New Ham

Ed Gibbs, KW4GF

Throughout my 27 years as a ham, I have never mentored a beginner operator, but I support my local Amateur Radio community as Vice President of the Virginia Beach Amateur Radio Club (W4UG) and as a member on the Board of Directors of the K4AMG Memorial Amateur Radio Club. I was surprised and delighted when Duane Ettwein, KJ4YKG, the President of K4AMG, called me to mentor a middle schooler who wanted to become a ham.

Twelve-year-old Tyler Kazelesky became interested in Amateur Radio after reading articles online about its critical role in communication during the 2017 hurricane season. As a scientifically minded person, he was fascinated by the idea of talking to people all over the world and was eager to learn more.

Teaching Tyler

A work colleague introduced Tyler's mother, Jamie, to the K4AMG Memorial Amateur Radio Club to help him get started (see the sidebar, "The K4AMG Memorial Amateur Radio Club"). Mentoring Tyler was the first extensive project I have done with the club, but because Tyler and I both live in the same town, I was the best man for the job.

I first met Tyler in September 2017, and with the support of his parents, we began working toward his Technician license. My previous experience in elementary education helped me identify Tyler's individual learning style and connect the teaching to his experiences. As an educator, I think it is important for hams to remember that children may not understand a lot of the radio information immediately, so it must be presented in short bits that can be easily ex-plained and brought to their age level. Using the book *Pass Your Amateur Radio Technician Class Test* by Craig Buck, we began working weekly in 1½-hour sessions, combining book work with operating. He liked the quizzes I developed from the book, which mimicked the testing he was used to doing at school.

When a local teen takes an interest in Amateur Radio, a longtime ham shoulders the responsibility of mentorship for the first time.

Tyler, KN4JRC, holding his new dual-band handheld with his mentor, Ed, KW4GF. [Ed Gibbs, KW4GF, photo]

I found that operating was key in keeping Tyler's interest. There were always hams on our 2-meter or 440 MHz repeaters here in Virginia Beach, so I was able to teach Tyler proper operating techniques and etiquette, and he joined the rotation on W4GBH's Youth Net.

With his parents' permission, I took Tyler on a few field trips to visit expert hams in the area. Ed Williams, KN4KL, helped him learn about digital modes and IRLP using his 146.49 node, and Joe Ostrowski, KI5FJ, worked with him to build a Morse code oscillator.

Tyler said the hardest part was getting a grasp on the Amateur Radio information and vocabulary at the same time. Coming from an entirely non-ham family, it was rather new to him, although his interest in science helped him to pick it up quickly. In February 2018, he passed his Technician-class licensing exam. Since then, K4AMG has presented Tyler with a dual-band VHF/UHF handheld, a VHF loaner, and a 2-meter J pole.

Tyler, KN4JRC, showing off his Morse code oscillator, built with help from Joe, KI5FJ. [Ed Gibbs, KW4GF, photo]

The K4AMG Memorial Amateur Radio Club

The K4AMG Memorial Amateur Radio Club was founded by Richard Siff, W4BUE, in 2007 and functions as a training ground to promote science, technology, engineering, and math disciplines to young people in the South Hampton Roads community of Virginia. The club uses funds obtained through selling donated equipment, or cash donations.

To get local youth successfully involved, the club provides support at every step of the licensing process, including supplying study materials to prepare for exams and connecting the student with a mentor in their area. They also encourage continued engagement through their sponsored Amateur Radio club at Great Bridge High School, W4GBH, in Chesapeake, Virginia.

The sign over the door to the Great Bridge High School classroom where W4GBH meets. [Duane Ettwein, KJ4YKG, photo]

K4AMG President Duane Ettwein, KJ4YKG, believes that becoming involved with the local high school was the best way to find teens interested in radio and give them an avenue to pursue it. He said, "In our fast-paced, instant gratification world of today, reaching and holding a youth's attention to develop a hobby as complex as Amateur Radio is difficult at best. Recruitment is better when the students find other students to join in, peer to peer."

To begin, Duane advised that "coordination is better built from the bottom up." K4AMG first had to identify a teacher at the school who could see the advantage of using Amateur Radio to support the subject they are teaching, and who is willing to get licensed. It is then easier to get school officials on board when a leader is already provided to support the implementation.

K4AMG has equipped the high school club with an HF/VHF/UHF radio station and they conduct FCC license test sessions during the school year. After a student passes the exam, K4AMG reimburses them for the cost and provides them with their first radio, which is usually a handheld UHF/VHF transceiver. When a student goes on to their General-class license, the club assists with the setup of an HF station, from loaning or selling them used equipment at a lower cost to providing help to build it. They also support a "Youth Net" on the K4AMG 145.15 MHz repeater, where W4GBH's members gain experience by rotating the net control operator position and working together on radio-related trivia questions.

On the Way to General

After speaking with hams on air and looking them up on **qrz.com**, Tyler began meeting with other amateurs his age in his area. Together, they enjoy operating and learning together, including this year's ARRL Field Day. A local news station covering the Field Day activity even interviewed Tyler to find out how he and his friends became involved.

Tyler has gone on to work on his General license with his peers at K4AMG, among other technical pursuits. He also enjoys learning how to build and restore older computers, like a Commodore 64 model from the 1980s that he took apart and installed refurbished parts into — now, he uses it to play video games. As he gets older, Tyler would like to work in communication technology with the military. When it comes to other hams his age, he says anyone can become licensed if they stick with it and keep practicing.

Passing it On

Training young people to be hams is the responsibility of each Amateur Radio community. With young people, it takes constant presence, interest, and dialog. After this experience, I went on to successfully train another teen this summer. I have found that my purpose as a mentor is introducing the concepts to guide the student to their Technician's license, and then allowing them to learn among their peers at K4AMG for license upgrades.

Our community is doing a wonderful job, and I have been grateful for their presence as we have brought ham radio to Tyler, KN4JRC, one of our newest young Amateur Radio operators in South Hampton Roads.

Tyler at the mic on Field Day, as featured on WAVY-TV by reporter Kara Dixon. [Kara Dixon, photo]

Ed Gibbs, KW4GF, was licensed in 1990 as KC4UFN. Ed holds an Amateur Extra-class license, is Vice President of the Virginia Beach Amateur Radio Club (W4UG), the QSL Manager for the USS Wisconsin Radio Club (N4WIS), and a member of the K4AMG Memorial Radio Club Board of Directors. Ed is a retired 40-year public school educator and served as a teacher and administrator with the Virginia Beach City Public Schools. Ed can be reached at **malignswine@gmail.com**.

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Radio on the Rails

Steve Ford, WB8IMY

The United States is crisscrossed with ribbons of steel, upon which move millions of tons of freight and millions of people every year. Most of us recognize the big cargo movers, such as CSX and Norfolk Southern, and passenger haulers, such as Amtrak and the commuter railroads. But there are many other trains riding the "high iron," including so-called *short line* and *Class II* railroads, most of which you've never heard of.

One of the many things these railroad carriers have in common is that they all employ radio for a substantial portion of their communication needs. Many amateurs would be surprised to know that much of this communication takes place on analog FM at frequencies they can easily receive on their handheld or mobile transceivers.

Almost all VHF and UHF amateur transceivers have extended receive capability. The receive ranges can vary, but even basic models can usually receive up to 175 MHz, which includes most railroad communication networks.

Listen to railroad communications with a radio you may already own.

Much of the communication you'll be monitoring will be *simplex*, meaning that it is a direct, point-to-point exchange. This being the case, it helps to have an elevated antenna so that you can receive over a wide area. Still, even a handheld with a "rubber duck" antenna will work, if you are reasonably close to the rail lines.

Eavesdropping on Amtrak

If you're fortunate enough to live near an Amtrak line, you'll pick up conversations as the trains fly through. If you live in a busy Amtrak corridor, such as the west coast or the Northeast Corridor, you can count on hearing a substantial amount of radio traffic, especially during the daytime and early evening.

Above — If you live near an Amtrak line, listen for activity between about 160 and 162 MHz. [National Public Radio photo]

While signals may be strong, comprehending the communication can present a challenge. Personnel tend to bark into their radios to overcome background noise, and of course, they are barking in their own jargon-filled dialect. For instance, you might hear someone say that a rail car is a "bad order," which means it has a mechanical defect. Or you may hear that a train is going to "take the hole," which isn't as bad as it sounds. It simply means that when two trains are approaching each other head on, one train will "hold the main" (stay on the main line), while the other train will "take the hole" by going onto a siding.

Listen for Amtrak activity between 160 and 162 MHz. On these frequencies, you'll hear conversations between onboard personnel, as well as communication among MoW — Maintenance of Way — crews. Amtrak also has its own police force, and you are likely to hear their chatter as well.

If you are lucky enough to own a transceiver that will continuously scan between two frequencies and store its discoveries in memory, this is an ideal tool for determining the active Amtrak channels in your area. If not, check **www.trainweb.org/dispatchoffice/amtrak.htm** for a comprehensive list of Amtrak frequencies.

Railroad Mobile

Rather than being a passive listener near a rail line, consider taking a handheld transceiver on your next Amtrak trip. You can eavesdrop on your train crew and potentially pick up some interesting information. A couple of years ago, I brought a handheld along for an Amtrak journey between New York City and Washington, DC. I happened to notice that our train seemed to be going significantly slower than it should have been between Philadelphia and Baltimore, but with a little listening, I soon learned that our speed had been deliberately restricted. Apparently, there was concern about the adverse effects the sweltering summer heat might have on the rails.

"Noooo Defects"

While listening at a railroad frequency, you may hear a transmission with a synthesized voice saying, "Detector, milepost seventy. Total axles: forty. Temperature: five three degrees. No defects." The synthesized voice almost always stretches the pronunciation of the word "no," for whatever reason. Soon after the transmission ends, you may also hear the voice of an engineer quickly acknowledging with something like, "CSX 475. No defects."

A typical defect detector installation.

What you heard was an automated *defect detector* announcing its results after a train had just passed its location. The detectors look for overheated roller bearings, or hot wheels caused by sticking brakes. A sticking brake or bearing failure generates an extraordinary amount of friction and heat. The heat is enough to cause the destruction of a wheel assembly, a catastrophic fire, or both. In addition, many detectors monitor for what is called "dragging equipment." As you might guess, dragging equipment on a train is a bad thing, especially if what is dragging is a wheel that has come off the rail.

Until cabooses were phased out in the 1980s, crews occupied these cars at the ends of trains and watched for the telltale signs of a disaster in the making. Today, cabooses are found only in railroad museums and their crews have been replaced by defect detectors.

You'll hear defect detector transmissions on "road" frequencies — the frequencies trains use when they are running outside a station area or rail yard. If you are hoping to catch a glimpse of a train, a transmission from a defect detector provides an excellent warning that a train is near.

Can you make amateur contacts from an Amtrak train? You bet! You may be inside the moving equivalent of a Faraday cage, but if you are seated at the window, you'll be surprised at how well you can communicate. I've routinely made contacts through repeaters and have received good signal reports. It helps to keep the conversations brief, because it won't be long before the train carries you out of range.

If you want to operate "railroad mobile," I have two important pieces of advice:

- Bring headphones or earbuds. Don't inflict the sound of your radio on the people around you.
- When talking, keep your voice as low as possible. Few things are more obnoxious than the sound of someone yammering into a cell phone — or a handheld Amateur Radio transceiver.

For the ultimate Amateur Radio railroading experience, I highly recommend booking a roomette on a long-haul Amtrak train. Working VHF or UHF is much easier in the privacy of your own room. I've heard that it is also possible to tape a tiny HF loop antenna to the roomette window and enjoy making contacts with a low-power transceiver, although I've never tried this.

Listening to the Freight Roads

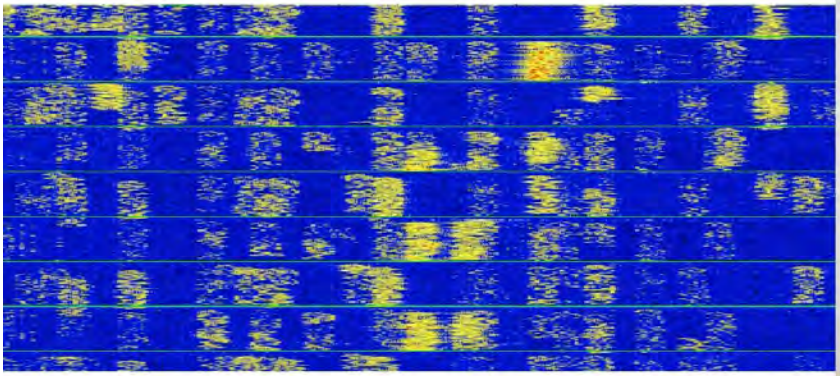
You stand a good chance of hearing communication among the freight railroads in almost every area of the country. Transmissions from trains are often between engineers and dispatchers. In addition, the big freight railroads are constantly checking and repairing their tracks, so you may hear more transmissions from the Maintenance of Way personnel than train crews.

You'll find most freight communication between 160 and 169 MHz, although don't neglect UHF between about 452 and 472 MHz. The memory scanning and storage technique I mentioned earlier is very helpful here, if your radio offers this feature. You may also want to look at the granddaddy of all railroad frequency databases at **www.trainweb.org/dispatchoffice/roads.htm**, which lists everything from the major railroads to small tourist trains.

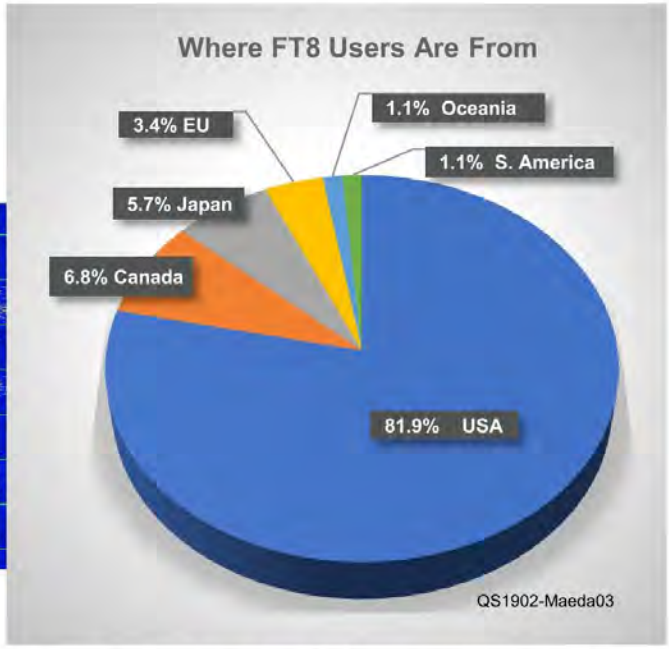
Steve Ford, WB8IMY, is the Editor of *QST*. You can contact him at **sford@arrl.org**.

Providence & Wooster is a Class II railroad operating in Connecticut, Massachusetts, and Rhode Island. Freight carriers offer plenty of opportunities for monitoring crew communications. [Steve Ford, WB8IMY, photo]

Who's Using FT8?



An informal look at the demographics of FT8 operators.

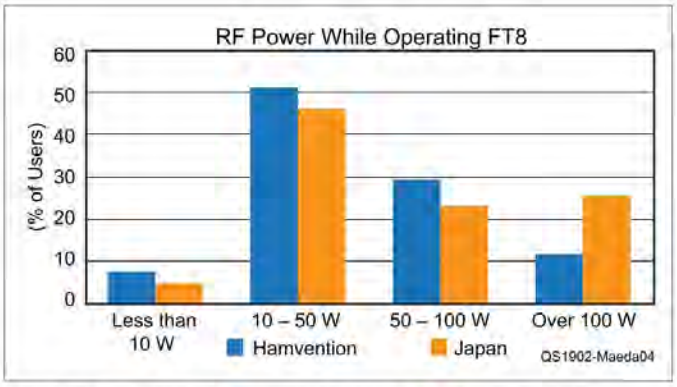


The geographical distribution of FT8 users, as supported by the results of the Hamvention 2018 questionnaire.

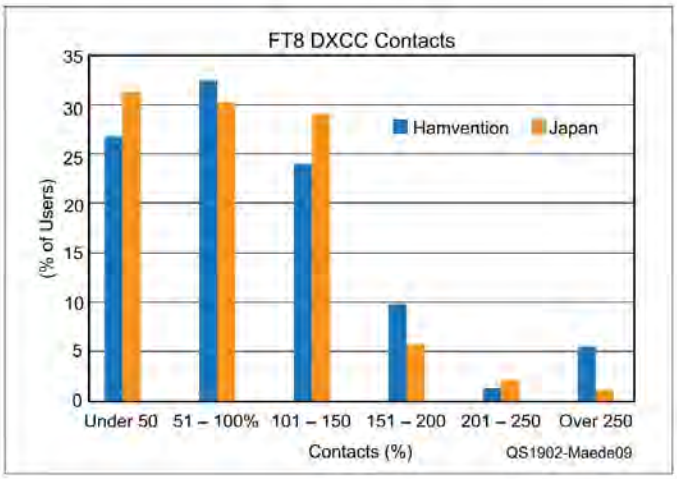
Masaaki Maeda, W2/JR1AQN

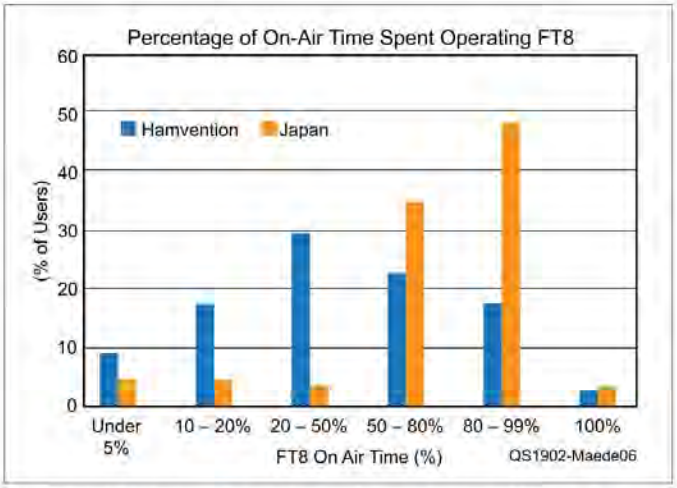
At the 2017 and 2018 Hamvention, we conducted an informal study to better understand the demographics of FT8 operators in Japan and the US. At Hamvention in 2017, we showcased JT65, and in 2018, we presented a real-time FT8 contact. Both demonstrations were met with great enthusiasm, with over 500 attendees to our booth over the course of each event. The purpose of the exhibition was to expose FT8 to those unfamiliar with the mode, and we surveyed current FT8 users with an informal, prepared questionnaire. For comparison, we gathered data from Japanese users with Facebook and a JT65 mailing list. We ended up with 80 US participants, and 100 Japanese participants.

Representatives of the Japan Amateur Radio League, who conducted the informal FT8 study. Left to right: Katsumi Yamamoto, JA1CJP; Nao Mashita, JA1HGY, and Masa Maeda, JR1AQN. [Steve Ford, WB8IMY, photo]

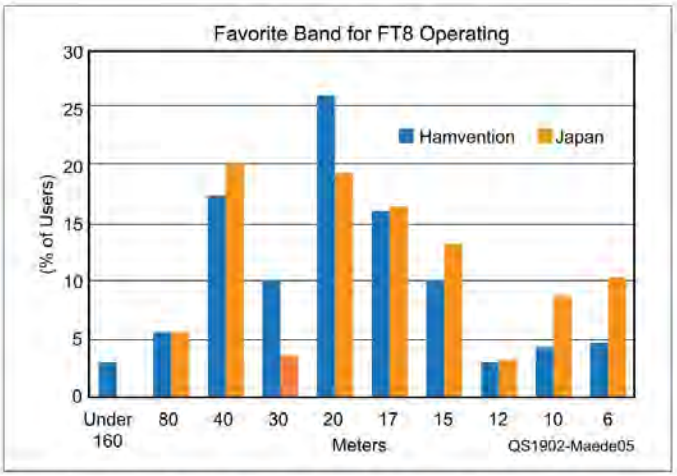


The study revealed an unexpected result in that the number of high-power stations beyond 100 W is rather high in Japan, where interference from neighboring high-power stations causes a serious problem. While FT8 stations are still on the rise, consensus about appropriate RF power is required.



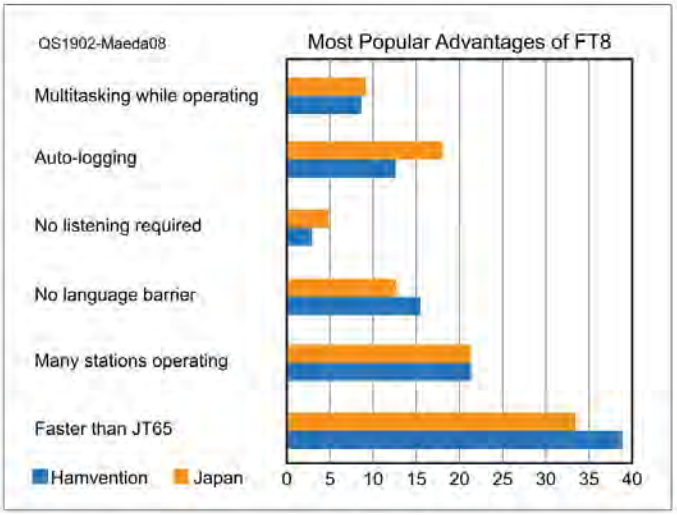


Overall, FT8 takes up the majority of on-air time. At Hamvention, I noticed that many attendees did not think of FT8 as a special mode. By contrast, in Japan, FT8 has a devoted following that almost exclusively uses FT8.

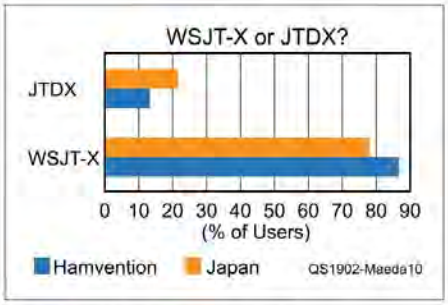


The distribution of users' favorite FT8 operating bands revealed another relatively significant contrast, especially in the gap between US and Japanese use of 30 meters. The fact that there are many high bands overall may be an influence of the housing situation in Japan (low bands require a large antenna). The unpopularity of less than 160-meter bands in Japan, and the popularity of the 6-meter band may also reflect this. (30 and 20 meters are only allowed for Class 1 and 2 license holders in Japan.)

Although it is a new mode that has only been around for 1 year, everyone is actively enjoying contacting DX stations with FT8. Besides the fact that some lucky users are experiencing over 200 contacts with DXCC entities, FT8 is also making it possible for hams who were previously inhibited by location to communicate with foreign countries.



The overwhelming response was that the biggest advantage of FT8 is that it is faster than JT65. Interestingly, in 2017, most users said they didn't use JT65 — even though it had many benefits — because it was too slow, but many hams were drawn to FT8 because of the reduction in the time it takes to make a contact. Another interesting result is that most users in both Japan and the United States agree that FT8 eliminates many issues caused by language barriers, thus leading to a better, more mistake-free experience for both sides.



The ratio of the two main software packages used for FT8 are nearly the same in Japan and the United States.

Conclusion

After examining the results of the questionnaires, I learned a lot about the experiences of FT8 users and how the attitudes and operations compare between the US and Japan. In comparison to last year, there was more enthusiasm about FT8, and it was no longer seen as a minor mode. With this major popularity increase, questions such as appropriate RF output must be discussed, and I hope to contribute to the continued development of FT8.

Masa Maeda, JR1AQN, has been licensed since 1969. With an MBA from MIT Sloan School of Management, he's spent 15 years working as a Senior Vice President and President & CEO for NTT DOCOMO USA, Inc., a subsidiary of Japan's largest mobile operator. He is interested in HF digital modes, such as RTTY, PSK31, JT65, and FT8. He is a core member of **JT65-DX.com**, a club dedicated to the weak-signal mode in Japan. Masa is an active article writer for *CQ Ham Radio*, a magazine in Japan, and he reports on US ham activities. You can reach Masa at **maeda@sloan.mit.edu**.

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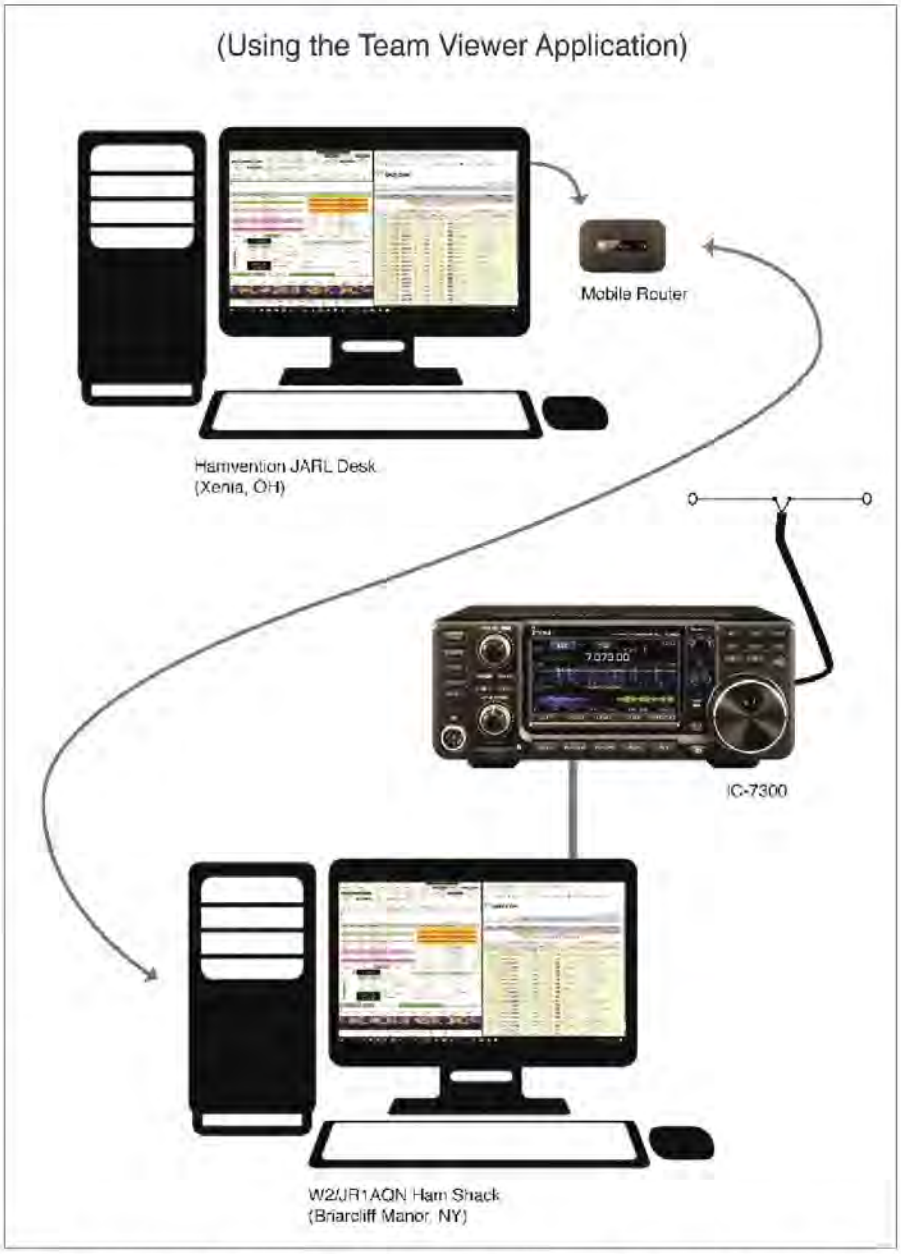

The FT8 system configuration for the Hamvention 2018 exhibition, during which the FT8 contact was transmitted directly from the venue, but remotely operated with a transceiver at a shack in New York.

Feedback

In "Hints and Hacks" in the December 2018 issue of *QST*, Paul Dobosz, K8PD, described a circuit to allow the use of dynamic microphones with transceivers that require electret microphones. The schematic diagram in Figure 3 omits a resistor that needs to be included in series with the collector of the transistor (Q1), prior to the junction of R1 and C2. Adding a 1.2 or 1.8 kΩ resistor in series replicates the power supply impedance that the preamp was designed for. In addition, the captions of Figures 2 and 3 make reference to "phantom power." The correct terminology is "plug-in power."

SPRINTS

The Indy 500 of Radiosport

Jim George, N3BB

A look at this fast-paced contest format, from the perspective of the popular North American CW Sprint.

For several hundred operators, the North American CW Sprint is the most important event on their radio calendar. Held twice a year, in February and September, "The Sprint," as it's known, is perhaps the pinnacle of old-fashioned contesting ability, because the rules require a full exchange of information, along with the unique requirement to continuously jump around from frequency to frequency.

Low Power winner Randy, K0EU, attributes his Sprint success to the weekly NCCC NS practice sessions on Thursday nights. [Randy Martin, K0EU, photo]

Most contests use the time-tested strategy of calling CQ on one frequency and "running" stations as they call you on "your" spot. In the Sprint, you are allowed to make only one contact as the "owner" of a particular frequency. You can take ownership of a frequency either by calling CQ from a clear frequency, or by calling another station on "their" frequency — after that contact, the resident ham must leave the frequency, and it becomes "yours" for one more contact. The process of 1) calling someone and making that contact exchange, and 2) having someone immediately call you, is called a "twofer" or a "couplet." After that, you must leave the frequency and either find someone else who's calling CQ, or locate a clear frequency and call a CQ yourself.

This "dance of the Sprinters" is exciting, fast-paced, and often maddening. Participants are required to change frequency (QSY) a certain distance away from the frequency they were just on. The ability to tune quickly and find a station you haven't already contacted (stations can be worked only once per band) requires quick wits and keen ears. Often, multiple stations answer a CQ at the same time. This is called a "jump ball," and, of course, only one station makes it through. This can be frustrating, or part of the fun, depending on your attitude.

This event (along with a sister contest: the RTTY Sprint), is sponsored by *National Contest Journal*, with support from ARRL. For the CW running, great support is provided by the Boring Amateur Radio Club of the Portland, Oregon area. Larry Tyree, N6TR, provides significant log-checking and data analyses as well.

Basic Sprint Rules

The North American CW Sprint covers 20, 40, and 80 meters. Stations can be worked once on each of those three bands. With propagation being what it is for an evening contest, most participants start on 20 meters, drop to 40 meters when 20 closes, and end on 80 meters for at least the final hour of the event. Although anyone, anywhere, can be worked for credit, multipliers are

defined as the 50 states (DC counts for MD and Hawaii counts as a multiplier, even though it's in Oceania), and all the Canadian Provinces and Territories (NFL, LAB, PEI, YUK, NWT, NUVA, etc.), as well as all other NA DXCC entities. A multiplier counts only once, regardless of how many bands it is contacted on. The Sprint's duration is short (but spirited), lasting 4 hours.

The Sprint's Exchange

The event's exchange is: call sign, name, QSO number, and state/province. Because stations are coming and going on a frequency, the order in which the call signs are given is important.

The rule is that the call sign of the station leaving the frequency is sent first in the exchange, and the call of the station retaining the frequency for one more contact is sent last. That helps people tuning across a contact in progress to know which station is a new potential contact. Here's an example in which Norm, W3IZ, is parked on a frequency, calling CQ in the Sprint:

CQ NA W3IZ (Norm calls CQ "NA," for "North America," indicating that he is looking for responses that qualify for the Sprint)

N3BB (I respond to W3IZ's CQ)

N3BB W3IZ Norm #125 CT (Note that Norm sends his call as the first element of the exchange, not the last, because he will be leaving the frequency after the contact)

W3IZ JIM #132 TX N3BB (Note that I send my call at the end of the exchange, so listeners know that I will remain on frequency and be available for a contact)

TU (W3IZ acknowledges my exchange information by sending "TU" or "R")

If W3IZ had needed a fill, he'd send a short string of dits, at which point, I'd repeat my exchange. Operators who might be waiting to call me should wait long enough to ensure that W3IZ's acknowledgment can be heard. At that point, I will listen for a possible caller (for a couplet), or if no one calls, I'd call CQ on the frequency.

Sprint Tips and Strategies

Operators with low-power (QRP) stations, as well as those with small antennas, will do much better on the tail-end portions on each band. The louder stations will already have worked one another, so their CQs might not be getting many answers. They'll be glad to hear additional callers.

Often, it's easier to find a clear spot and call CQ yourself. This allows you to set the pace for the CW speed you're comfortable with. You will do better out at the upper and lower fringes of the main activity (which is 15 kHz wide most of the time), because you are more in the clear.

You'll definitely need software for the Sprint. Programs such as *WriteLog*, *N3FJP*, *TR4W*, and *N1MM* all have Sprint formats, and of course, the venerable *TR LOG* does as well for DOS dinosaurs (of which I am one).

One of the best ways to involve your club and/or your friends is to put together a team of five or fewer

Marko, N5ZO, cracked the Top Ten from San Diego, California, using a pair of Elecraft K3s. Marko operates SO2R (Single Operator, Two Radio) with one audio stream in each ear — a common technique among top operators that helps keep the rate (and interest) up throughout the contest. [Marko Myllymaki, N5ZO, photo]

Barb Schuyler, N9NM, operating at her station in Fredericksburg, Texas during the Sprint. [Barb Schuyler, N9NM, photo]

Mark, K6UFO/NN7SS, operates remote through the internet and **remotehamradio.com**, despite his remote station being 4 feet to his left. Mark's station is one of the RHR network stations when he's not using it, but he no longer reconfigures it for local use. [Mark Aaker, K6UFO, photo]

North American CW Sprint Resources

Official Rules can be found at **ncjweb.com/Sprint-Rules.pdf**.

A Summary and Beginners Guide can be found at **www.contesting.com/articles/198**.

participants. Become a Sprint team captain for your group, or get on the air from a rare state and watch the excitement grow.

Truth and Training

At this point, I must confide that sprints are high-level stuff. There are world-class operators from stations sporting big antennas and high power, along with CW speeds as high as 35 – 38 WPM. This can be intimidating. But this event has a basic truism: the big guys need your contact more than you need their contact. If you are solid at 20 WPM, and send "QRS" when you need someone to slow down for you, you can make plenty of contacts.

Some hardy souls have jumped into the two biggest Sprints with no preparation other than a solid 20 WPM CW ability and a willingness to give it a go. One excellent example is my mentee, Barb, N9NM, who had never operated in a single contest. After responding to a call for Sprint teams from the CTDXCC, Barb got into it, and with an average 100 contacts per Sprint, she always has fun.

You can also train for the big Sprints by participating in mini Sprints that run for 30 minutes every week. These are sponsored by the Northern California Contest Club, and they run Thursday nights at local time. These have very similar rules, with slight variance on multipliers, and are a great way to practice. Check them out at **www.ncccsprint.com/rules.html**.

Jim George, N3BB, has been licensed since 1958. He graduated with a BSEE from Virginia Tech and an MSEE from Arizona State University. He worked in the semiconductor industry, specializing technically in semiconductor materials and MOS device design, holding many managerial positions throughout his career. An avid CW operator, Jim competed in the WRTC 2000 in Slovenia, and refereed at WRTC 2002 in Finland. For more information, see his website, **www.authorjkgeorge.com**.

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AREDN Mesh Tunnel via Satellite at Baker 2 Vegas 2018

Setting up the communications system at this large annual event.

Oliver Dully, K6OLI

From March 17 to 19, 2018, Dave Gross, W6JDG; Brian Kanegawa, KM6IGY; Tran Huynh, K6NHI, and Oliver Dully, K6OLI, helped support the Baker 2 Vegas Relay Race (**bakervegas.net**). The relay race takes place every spring, starting in Baker, California, and ending in Las Vegas, Nevada. Covering 120 miles, and with 8,000 runners, there needs to be a lot of communications support. Our ARES LAX Northeast District Mesh group was stationed at Stage 8 of the race (located 6 miles east of Shoshone, California), which happens to be a great location for emergency communications testing, because there are no cell phone towers, water, or electricity nearby. Radio operators have to be completely self-sufficient.

Amateur Radio Emergency Data Network (AREDN) mesh connections are mainly used with MeshChat, Voice over Internet Protocol (VoIP), Winlink, shared data storage, and cameras. These mesh connections are line-of-sight, thus presenting a geographical challenge because Stage 8 is obscured from Mile Out by steep hills (see Figure 1).

We successfully created and tested a local area mesh network (see Figure 2), using four full mesh go-kits, which included AirRouters HP with 9 dBi TP Link antennas, 2.4 GHz and 5.8 GHz

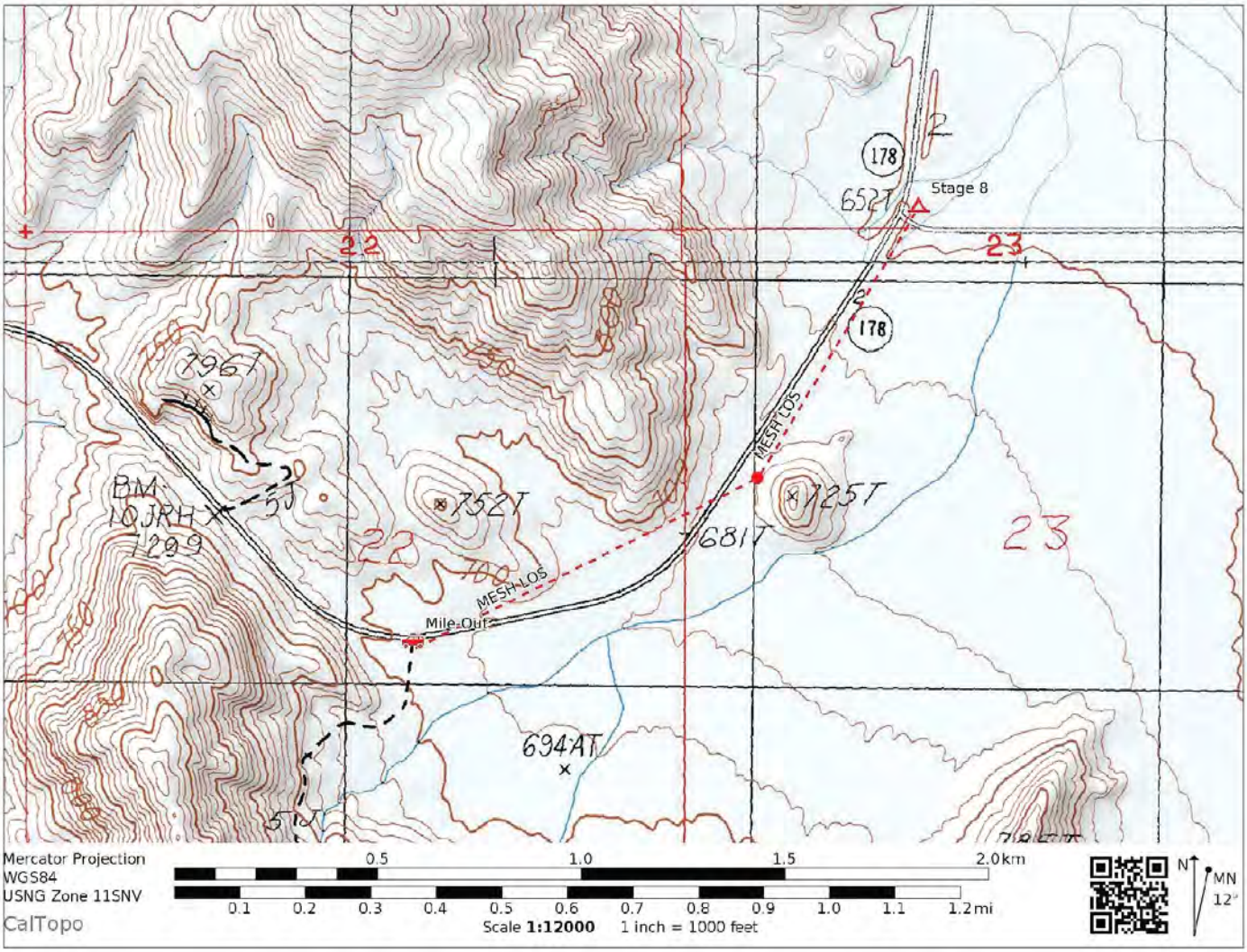


Figure 1 — A map to show the topography around Stage 8 and Mile Out.

Figure 2 — An example of an AREDN mesh go-kit, which was employed at Stage 8.

NanoStations Loco and NanoBeams, a GL.iNet travel router (to bridge between the AREDN mesh and a Mac computer), VoIP phones, IP cameras, and laptops. The kits were powered by Bioenno LiFePO4 batteries, solar controllers, and solar panels.

A Stellar Opportunity

This year, Curtis Mentz and his Verizon Crisis Response Team deployed Cell On Wheels (COW) trailers at Stages 8 and 9. COWs are mobile communications units that provide localized cell phone coverage, as well as wireless and wired network access, all via a satellite connection to a commercial geosynchronous satellite. Connection speed can reach up to 20 Mbps.

We used the internet connection through the COW to test a wireless bridge connection. We configured Tran's, K6NHI, travel router as a bridge, meaning it received the Wi-Fi signal from Verizon and passed it on through the LAN port of the travel router to the WAN port of an AirRouter HP (see Figure 2 for a more detailed view of the connections). From there, all the connected local AREDN mesh nodes could connect and share the internet connection.

Around noon, we turned off our local mesh and just kept the AirRouter HP and its attached computers running. We then switched from Wi-Fi to a wired ethernet connection, which linked one of the Verizon router LAN ports to the WAN port of the AirRouter HP.

Ease of Use

Amazingly, the setup was not difficult. For the wireless connection, we only had to connect to the SSID and enter the password in the appropriate settings of the travel router, then connect the AREDN node to the LAN port.

For the wired connection, Curtis simply identified an unused LAN port on the router, located in the COW, and we connected that with an ethernet cable to the WAN port of the AREDN node, in this case the AirRouter HP.

In both cases, the external router DHCP assigned an IP address to the connected AREDN mesh node.

Tunnel

AREDN is cleverly designed as a local area network, which allows Amateur Radio operators to create an ad-hoc Emergency Data Network with a myriad of resources. At our isolated location, a direct connection to the Southern California AREDN mesh had been beyond reach, but the COW allowed for the opportunity to set up a tunnel for the AREDN mesh nodes to connect to one another via the internet, as if they were connected via RF.

With our AirRouter HP as the tunnel client, we connected our local Stage 8 AREDN mesh to a tunnel host node in Pasadena. From there, we connected to the entire Southern California Amateur Radio Emergency Data Network mesh with all its resources: Winlink Gateways, VoIP phones, file servers, and more. We then had Dave, W6JDG, and Gary Wong, W6GSW, who is the ARES LAX Northeast District Coordinator, test the connection, and they both confirmed the high quality of the link (see Figure 3).

Game Changer

The combination of AREDN mesh and COW set a positive precedent for the future of disaster communications and the Amateur Radio Emergency Data Network. Within the ARES LAX Northeast District group, we have expanded our AREDN mesh capabilities over the last year. Our goal is for all interested operators in our District to provide AREDN mesh capability in addition to VHF/UHF and HF voice and data services when deployed, especially to hospitals, which could instantly share a connection to the outside world via satellite with just one COW at any mesh-connected hospital. Moreover, the hospitals would have instant high-speed access to many Amateur Radio services, such as Winlink, VoIP, or file sharing.

Training Implications

After seeing the results from our AREDN mesh experiments in the desert, we have begun further development of AREDN mesh nodes by training Amateur Radio operators on the effective use of nodes and standard operating procedures for

Figure 3 — Dave Gross, W6JDG, demonstrating the tunnel connection. On the left side of the computer screen, the SoCal AREDN mesh nodes are clearly visible.

AREDN mesh use, and we continue to develop our capabilities.

Winlink has also grown exponentially in importance, providing Amateur Radio operators the ability to send and receive emails across bands using multiple modes, both via gateway and peer-to-peer connections. Moreover, when Winlink is paired with *Linphone* (an open-source VoIP software) on a laptop on mesh, it becomes an all-in-one solution for high-speed voice and data on the Amateur Radio Emergency Data Network.

Force Multiplier

A public/private cooperation between Amateur Radio and COW operators extends capabilities and increases Amateur Radio operators' crucial role as force multipliers in any disaster. Mesh nodes are quick and easy to deploy, offer higher data rates, use very little power, and offer more room for interoperability. With only a few COWs, AREDN mesh clusters can connect via satellite and potentially overcome topographical challenges like mountain ranges, valleys, flood zones, and more.

Amateur Radio operators could also work more productively with any similar satellite connection provided by any company, governmental organization (e.g. FEMA), non-governmental agency (e.g. SATERN), or even the military. It also demonstrates that Amateur Radio is a modern service that can focus on the needs of served agencies and its served communities.

The Amateur Radio Emergency Data Network is an important part of our already impressive capabilities in VHF/UHF and HF, and it will provide valuable and meaningful service to our communities when their need for Amateur Radio operators is greatest.

Oliver Dully, K6OLI, is an ARRL member and the Training and Education Coordinator for the ARES LAX Northeast District. An Amateur Extra, licensed since 2016, he is especially interested in digital modes. With his ham friends, Oliver regularly conducts workshops on Ham Basics, NBEMS, Winlink, AREDN mesh, and emergency communications in the Los Angeles area. Oliver enjoys interacting with hams from around the world and helping new hams find their way. Oliver can be reached at **k6oli@arrl.net**.

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

Rick Lindquist, WW1ME, ww1me@arrl.org

Happenings

Robust Member Voting Results in ARRL Division Leadership Changes

Central Division Director Kermit Carlson, W9XA.

Hudson Division Director Ria Jairam, N2RJ.

New England Division Director Fred Hopengarten, K1VR.

Northwestern Division Director Mike Ritz, W7VO.

Roanoke Division Director Bud Hippisley, W2RU.

ARRL members in four Divisions elected new representation on the ARRL Board of Directors last fall, in advance of the Board's annual meeting on January 18. After votes were tallied on November 16 at ARRL Headquarters, incumbent Directors in the ARRL Hudson, New England, and Roanoke Divisions lost their re-election bids to challengers. In addition, a new Director and Vice Director filled vacant seats in the Northwestern Division. A total of 22,257 votes were cast in seven contests within five ARRL Divisions.

In the Central Division, incumbent Kermit Carlson, W9XA, edged out challenger Valerie Hotzfeld, NV9L, 1,898 to 1,755. Carlson, of Batavia, Illinois, has been Central Division Director since 2016. Incumbent Vice Director Carl Luetzelschwab, K9LA, faced no opposition for re-election.

In the Hudson Division, incumbent Director Mike Lisenco, N2YBB, lost his bid for a new term to challenger Ria Jairam, N2RJ, of Sussex, New Jersey, 1,292 to 1,239. "I am very excited to have a front row seat to shape the future of our beloved pastime," Jairam stated on her **QRZ.com** profile. Lisenco had served as Hudson Division Director since 2013 and was most visible as a prime proponent of the Amateur Radio Parity Act and as ad hoc Legislative Advocacy Committee chair. Vice Director Bill Hudzik, W2UDT, was unopposed for a new term.

In the New England Division, challenger Fred Hopengarten, K1VR, of Lincoln, Massachusetts, edged out veteran incumbent Director Tom Frenaye, K1KI. Frenaye first served as Director from 1985 until 1992, when he was elected as an ARRL Vice President, an office he held until January 1996. Later that year, he was again elected as Director, taking office in 1997.

Hopengarten, an attorney, is the author of the book *Antenna Zoning for the Radio Amateur*, now in its 2nd edition. An ARRL Volunteer Counsel, Hopengarten said in his campaign that ARRL should work to attract more new members and retain more Technician licensees. Incumbent Vice Director Mike Raisbeck, K1TWF, also an attorney, faced no opposition.

In the Northwestern Division, incumbent Jim Pace, K7CEX, opted not to seek a new term after serving since 2014, opening the door to a three-way race for the seat. With 1,589 votes, Mike Ritz, W7VO, of Scappoose, Oregon, topped the field, outpolling Vice Director Bonnie Altus, AB7ZQ, who garnered 1,308, and Horace Hamby, N7DRW, who had 495 votes.

"I am grateful beyond measure, and will work diligently for all of you," Ritz said in a message to the Division's membership. He also thanked Pace and Altus for their "leadership and dedication."

Succeeding Altus as Northwestern Division Vice Director was Mark Tharp, KB7HDX, who topped a field of three candidates with 1,368 votes, to 1,228 for Daniel Stevens, KL7WM, and 767 for Delvin Bunton, NS7U. Before, Tharp served as Eastern Washington SM for 15 years. Jack Tiley, AD7FO, of Spokane Valley, Washington, was appointed to serve out Tharp's unexpired Section Manager term.

In the Roanoke Division, George "Bud" Hippisley, W2RU, of Penhook, Virginia, defeated incumbent Director Dr. Jim Boehner, N2ZZ, 1,891 to 1,365 votes. Boehner had been Roanoke Division Director since 2015. Hippisley served as ARRL Atlantic Division Vice Director from 1982 until 1985, and more recently as the Eastern Area Chair for the ARRL National Traffic System (NTS™). The co-author of *Practical Antenna Handbook*, Hippisley is a 2010 recipient of the ARRL George Hart Distinguished Service Award.

Incumbent Roanoke Division Vice Director Bill Morine, N2COP, fended off a challenge from John Humphrey, W4IM, 1,742 to 1,505 votes.

All successful candidates began 3-year terms at noon on January 1, 2019.

Appointment Made in Rocky Mountain Division

ARRL President Rick Roderick, K5UR, named Robert Wareham, N0ESQ, of Highlands Ranch, Colorado, as Rocky Mountain Division Vice Director. Wareham will serve the remaining term of Jeff Ryan, K0RM, who assumed the position of Rocky Mountain Director upon the resignation of Dwayne Allen, WY7FD. An ARRL Life Member, Wareham served as Colorado Section Emergency Coordinator since 2011 and previously was Colorado State Government Liaison and Public Information Officer. He will serve the remainder of the Vice Director's term, which runs through 2019.

California Fires Spur Amateur Radio Emergency Service Activations

Amateur Radio volunteers were active or on standby on several fronts this past fall, as wildfires raged in large sections of California. In Northern California's Butte County, the deadly and destructive Camp Fire triggered a call up of Amateur Radio Emergency Service (ARES®) members for communication support. A small wildfire that started on November 8 in a mountainous area grew quickly due to high winds. Eventually, more than 25,000 people were evacuated. As multiple shelters opened to assist evacuees, five Sacramento Valley ARES groups were called out to support communication between the Red Cross Disaster Operations Center (DOC) and the shelters.

The uncontrolled wildfire eventually consumed the town of Paradise, a town of some 27,000 residents. The Camp Fire consumed more than 150,000 acres, destroyed nearly 14,000 residences, and resulted in nearly 90 deaths.

Utilizing mutual assistance, more than 20 ARES members from five ARES groups supported the shelters. ARES members were also tasked by Red Cross to shadow Red Cross delivery vehicles to provide communication in the mountain areas to the shelters.

ARES communication at the shelters has been carried out using voice, *Winlink*, and email to pass shelter counts and tactical messages between the shelter, the Red Cross Disaster Operations Center, and the California Office of Emergency Services. The Red Cross supported ARES at the shelters with hot spots and backup radios.

The Woolsey Fire that swept through the westernmost portion of Los Angeles County, including Malibu, and the easternmost area of Ventura County in the ARRL Santa Barbara Section, required the evacuation of some 295,000 residents — an unprecedented number in recent decades. Evacuees included several celebrities, many of whom lost homes in the fire.

Sacramento Valley ARES volunteer Neil Bossard, N6CNY, was among those active in Northern California. [Photo courtesy of Greg Kruckewitt, KG6SJT]

"[G]overnmental radio systems used by fire and sheriff held up well, even though cell phone and internet service went out in many fire areas because of burned utility poles," said Los Angeles Section Manager Diana Feinberg, AI6DF. "Evacuees went to areas where cell phone service was generally available."

Feinberg said Los Angeles ARES (ARES LAX) was not activated because no county hospitals were in the affected area, and no hospital outside the fire zone was in danger of losing communication. She added, though, that a sizable team of ARES LAX operators organized by LAX-Northwest District Emergency Coordinator Roozy Moabery, W1EH, did extensive logistics work over the November 10 – 11 weekend at a major drop-off site in the San Fernando Valley for evacuee

The Woolsey Fire caused a massive evacuation. [Brenden Moses, photo]

supplies. ARES team members worked with other volunteers to accept nearly 10 tons of pet food, plus thousands of boxes of items such as soap, toothpaste, toothbrushes, shampoo and other personal care products, as well as baby food, formula, diapers, towels and bedding, snacks, and non-perishable food items, Feinberg said.

On the air for the Woolsey Fire, both the Los Angeles County Disaster Communications Service (DCS) — Amateur Radio volunteers overseen by the Sheriff's Department — and the City of Los Angeles Fire Department (LAFD) Auxiliary Communication Service (ACS) operated nets and monitored their respective frequencies. "The City of Los Angeles' ACS group was involved when the city's West Hills neighborhood in the San Fernando Valley became the fire's northeastern front, forcing about half of the West Hills community to evacuate," Feinberg said. Santa Barbara Section Manager John Kitchens, NS6X, told ARRL that Ventura County ACS (ARES) supported evacuation centers and the Red Cross in the Santa Barbara Section.

Feinberg said ACS members also delivered food and water to LAFD firefighters and performed fire patrols. American Red Cross volunteers used Amateur Radio in connection with some of their fire response activities, Feinberg reported. The Woolsey Fire covered nearly 100,000 acres, destroyed more than 1,600 structures, and left five people dead. — *Thanks to Sacramento Valley Section Emergency Coordinator Greg Kruckewitt, KG6SJT, and Los Angeles Section Manager Diana Feinberg, AI6DF*

Section Manager Nomination Notice

To all ARRL members in Maryland/DC, Nevada, New Hampshire, Northern New Jersey, Rhode Island, San Joaquin Valley, Utah, and West Texas: 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 ARRL 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 8, 2019. If more than one member is nominated in a single Section, ballots will be mailed from Headquarters no later than April 1, 2019, to full members of record as of March 8, 2019, which is the closing date for nominations. Returns will be counted May 21, 2019. Section Managers elected as a result of the above procedure will take office July 1, 2019.

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, 2019. If no petitions are received from a Section by the specified closing date, such Section will be resolicited in the July 2019 issue of *QST*. A Section Manager elected through the re-solicitation 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*

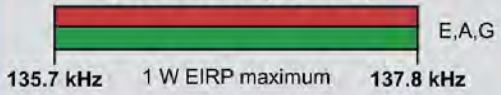
US Amateur Radio Bands

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®

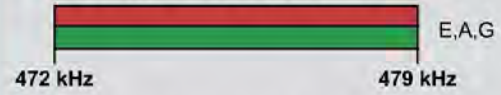
Amateurs wishing to operate on either 2,200 or 630 meters must first register with the Utilities Technology Council online at **https://utc.org/plc-database-amateur-notification-process/**. You need only register once for each band.

2,200 Meters (135 kHz)



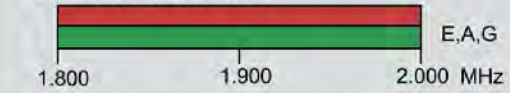
630 Meters (472 kHz)

5 W EIRP maximum, except in Alaska within 496 miles of Russia where the power limit is 1 W EIRP.

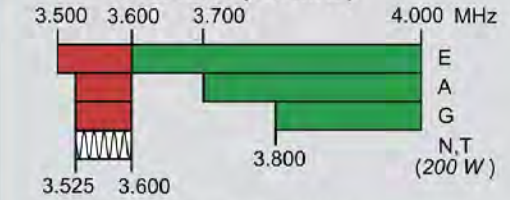


160 Meters (1.8 MHz)

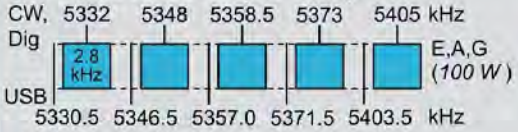
Avoid interference to radiolocation operations from 1.900 to 2.000 MHz



80 Meters (3.5 MHz)

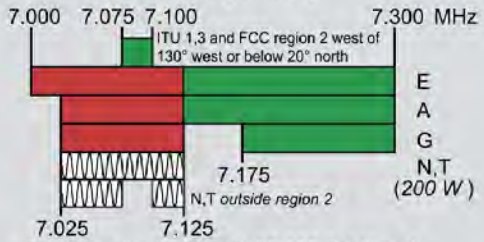


60 Meters (5.3 MHz)



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.

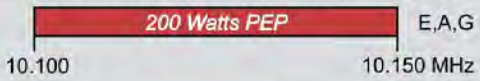
40 Meters (7 MHz)



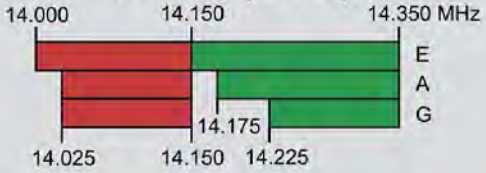
See Sections 97.305(c), 97.307(f)(11) and 97.301(e).These exemptions do not apply to stations in the continental US.

30 Meters (10.1 MHz)

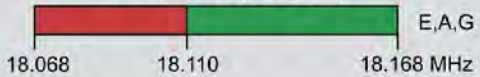
Avoid interference to fixed services outside the US.



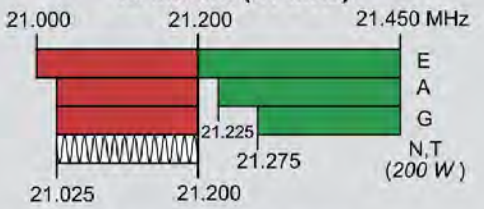
20 Meters (14 MHz)



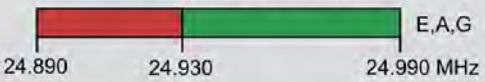
17 Meters (18 MHz)



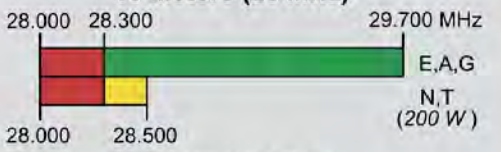
15 Meters (21 MHz)



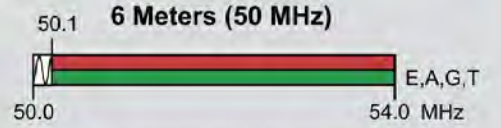
12 Meters (24 MHz)



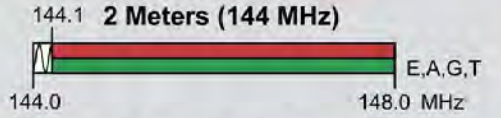
10 Meters (28 MHz)



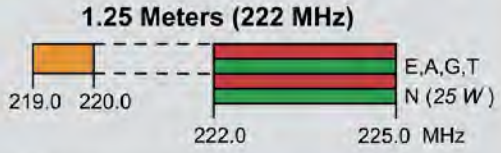
6 Meters (50 MHz)



2 Meters (144 MHz)

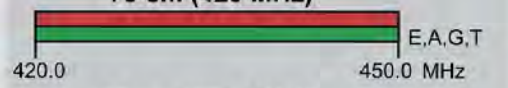


1.25 Meters (222 MHz)

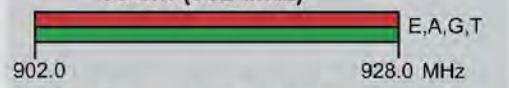


*Geographical and power restrictions may apply to all bands above 420 MHz. See *The ARRL Operating Manual* for information about your area.

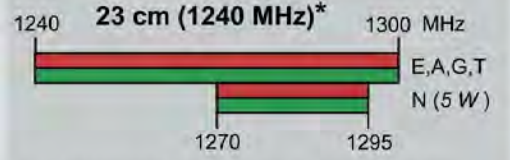
70 cm (420 MHz)*



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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Rick Palm, K1CE, k1ce@arrl.org

Public Service

Profiles in Public Service:

Rob Macedo, KD1CY

Rob Macedo, KD1CY, presented with the Blue Hill Observatory Outstanding Service Award.

The prestigious Blue Hill Observatory and Science Center outside of Boston recently conferred its Outstanding Service Award upon Eastern Massachusetts ARES®/SKYWARN Coordinator and ARRL Section Emergency Coordinator Rob Macedo, KD1CY, one of the leading lights for the Amateur Radio/National Weather Service relationship. I interviewed Macedo for this month's column.

Q What's your background in Amateur Radio, and how did your passion in meteorology, severe weather, storm tracking, SKYWARN, and so on develop?

A It began when I was 8 years old, living in Saratoga Springs, New York, where I was born and raised. My dad gave me a 2-meter radio, and I listened to the Western Massachusetts Severe Emergency Weather Net, which was essentially a SKYWARN net during severe weather. I also listened to the daily Capital District Weather Net.

Listening to these nets, I learned of weather information that wasn't available by other means. This was in the 1980s, before the internet was accessible. When I earned my Amateur Radio license in 1988, when I was 15 years old, I enjoyed running SKYWARN nets for the Saratoga County RACES [Radio Amateur Civil Emergency Service] Club. My net control skills were honed by a mentor, John Farina, W2QCY. My uncle, Louis Macedo, W1WAY, told me about how he assisted during hurricanes that affected the southern coast of Massachusetts in the 1950s and early 1960s, also fueling my interest.

Q How did the southern New England SKYWARN program, amateur station WX1BOX, and the National Weather Service relationship develop?

A The program started when the NWS Forecast Office was located at Boston's Logan Airport. Amateurs including Jeff Arnold, K1EMS (formerly N1FWV); Terry Stader, KA8SCP, and Mike Naselroad, N1EVH, would go to that office during severe weather and support the NWS staff's operations. When the office moved to Taunton (outside of Boston) in 1993, the coverage area became much larger, as smaller NWS offices in Connecticut, Rhode Island, and western Massachusetts were consolidated there. Bob Mims, WA1OEZ, started amateur operations there, and in 1996, I took over.

We were able to stitch together all the SKYWARN groups across the coverage area to report and funnel information into our NWS Forecast Office. In severe weather incidents, we use more than a dozen repeaters, depending on how much of the coverage area is affected; we use EchoLink and IRLP in our operations as well.

We have close to 8,000 SKYWARN spotters in our coverage area, with one-third of them being Amateur Radio operators. We also have over a dozen coordinators and several additional net control stations that call up nets as required during severe weather. The relationship between the trained volunteers and paid professionals has evolved into a strong one, and it is a shining example of the manifestation of the *Memorandum of Understanding* between ARRL and the National Weather Service. It is one of the most strategic relationships in the Eastern Massachusetts section and has evolved into one that serves not only the National Weather Service but Emergency Management and local and regional media outlets as well.

Q How did the VoIP Weather Net come about, and what relationship do you have with the National Hurricane Center and the WX4NHC operators?

> *"It's not very often you meet someone with a passion for weather and emergency service. You don't have to be around Rob very long to know that he has answered his calling."*
> — *Hurricane Watch Net Manager Bobby Graves, KB5HAV*

Macedo operates the station at the Town of Acushnet EOC during a recent winter storm.

A The VoIP Weather Net was founded by Kevin Anderson, KD5WX, and Danny Musten, KD4RAA. At one time, Kevin ran the net on EchoLink, with Danny running a net on IRLP. As technology became available through the efforts of Tony Langdon, VK3JED, and others, it allowed for the two technologies to be combined into one net in 2004. That year, I joined the net as a net control station, and with the historic spate of hurricanes in Florida and the long duration of those activations, it became apparent that the need for scheduling net controls was required. I was assigned that responsibility.

After the 2005 hurricane season, Kevin and Danny asked me to become the director of operations for the VoIP Hurricane Net. Over the years, we developed relationships with Julio Ripoll, WD4R; John McHugh, K4AG, and the team at WX4NHC — the amateur station at the National Hurricane Center in Miami. Those have evolved into personal friendships. WX4NHC is one of the most special teams we have in the amateur public service arena, with 38 years at the NHC. They do amazing work in saving lives, providing communications when no other communications are available, and providing important ground truth weather reports that can change forecasts and aid the warning process. Our net supports their critical mission, and their faith in our net motivates us to continue our support.

Q Do you have any special stories on hurricane responses you would like to share?

A There have been many over the years, but I will share two recent ones. The first is from September 2017 during Hurricane Maria and her impacts in Dominica and Puerto Rico. I recall an amateur operator on St. Lucia relaying reports from hams on Dominica who were sustaining significant personal property losses as Maria ripped through the island, yet they reported out to the world what was happening. They were some of the only reports received on the devastated island. As Maria slammed Puerto Rico, one of our longtime net participants, Francisco Diaz-Gonzalez, NP3OD, was impacted with the loss of his antennas, trees down, and minor structural damage. Yet, he gave us those reports live on our net.

This past season, I recall a water rescue that we helped facilitate based on an amateur operator in Texas in contact with a friend in the affected area of Hurricane Florence. We were able to let first responders know about that rescue and learned she was on a long list. Our call was important, as it told them the person in question still needed a rescue. It's a direct case where a life was saved from our efforts.

Q Do you see any trends in the Amateur Radio/severe weather forecasting and reporting interface, such as the use of more digital modes, cooperation with other services, reporting protocols, etc.?

A One of the things that we, as Amateur Radio operators, can facilitate is crowd-sourcing and centralizing reports. Our ability to monitor other communications services and modes puts us in a unique position to support this mission for served agencies. Severe weather is one of the primary cases, but it could be applied in other types of disasters as well.

Cellular-based instant message and VoIP applications can be useful tools, but often, there is a lack of the discipline we have as Amateur Radio operators. We could help in these areas by using those means to reach out to non-amateurs to gather more information and help with communications discipline. These efforts may also allow us to recruit new amateurs. We are also working toward other ways to centralize weather information that we hope to release over the course of 2019, and which might be of benefit nationally to further Amateur Radio's unique relationship with the National Weather Service. As far as adding new modes, we are looking at DMR [digital mobile radio] and other digital modes for greater communications flexibility and utility.

"[Rob] has been an incredible asset to WX4NHC since 2004. [He] is a skilled operator and organizer and has always gone beyond the call of duty to help others, on and off the air." — *National Hurricane Center WX4NHC station Assistant Coordinator Julio Ripoll, WD4R*

George J. Misic, KE8RN, ke8rn@comcast.net

Classic Radio

The Hammarlund SSB Transmitters

The Hammarlund HX-50 and HX-500 were the manufacturer's single-sideband (SSB) transmitter products. The HX-500 came first, debuting in 1960, and the lower-cost HX-50 was produced in 1962. The biggest limitation on Hammarlund's transmitter offerings was their inability to transceive with a Hammarlund receiver. The suggested companion receiver from Hammarlund was the HQ-170.

Hammarlund did not adopt the crystal-controlled front-end concept on their receivers until the solid-state HQ-215 in 1968. The HX-500 and HX-50 used the fixed VFO range and crystal-controlled heterodyne oscillator to reach the ham bands, but the HQ-170 did not use these concepts. The Hammarlund HX-50 and HX-50A had a back-panel input so an external receiver could control the operating frequency of the transmitter, but Hammarlund never made a receiver that could work with the HX-50 and HX-50A, and the earlier HX-500 did not have any provisions for transceiving.

Figure 1 — The Hammarlund HX-500. [Barbara Misic, KB3MPF, photo]

The HX-500 Transmitter

The HX-500 was a self-contained triple-conversion transmitter with a built-in AC power supply that provided LSB, USB, AM, double sideband (DSB), CW, FM, and FSK emissions on the 80/75-, 40-, 20-, 15-, and 10-meter bands (see Figure 1). It ran about 200 W PEP input on SSB, 180 W on CW, and about 70 W of carrier input power on AM. The signals including modulation were first created at 60 kHz by a stable, free-running oscillator with a reactance modulator for FM and FSK modes. It was followed by a solid-state balanced modulator made from two 1N634 signal diodes. This balanced modulator essentially eliminated the carrier, but both sidebands appeared in the output. The output of the modulator went through a sharp filter made from inductors and capacitors (except for CW, AM, FSK, and FM modes, which bypassed the filter). The filter characteristics could be shifted to remove either the upper or lower sideband to produce a single-sideband signal. The filter was followed by an amplifier stage operating at 60 kHz and using a 6EW6 pentode tube.

For the modes that bypassed the filter (or after the filter and amplifier stage), the 60 kHz signal went to a mixer that mixed the signal with a 1,590 kHz crystal oscillator. The pentode section of a 6U8 tube was used as the mixer, and the triode of the same tube was used as the crystal oscillator at 1,590 kHz to produce a 1,650 kHz output — the second IF.

The VFO produced an output of 3.90 – 4.40 MHz, which was combined with the 1,650 kHz signal to make the third IF, which was 5.550 – 6.050 MHz. A 6U8 was used with the triode, operating as the VFO, and the pentode as the mixer. The third IF, which was a tunable IF, was amplified by two type 6CB6 pentode tubes in a broadband amplifier at the third IF of 5.550 – 6.050 MHz. These two amplifier stages were cut off by –50 V DC of bias when the station was in receive mode. Depressing the key, triggering the VOX relay, or selecting MOX put the HX-500 in transmit mode and removed the –50 V DC bias. The two amplifier stages also had the automatic level control (ALC) bias applied to them to increase the SSB talk power.

A final mixer added the input from one of the eight heterodyne crystals to produce the final output frequency on the 80 – 10 meter bands. The crystal oscillator was a 6C4 triode, and a 6EW6 pentode served as the mixer. This mixer drove a 12BY7 serving a driver for the pair of 6146 pentode transmitting tubes in parallel in the final amplifier stage. The final amplifier stage used a conventional Pi coupler circuit with a tapped coil to switch bands and fixed loading optimized for a 50 Ω resistive load.

The HX-500 had a built-in antenna relay, which many transmitters lack. An output using a phono connector was provided to go to the receiver antenna input. For receiver muting during transmission periods, the HX-500 provided both a negative bias output voltage and a pair of isolated contacts that closed when receiving and opened when transmitting.

The HX-500 may have been the first product with new styling; it had knob styles not used by any other Hammarlund products. The HX-500 had no provisions to transceive with any receiver. The concept of transceiving was introduced by Collins with the S Line in 1958 and the idea was picked up by many manufacturers.

The HX-500 did not offer push-to-talk (PTT) operation. The microphone connector only had a single contact, so a PTT microphone couldn't be used. The operator had a choice of using a manual switch on the front panel to activate the transmitter or the built-in VOX could be used to switch the transmitter to transmit when the operator began talking.

The HX-50 and HX-50A

The more popular Hammarlund HX-50 sought to offer an SSB transmitter as a less expensive alternative to the HX-500 (see Figure 2). The HX-50 was rated at 90 W input on SSB and CW and about 60 W input on AM. The HX-50 came with 80/75, 40, 20, 15, and most of 10 meters operational as standard. The 160-meter band could be factory installed or added by the user with a modification kit from Hammarlund. The 10-meter band was divided into three segments — 10A, 10B, and 10C. The 10A band segment covered 28.00 – 28.550 MHz, 10B covered 28.550 – 29.100 MHz, and 10C covered 29.100 – 29.650 MHz. The HX-50 could be crystal controlled and the input power on CW could easily be reduced to 75 W input, so it could be legally used for Novice operation.

The HX-50 later became HX-50A when the 5R4GY tube was replaced with solid-state silicon diode rectifiers. This reduced the internal heat in the HX-50A and raised the plate voltage to the output 6DQ5 tube, enabling the power ratings to increase to 200 W PEP on SSB and 200 W input on CW.

Figure 2 — The Hammarlund HX-50, a less expensive, modified version of the HX-500. [Barbara Misic, KB3MPF, photo]

The HX-50 had a rear-panel input for an external VFO, so it had provisions for transceiving. Unfortunately, Hammarlund never made a receiver that could transceive with the HX-50. The instruction manual only discussed using it with Hammarlund HQ-170 and HQ-180 receivers, which were not capable of transceiving with the HX-50.

The HX-50 provided a pair of contacts that were shorted on receive and open on transmit. They could be used for receiver muting and a switched –100 V DC output, which could be used to mute a receiver while transmitting. The Hammarlund receivers had one of the contacts to mute the receiver connected to ground, so the normally open contact could be used to control a linear amplifier.

Like the earlier HX-500, the HX-50 did not accommodate a PTT microphone. The HX-50 also had a single contact microphone connector. On the station control terminal board on the back panel, there was a terminal for PTT operation, which was not present on the HX-500. Grounding terminal two would place the HX-50 in transmit mode and mute a connected receiver. The manual mentioned using a foot pedal for transmit/receive control and discussed a microphone with PTT capabilities, but offered no help in connecting it.

A Changing Marketplace

The HX-50 and HX-50A were both very capable SSB, CW, and AM transmitters. Their biggest limitation was the inability to transceive with a matching receiver from their manufacturer. Complete stations of well-integrated equipment from manufacturers like Kenwood and Yaesu took over the ham radio marketplace. After undergoing several changes of ownership, Hammarlund was bought by the Electronic Assistance Corporation in the late 1960s. All product lines were sold off over time, and Hammarlund officially closed in 1973.

Bruce Draper, AA5B, aa5b.corral@gmail.com

Contest Corral

February 2019

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 Date-Time		Date-Time		Bands	Contest Name	Mode	Exchange	Sponsor's Website
2	0000	3	2359	1.8-UHF	Vermont QSO Party	CW Ph Dig	RS(T), county or SPC	www.ranv.org/vtqso.html
2	0001	3	2359	28	10-10 International Winter Contest, SSB	Ph	Name, mbr or "0," SPC	www.ten-ten.org
2	1200	3	1159	1.8-28	Black Sea Cup International	CW Ph	RS(T), club/org abbreviation or ITU zone	bscc.ucoz.ru
2	1200	3	1200	3.5-28, 144	F9AA Cup, CW	CW	RST, serial	www.site.urc.asso.fr
2	1200	3	2359	3.5-28	Mexico RTTY International Contest	Dig	RST, XE state or serial	www.rtty.fmre.mx
2	1400	2	2359	1.8-28	FYBO Winter QRP Sprint	CW Ph Dig	RS(T), SPC, name, power, temperature	arizonascqrpions.apps-1and1.com
2	1400	2	2359	1.8-28	Minnesota QSO Party	CW Ph Dig	Name, county or SPC	www.w0aa.org
2	1600	2	1900	3.5	AGCW Straight Key Party	CW	RST, serial, class, name, age	agcw.org/index.php/en
2	1600	3	2359	1.8-28	British Columbia QSO Party	CW Ph Dig	RS(T), BC district or SPC	orcadxcc.org/bcqp_rules.html
2	1700	2	2100	3.5-28	FISTS Winter Slow Speed Sprint	CW	RST, SPC, name, mbr or power	fistsna.org/operating.html#sprints
3	0000	3	0400	3.5-14	North American Sprint, CW	CW	Other station's call, your call, serial, name, SPC	ncjweb.com/Sprint-Rules.pdf
4	2000	4	2130	3.5	RSGB 80-Meter Club Championship, SSB	Ph	RS, serial	www.rsgbcc.org/hf
5	0200	5	0400	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqrp.blogspot.com
6	2000	6	2100	3.5	UKEICC 80-Meter Contest	Ph	4-character grid square	www.ukeicc.com
7	1800	7	2200	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	www.nrau.net/activity-contests
7	2000	7	2200	1.8-28	SKCC Sprint Europe	CW	RST, SPC, name, mbr or power	www.skccgroup.com
9	0000	10	2359	3.5-28	CQ WW RTTY WPX Contest	Dig	RST, serial	www.cqwpxrtty.com
9	1000	10	1000	1.8-28	SARL Field Day Contest	CW Ph Dig	RS(T), number of transmitters, category, QTH	www.sarl.org.za
9	1100	9	1300	7,14	Asia-Pacific Spring Sprint, CW	CW	RST, serial	jsfc.org/apsprint/aprule.txt
9	1200	10	1200	1.8-28	Dutch PACC Contest	CW Ph	RS(T), Dutch province or serial	pacc.veron.nl
9	1200	10	1200	1.8	KCJ Topband Contest	CW	RST, Prefecture or continent code	www.kcj-cw.com
9	1200	10	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
9	1400	11	0200	1.8-UHF	YLRL YL-OM Contest	CW Ph Dig	Serial, RS(T), SPC	ylrl.org/index.php
9	1500	10	1500	1.8-28	OMISS QSO Party	Ph	RS, SPC, mbr (if any)	omiss.net/Facelift/qsoparty.php
9	1700	9	2100	3.5-28	FISTS Winter Unlimited Sprint	CW	RST, SPC, name, mbr or power	fistsna.org
9	1900	9	2300	1.8	RSGB 1.8 MHz Contest	CW	RST, serial, UK district code or serial	www.rsgbcc.org/hf
10	1300	10	1700	3.5-7	Balkan HF Contest	CW Ph	RS(T), serial	arabih.ba
11	0100	11	0259	3.5-14	CQC Winter QSO Party	CW	RST, SPC	www.coloradoqrpclub.org
11	0100	11	0300	1.8-28	4 States QRP Group Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqrp.com
11	1300	15	2359	All, no WARC	ARRL School Club Roundup	CW Ph	RS(T), Class (I/C/S), SPC	www.arrl.org/school-club-roundup
13	0130	13	0330	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
13	2000	13	2130	3.5	RSGB 80-Meter Club Championship, Data	Dig	RST, serial	www.rsgbcc.org
14	0000	14	2359	1.8-7	PODXS 070 Club Valentine Sprint	Dig	Name, OM/YL, SPC	www.podxs070.com
16	0000	17	2359	1.8-28	ARRL International DX Contest, CW	CW	RST, SP or power	www.arrl.org/arrl-dx
16	0800	16	1000	7	SARL Youth Day Sprint	Ph	RS, age	www.sarl.org.za
16	1200	17	1159	1.8-28	Russian PSK WW Contest	Dig	RST, 2-letter oblast or serial	rdrclub.ru/russian-ww-psk-contest
16	1900	16	2059	1.8-28	Feld Hell Sprint	Dig	RST, mbr, SPC, 4-char grid	sites.google.com/site/feldhellclub
16	2300	17	2300	1.8-14	AWA Amplitude Modulation QSO Party	Ph	Name, SPC	www.antiquewireless.org
18	0200	18	0400	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
20	1900	20	2030	3.5	AGCW Semi-Automatic Key Evening	CW	RST, serial, year first used a bug	www.agcw.org
22	2200	24	2200	1.8	CQ 160-Meter Contest, SSB	Ph	RS, SP or CQ Zone	www.cq160.com
23	0600	24	1800	3.5-28	REF Contest, SSB	Ph	RS, Department or serial	concours.r-e-f.org/contest
23	1300	24	1300	3.5-28	UBA DX Contest, CW	CW	RST, serial, province (if ON)	www.uba.be/en
23	1500	24	0159	1.8-50	South Carolina QSO Party	CW Ph Dig	RS(T), county or SPC	scqso.com/rules
23	1800	24	0559	3.5-28	North American QSO Party, RTTY	Dig	Name, SPC	www.ncjweb.com
24	0900	24	1700	3.5-28	High Speed Club CW Contest	CW	RST, mbr or "NM"	www.highspeedclub.org
24	1400	24	1700	3.5-14	SARL Digital Contest	Dig	RST, serial	www.sarl.org.za
24	1400	27	0800	1.8-144	Classic Exchange, Phone	Ph	Name, RS, SPC, rig model	www.classicexchange.org
24	1500	25	0059	3.5-144	North Carolina QSO Party	CW Ph Dig	County or SPC	ncqsoparty.org/rules
27	0000	27	0200	1.8-28	SKCC Sprint	CW	RST, SPC, name, mbr or power	www.skccgroup.com
27	2000	27	2100	3.5	UKEICC 80-Meter Contest	CW	4-char grid square	www.ukeicc.com
28	2000	28	2130	3.5	RSGB 80-Meter Club Championship, CW	CW	RST, serial	www.rsgbcc.org/hf

All dates refer to UTC and may be different from calendar dates in North America. Contests are not conducted on the 60-, 30-, 17-, or 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.contestcalendar.com*** *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.*

ARRL International Grid Chase Update

Join the discussion on Facebook at https://www.facebook.com/groups/IGC2018 and check out the #IGC hashtag on Twitter.

With the November portion of the International Grid Chase (IGC) finished, interest remains high, despite activity decreasing somewhat compared to October (with activity falling off as temperatures drop). Although there were fewer portable operations/gridpeditions, the annual ARRL November Sweepstakes and CQ Contests held log submissions at a strong 23,469. Overall, confirmed IGC contacts decreased about 16% across all bands as compared to October, mainly due to changes in season affecting fall HF propagation.

December activity will benefit from the many QSO parties, sprints, foreign contests, and the ARRL 160-Meter and 10-Meter Contests. Even so, December operating will be tempered by the holidays keeping people busy.

November Activity

Per the IGC leader board at **https://igc.arrl.org/leader-board.php**, the month of November saw 23,469 Logbook of The World (LoTW) submissions. This was just under October's event high of slightly over 24,000 submissions.

November activity reported a 16% overall activity decrease from October. Breaking down the data, 630, 160, and 80 meters saw expected seasonal activity increases, while 40 through 10 meters saw seasonal decreases. HF overall had a 17% decrease from October, while VHF+ activity bumped up about 22%.

December numbers are expected to remain similar to those of November, with low and very low frequency activity stronger than medium and upper HF.

Remember: You can always find complete International Grid Chase information online at **www.arrl.org/international-grid-chase-2018**. See you next month, and on the air!

Photo credit correction: In our January 2019 (p. 92) IGC Update, the photo should have been credited to Dan Brandner, N9DJB.

Jerry, VE6AB, makes sure to bring plenty of gear on any radio expedition. [Jerry Clement, VE6AB, photo]

November 2018 ARRL International Grid Chase (IGC) Station Stats (630 meters through 3 centimeters)

Band	630m	160m	80m	40m	30m	20m	17m	15m	12m	10m	6m	2m	1.25m	70cm	33cm	23cm	13cm	3cm	Mode Totals
CW	6	3,404	5,710	7,700	2,768	7,527	2,601	4,822	247	1,119	59	221	3	68	0	18	0	0	36,273
Phone	0	326	2,691	4,528	4	5,106	1,312	1,137	139	203	114	590	5	488	1	25	0	2	16,671
Digital	33	4,118	9,179	13,381	8,759	13,218	8,239	7,997	2,804	2,263	638	574	0	55	0	23	0	0	71,281
Band Totals	39	7,848	17,580	25,609	11,531	25,851	12,152	13,956	3,190	3,585	811	1,385	8	611	1	66	0	2	124,225

—November submissions: 23,469
—This report represents all IGC-eligible* QSOs matched in LoTW during November 2018 as uploaded to LoTW by 2359 UTC December 10, 2018.
*IGC-eligible LoTW matches occur only when both stations upload their QSOs to LoTW during the reporting month (by the 10th of the month following the reporting month), and both stations include their grid square in their LoTW TQSL Station Location(s).
—30-meter contacts may be a logging error, as phone is not permitted in the US.
—No contacts were reported to LoTW in November 2018 on 2200 meters, 33 centimeters, or on most microwave bands above 13 centimeters (except for 3 centimeters).

★ **Closeout Sale!** Get your commemorative IGC merchandise while supplies last. Show off your achievement with polo shirts, mugs, pins, stickers, and maps. Browse and order the remaining items at http://www.arrl.org/shop/IGC2018/.

2018 ARRL 10 GHz and Up Contest Results

During the 2018 ARRL 10 GHz and Up Contest, Pat, N6RMJ, captured this sunrise from just west of Newman, California (grid DM97kh), while checking out the Frazier Mountain beacon 344 kilometers away. [Pat Coker, N6RMJ, photo]

Jeff Wadsworth, KI5WL, ki5wl@arrl.net

This year's ARRL 10 GHz and Up Contest weekends took place August 18 – 19 and September 15 – 16, 2018.

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

Top Ten Scores

10 GHz Only		10 GHz and Up	
Call	Score	Call	Score
KB8U	70,704	K3SIW	70,614
W9FZ	60,079	AA6IW	65,795
KA9VVQ	59,534	WB8TGY	65,735
KC0P	57,401	K6ML	65,572
K0CQ	52,967	WA2VOI	59,051
N0UK	48,492	W6QIW	58,125
K9JK	46,740	K9PW	57,246
K0HAC	44,199	W0ZQ	55,969
N6RMJ	38,634	WB0LJC	54,009
K1RZ	38,117	W7QQ	43,408

Best Terrestrial DX by Band

Call	Band	Distance (km)
AA1I/K1OR/K1RZ/ N1DPM/W2RMA	10 GHz	735
VE3KRP	24 GHz	365
VE3FN	47 GHz	111
VE3KRP/VE4MA	75 GHz	1
AF1T/W1MKY	300 GHz	8

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 next ARRL 10 GHz and Up Contest weekends will be held August 17 – 18 and September 21 – 22, 2019.

Call Area Leaders

10 GHz		10 GHz and Up	
Call	**Score**	**Call**	**Score**
Area 0		**Area 0**	
W9FZ	60,079	K9PW	57,246
KA9VVQ	59,534	W0ZQ	55,969
K0CQ	52,967	WB0LJC	54,009
N0UK	48,492	W7QQ	43,408
Area 1		**Area 1**	
N1DPM	21,958	AF1T	41,221
AA1I	21,401	W1MKY	38,916
W1AIM	20,705	K1OR	23,543
KB1VC	18,195	N1JEZ	21,418
Area 2		**Area 2**	
KA2LIM	27,549	K2DH	33,328
N3RG	12,729		
K2CBA	7,815		
N2MKT	406		
Area 3			
K1RZ	38,117		
W2RMA	26,548		
WA3GFZ	22,493		
WA3PTV	13,577		
Area 4			
N9ZL	3,663		
K0VXM	2,508		
WA7ZZI	940		
AA2LY	403		
Area 5		**Area 5**	
WA5YWC	11,292	W5LUA	16,937
WQ5S	5,751	AA5C	4,940
W5AFY	2,319	AA5AM	2,884
K5LLL	1,570		
Area 6		**Area 6**	
N6RMJ	38,634	AA6IW	65,795
N6VI	36,809	K6ML	65,572
K6WCI	31,232	W6QIW	58,125
N5BF	31,059	N9JIM	39,704
Area 7			
W7GLF	928		
W7PUA	652		
KI5WL	378		
KJ7OG	263		
Area 8		**Area 8**	
KB8U	70,704	WB8TGY	65,735
KC0P	57,401	WA2VOI	59,051
N0HZO	32,657	K8ZR	27,009
		KB8VAO	19,605
Area 9		**Area 9**	
K9JK	46,740	K3SIW	70,614
KA9VDU	17,585	K0KFC	31,272
WA9TT	5,482	W9SZ	25,109
N9LB	2,815	W9SNR	24,334
Area 15 (Canada)		**Area 15 (Canada)**	
VE3EG	18,800	VE4MA	40,711
VA3TO	18,431	VA3ELE	21,097
VE3KH	13,850	VE3SMA	19,856
VE3JGL	4,718	VE3KRP	14,766
Area 20 (DX)			
XE2HWB	127		

Best DX by Band in Kilometers

10 GHz	
Call	**Best DX**
AA1I	735
K1OR	735
K1RZ	735
N1DPM	735
W2RMA	735
AF1T	663
W1MKY	663
WA3PTV	634
N9ZL	629
AA6IW	616
N6NU	615
N6VI	615
W6NUC	615

24 GHz	
Call	**Best DX**
VE3KRP	365
K6ML	347
N6NU	293
N6TEB	276
AA6IW	268
N9JIM	268
KB6BA	257
W6QIW	257
W0ZQ	241
K9PW	240
W7QQ	240
N6JET	221

47 GHz	
Call	**Best DX**
VE3FN	111
VE2UG	110
K2DH	105
N1JEZ	100
W1EX	100
WA1MBA	100
AF1T	90
W1MKY	90
W1GHZ	90
WB8TGY	49
K3SIW	48

75 GHz	
Call	**Best DX**
VE3KRP	1
VE4MA	1

300 GHz	
Call	**Best DX**
AF1T	8
W1MKY	8

Top Ten QSO Leaders

10 GHz	
Call	**Total QSOs**
KB8U	308
W9FZ	254
KA9VVQ	253
KC0P	238
K0CQ	223
K9JK	209
N0UK	197
K0HAC	184
N6RMJ	182
N5BF	153

10 GHz and Up	
K3SIW	322
WB8TGY	304
AA6IW	292
WA2VOI	260
K9PW	259
K6ML	256
W6QIW	252
WB0LJC	233
W0ZQ	219
W7QQ	181

Top Unique Call Leaders

10 GHz		10 GHz and Up	
Call	**Unique Calls**	**Call**	**Unique Calls**
K1IIG	61	AA6IW	61
WB6TFC	55	AF1T	60
KA2LIM	52	W6QIW	58
N6VI	51	W1MKY	57
N5BF	49	K2DH	56
K6WCI	49	K6ML	52
K1RZ	48	K9PW	51
N6RMJ	47	K3SIW	49

Countdown to the AM Rally, February 2 – 4, 2019

The purpose of this event is to encourage the use of Amplitude Modulation (AM) on the 160-, 80-, 40-, 20-, 15-, 10-, and 6-meter bands, and to highlight the various types of AM equipment in use today. The AM Rally is open to all radio amateurs who are running full-carrier amplitude modulation (standard AM), using any type of radio equipment. The Rally starts at 0000Z on Saturday, February 2, and ends at 0700Z on Monday, February 4. You'll find more information online at **www.AMRally.com**.

2018 ARRL 222 MHz and Up Distance Contest Results

This year's event was held August 4 – 5, 2018.

John "JK" Kalenowsky, K9JK, k9jk@arrl.net

Regional Winners

Regions are defined in the contest rules (**www.arrl.org/222-mhz-and-up-distance-contest**). Category key: R — Rover; SOF — Single Operator, Fixed, and MOF — Multioperator, Fixed.

Region	Category	Call	Score
1	R	KE7MSU/R	6,871
	SOF	AC7MD	9,823
2		No entries	
3	R	N6NB/R	154,688
	SOF	W6IT	51,977
4	SOF	NJ7A	6
5	MOF	KC5MVZ	1,367
	R	KI5WL/R	421
	SOF	KC6SEH	4,162
7	SOF	KB0ZOM	3,238
8	R	W5VY/R	6,048
	SOF	K5LLL	28,801
9	R	W9SNR/R	29,358
	SOF	K2DRH	34,410
10	R	K9PW/R	52,283
	SOF	W0UC	43,380
11	MOF	N2SLN	17,273
	R	KF2MR/R	62,401
	SOF	VE3ZV	76,265
12	MOF	AG4V	9,387
	SOF	N4QWZ	14,455
13	MOF	N9HF	4,079
	R	N2CEI/R	74,123
	SOF	K0VXM	85,000
14	R	N9ZL/R	10,504
	SOF	K1RZ	153,837
15	MOF	N2NT	29,199
	R	NN3Q/R	28,056
	SOF	K3TUF	55,315
16	R	W1RGA/R	12,427
	SOF	K1TEO	100,724
17		No entries	
18		No entries	

Affiliated Club Competition

Club	Score	Entries
Medium		
Mt. Airy VHF Radio Club	352,332	13

During the 2018 ARRL 222 MHz and Up Distance Contest, Barry, AC7MD, handled his five-band effort from this perch on the eastern edge of the Olympic National Forest (grid CN87km, just west of Seattle, Washington). [Barry Williams, AC7MD, photo]

Teams

Name	Score	Region
Large		
Going The Distance	157,070	9
Small		
An Orange County Quintet	309,030	3
Alpha Hotel	247,739	13
Really Weak Signal Group	219,349	16
Lake Ontario Group	133,181	11
Pack Rats	110,096	15
Northern Lights Radio Rangers	86,237	10
Ferret	70	13

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 next ARRL 222 MHz and Up Distance Contest will be held August 3 – 4, 2019.

Bernie McClenny, W3UR, w3ur@arrl.org

DXpedition Macao 2019

After achieving almost 45,000 contacts in 2017, the members of the XX9D DXpedition to Macao, China, have announced plans to repeat the excursion in February 2019, once again under the call sign XX9D. The flight and hotel bookings are in hand for this year's trip, which will take place February 11 – 26. Macao ranks number 93 worldwide on Club Log's Most-Wanted List, 29th in North America, and 18th on the North American east coast.

The Historic Centre of Macao, a city in the southeast region of China that was a Portuguese territory until 1999. [Photo courtesy of **wiredtourist.com**]

The 2019 XX9D operators include XX9LT, DJ6TF, DJ7TO, DJ9HX, DJ9KH, DL1KWK, DL1RTL, DL2RNS, DL4SVA, DL4WK, DL6KVA, DL7JOM, DL7VEE, DL9GFB, and OZ1IKY. With 15 experienced operators, the group will be able to run at least four stations, with the fifth constantly monitoring 50 MHz during the 2-week operation. In addition to focusing on the low bands (160, 80, and 40 meters), they will also concentrate or getting North American stations into their logs.

Activity will be on 1.8 through 50 MHz on CW, SSB, FT8, and RTTY, and the team will have separate antennas for each of the low bands. XX9D will use two-element beams along with a pentaplexer, which will allow them to operate three stations simultaneously on the higher bands. As for equipment, they will use their own gear, including Elecraft K3s, and KPA-500 and Expert 1.3K-FA amplifiers.

The team has posted their targeted transmit frequencies (see Figure 1). They will be operating split, so be advised not to call them on the transmit frequencies.

Georg, DL4SVA, will be handling QSL duties. QSL cards are expected to be printed by 8 weeks after the

	CW	SSB	RTTY	FT8
160m	1,823.5 up	-	-	
80m	3,526 up	3,805 down	3,595 up	3,573
40m	7,026 up	7,095 up&dwn 7,182 up&dwn	7,046 up&dwn	7,074
30m	10,102 up	-	10,144 up	10,136
20m	14,026 up	14,210 up	14,090 up	14,074
17m	18,086 up	18,120 up	18,099 up	18,100
15m	21,026 up	21,275 up	21,090 up	21,074
12m	24,906 up	24,955 up	24,917 up	24,915
10m	28,026 up	28,465 up	28,090 up	28,074
6m	50,105 up	50,120 up	-	50,313

Figure 1 — The frequencies that XX9D will be transmitting on. Listen carefully as they will be announcing what frequency range they are listening and where you should be calling them — not directly on their transmit frequency. [Image courtesy of XX9D]

Members of the second XX9D DXpedition team will be operating from Macao on February 11 – 26. [Photo courtesy of XX9D]

DXpedition is over. As with most DXpeditions, you can get your QSL card from the team using their OQRS (online QSL reply system). The quickest and most reliable method is through the Club Log website, **https://clublog.org**.

Other routes include QSLing via the bureau to DL4SVA, direct to DL4SVA with a self-addressed envelope and US currency (no international reply coupons [IRCs]), or via Logbook of The World 6 months after the DXpedition. The team is also looking for financial donations to help with equipment transportation. For additional information about this DXpedition, check out the team's website at **http://xx9d.mydx.de**.

T31 — Central Kiribati

The DX Century Club (DXCC) program recognizes four Kiribati island groups: T30 — Western Kiribati (aka Gilbert Islands); T31 — Central Kiribati (aka Phoenix Islands); T32 — Eastern Kiribati (aka Line Islands), and T33 — Banaba Island (aka Ocean Island). Central Kiribati, which includes Birnie, Enderbury, Kanton, Manra, McKean, Nikumaroro, Orona, and Rawaki islands, is the most-wanted of the four DXCC counters. T30, T31, and T32 (originally VR1 and VR3) were not on the original DXCC list dating back to November 15, 1945, but were added in February 1947 and backdated for any contacts from the beginning of the post-World War II DXCC. T33 was not added to DXCC until February 1990 and was also backdated for any contacts made from the start date of DXCC.

The last operation from Kanton Island was T31T, which ended on October 15, 2016, with a total of 30,394 QSOs. T31 currently ranks number 27 worldwide on Club Log's Most-Wanted List. In Europe, it ranks number 16, with western European DXers needing it the most at a rank of number 13.

In mid-October 2018, a European team announced plans to put on a DXpedition to Kanton Island during the second half of February 2019. The team includes Guenter, DL2AWG; Hans, DL6JGN; Heye, DJ9RR; Wolf, DM2AUJ; Joe, DK5WL, and Ron, PA3EWP, all of whom have operated before in the Pacific Isles. "License is confirmed by CCK (Communications Commission of Kiribati) and we have permission from the Phoenix Islands Protected Area," said team member Ron Stuy, PA3EWP.

They will put T31EU on the air from Kanton Island, also known as Canton or Abariringa Island, from February 16 to March 5. Kanton, located some 1,765 kilometers east of Tarawa, the capital of Kiribati, is the largest and only inhabited island, with fewer than 30 people in the Central Kiribati group. Plans are to be on CW, SSB, RTTY, and some FT8 on 160 through 10 meters from the north coast near the airport. The group will be running generators 24/7 during their operation. Equipment will include two K3s and one K2, along with three amplifiers (Expert 1.3K-FA, Tokyo Hy-Power HL-1.1KFX, and HAL 1200). As for antennas, they will have verticals and vertical dipole arrays (VDAs). The guys will also be on the air both before and after the T31EU DXpedition from Tarawa, West Kiribati (T30). They have a website at **www.kanton2019.de**, and DL2AWG will be handling QSL duties.

P2 — Papua New Guinea

Derek, G3KHZ; Hans, SM6CVX, and Eddy, K5WQG, are heading back to Papua New Guinea to activate two more Islands On The Air (IOTA) groups. Their first stop will be from Manus Island (OC-025) where they will be operating as P29VCX from around midday January 31 until very early February 5. Activity will be on CW, SSB, and RTTY on 40 through 10 meters, with possible 160- and 80-meter activity. QSL P29VCX via SM6CVX.

Next, it's on to Daru Island (OC-153), where the group will be using the call P29NI from midday February 6 until very early on February 11. They will be operating on the same bands and modes as described for their first stop. QSL P29NI via G3KHZ or use the OQRS on the Club Log website. At times, all three operators will be QRV simultaneously on different bands/modes. For the low bands and SSB, they will have a 600 W amplifier. They will be using vertical dipoles on the high bands and, if space allows, an inverted **V** dipole on 160 and 80 meters. While on both islands, they will be focusing on difficult areas, such as the east coasts of North and South America. The P29 team is open to donations through PayPal or with your QSL request.

IOTA Gathering

Mark your calendar for March 29 – 30 to attend this year's IOTA Bash, sponsored by the Island Radio Expedition Foundation (IREF) and hosted by Mike Crownover, AB5EB. Details and registration information can be found at **https://irefradio.com/iota-bash/**.

Wrap-Up

That's all for this month, with thanks to DL7VEE, G3KHZ, PA3EWP, and *The Daily DX* (**www.dailydx.com**) for input to make this month's column possible. You can follow *The Daily DX* on Twitter @dailydx. Please forward any DX, IOTA, or contest expedition news, photos, and newsletters to **bernie@dailydx.com**. Until next month, see you in the pileups! — *Bernie, W3UR*

Jon Jones, N0JK, n0jk@arrl.org

DXpeditions Provide New Grids and DXCC Entities for 6-Meter Operators

AC0RA's Grid Rover Expedition

On the weekend of November 10 – 11, I did a rover grid expedition in some rare grids across Kansas, Nebraska, Oklahoma, Texas, New Mexico, and Colorado for 6-meter operators (see Figure 1). Using the special call W5Q, I activated 24 grids on 6 meters while traveling over 2,361 miles in my car in just 73 hours.

I used a hybrid three-element M2 Yagi at 25 feet, an Icom IC-7300 driving an Acom 1200S at 1,000 W, and about 50 feet of LMR-400 UF coaxial cable. I made 410 MSK144 contacts — at one point reaching 35 contacts per hour — and 69 unique contacts on 6 meters. The furthest contact was with Tim Heger, N3XX, at 1,152 miles, but my 1,144-mile contact with Michael Bilacic, KF8MY, was a close second.

Figure 1 — Wyatt Dirks', AC0RA, portable station as he stops to make a contact in Nebraska, on the EN00/01 grid line. [Wyatt Dirks, AC0RA, photo]

I uploaded all the contacts to Logbook of The World (LoTW) after receiving "RRR." In all but a few cases, I ended up working everyone that I decoded calling me, but some operators were outside the range of meteor scatter, and I'm disappointed that I couldn't contact them.

Thanks to everyone for all the contacts and support on this trip, especially to those who helped finance the expedition: W0JW, K0SIX, W3CP, K5GZR, WQ5S, AA5C, W5ADD, K3GYK, W5VY, N8CGY, WB2FKO, KA9CFD, N3XX, KV5W, KB7IJ, W0VTT, W9RM, K0TPP, W0LGQ, N0LWF, and WA7HQD. — *73, Wyatt Dirks, AC0RA*

Year-Round Meteor Scatter

K7ULS (DN41) logged W5Q in EM07 at 1512Z and Larry, N0LL (EM09), reported working W5Q on 6-meter MSK144 when Wyatt was in EM05 at 1915Z on November 10.

Because meteors enter the Earth's atmosphere daily, contacts are possible via meteor scatter year-round. In the past, grid expeditions on 50 MHz usually took place during the summer for sporadic E. Now, they can take place any time of year, as long as the roads are drivable. With meteor scatter, 100 W, a small Yagi, and *WSJT-X* MSK144 software, grid rovers can be confident that they can make contacts on 6 meters any time with distant stations. Contacts may be easier and more plentiful via meteor scatter during a major shower, but as Wyatt's results show, a grid expedition can do well on routine daily meteors.

There are many grids that stations pursue to achieve the Fred Fish Memorial Award (FFMA) and other grid awards. Some may be just a short drive from where you live. Consider a short grid expedition on a weekend or a vacation road trip. If you plan a trip, please utilize the Yahoo! FFMA email group (**FFMA@yahoogroups.com**) to let operators know your plans, so they can look for you.

C21GJ EME DXpedition to Nauru

Lance Collister, W7GJ

I arrived in Nauru for my 2-week DXpedition on September 28, 2018. The station was assembled and operational by moonrise on September 29. Degradation was not optimum, but operating a week ahead of the lowest degradation allowed me to spend more time contacting smaller stations during the optimum days. I always try to allow extra days of operation to accommodate unpredictable events, such as equipment malfunction, geomagnetic disturbances, and extreme weather. There were a couple of geomagnetic disturbances toward the end of the operation, but it didn't have much of an impact on my success; though it did cause me to terminate the moonbounce (EME) operation at the end of the eleventh moon pass.

Prior to the operation, I advised all stations to contact me earlier in the DXpedition, because the elevation of the moon in C2 would be rising beyond the ability of my antenna to elevate as the operation progressed. As expected, the number of successful contacts declined by the end of the operation. I contacted several single Yagi stations (a single five-element Yagi in one case), along with one 100 W single Yagi station.

Although the site available for the antenna was not ideal, with significant ground clutter near the antenna, it did allow the antenna to be erected very close to the station location, so that only 50 feet of LMR600UF was required. This was undoubtedly responsible for the excellent reception achieved during this operation. There was good gain toward the moonrise over the ocean, but the western moonset was noisier, because the antenna was aiming inland toward buildings, roads, and a rising land mass. Still, there was relatively low receiver noise because of the remote location. Toward the beginning of the operation, when the larger stations were calling, it was possible to achieve the expected three to five contacts before elevating the antenna.

Nauru is extremely rare on 6 meters outside of Region 3, which contributed to my decision to go, as I would be able to provide every contacted station with a new DXCC entity contact. I made 119 6-meter EME contacts in 34 DXCC entities. This surpasses my personal record of 106 6-meter EME contacts made last year from VK9X. Comparing the results of both DXpeditions, I have concluded that 10 moon passes should be sufficient to make a decent amount of contacts.

A special thanks to Mr. Criden Appi, Nauru's Chief Communications Regulator, who helped me obtain a radio license and a visa to enter Nauru. I also thank the many supporters who helped fund this operation, and to the many dedicated 6-meter DXers who turned out to provide 6-meter EME contacts.

On the Bands

50 MHz. On November 19, WA2GFN (FN20) reported a brief sporadic-E opening, working KF4WE (EM56), W4OSH, and W4BBN on SSB around 0100Z. Later that day, Mike, K7ULS, reported sporadic-E openings to W5LDA in Oklahoma at 1420Z on FT8.

Three rare 50 MHz EME DXpeditions took place in November: 7P8Z, 5R8UM, and VP8WOS. Lance, W7GJ, made is 209th 6-meter DX contact with Alex, 5R8UM, and this was the first time Alex had ever been on 6-meter EME.

November is summer sporadic-E season for our colleagues south of the equator. On November 23, VP8EME in the Falkland Islands, worked stations in Argentina and Uruguay via sporadic E around 2330Z. On November 28, FK8CP and CE2SV made a contact on 6-meter multi-hop E_s, using JT65 (see Figure 2). On November 29, LU5FF worked ZL1RQ at 2205Z, using FT8. This follows a pattern of long-distance, multi-hop sporadic-E openings in the Southern Hemisphere, which was also noted in 2017. The digital modes, such as FT8 and JT65, have allowed exploration and utilization of these previously scarcely known openings.

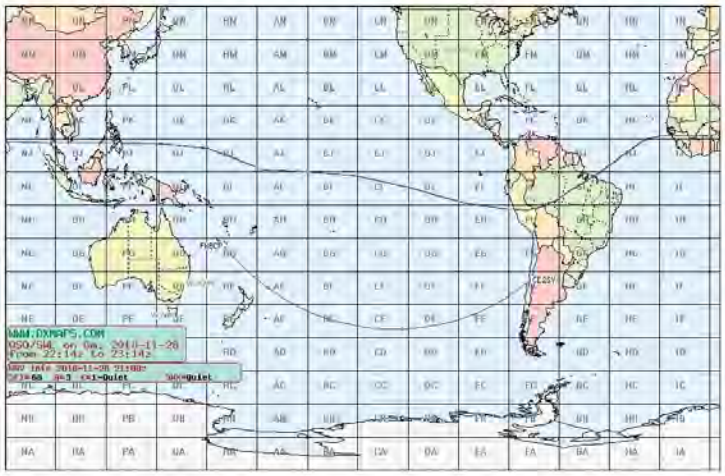


Figure 2 — The contact between CE2SV and FK8CP on a 6-meter, multi-hop sporadic-E opening, which took place on November 28, 2018. They were using *WSJT-X* JT65 mode. [**dxmaps.com**]

144 MHz. Mike, K7ULS (DN41), worked NH6Y on EME on November 3. He reported a low-power EME contact with Serge, R1AY, on November 23. Mike was running 350 W to two 12-element Yagis.

On November 25, Gary, KE8FD (EM64), "had a nice tropospheric opening into Florida from northern Alabama." On SSB, he made contacts with KD4ESV (EL87) on 144 and 432 MHz at 1400Z; N4TWX (EL89) on 144, 222, and 432 MHz at 1422Z; KK4HEP (EL88) on 144 and 432 MHz at 1432Z, and NP4WT (EL96) on 144 MHz at 1441Z. His best DX contact was with Carlos, NP4WT, who was 1,086 kilometers away.

Steve, NN4X, noted the weather fronts that were responsible on the Florida Storms website (**www.floridastorms.org**).

Special Event Stations

Working special event stations is an enjoyable way to help commemorate history. Many provide a special QSL card or certificate!

Jan. 12, 1700Z – 2359Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum Ship. **Desert Storm Kickoff**. 14.320 7.250; PSK31 on 14.070. QSL. USS *Midway* (CV-41) COMEDTRA, 910 N. Harbor Dr., San Diego, CA 92101.

Jan. 19 – Jan. 27, 0800Z – 1200Z, W7Q, San Luis, AZ. **Quartzfest**. 28.385 21.385 14.285. QSL. Kristyn Weed, 1519 N. Camino Emiliano, Tucson, AZ 85745. **quartzfest.org**

Feb. 1 – Feb. 28, 0000Z – 2359Z, N9SES, Lake Station, IN. Arab QRZ International Club. **JY1 Special Event Memorial Station 2019**. 14.250 10.103 7.0275 3.5275. QSL. Ayman Azar, 2861 Decatur St., Lake Station, IN 46405. *Look for worldwide participating stations, including these: 7X5TV, OD5NJ, OD5YY, 4X6TT, SU1HZ, KK4OW, KK4OK, KA2HTV, and N9SES.* **www.arabqrz.com/jy**

Feb. 2 – Feb. 3, 1500Z – 2300Z, K5C, Nacogdoches, TX. Nacogdoches Amateur Radio Club. **Space Shuttle *Columbia* Special Event**. 14.265 14.074 14.035 7.215. QSL. Nacogdoches Amateur Radio Club, 167 CR 2093, Nacogdoches, TX 75965. *All contacts will be confirmed via LoTW. QSL requests must include SASE.* **www.w5nac.com**

Feb. 9, 1700Z – 2359Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum Ship. **Mt. Suribachi Flag Raising**. 14.320 7.250; PSK31 on 14.070. QSL. USS *Midway* (CV-41) COMEDTRA, 910 N. Harbor Dr., San Diego, CA 92101.

Feb. 13 – Feb. 17, 0001Z – 2359Z, N4DAB, Daytona Beach, FL. **2019 Daytona 500**. Daytona Beach CERT Amateur Radio Team. 14.260 14.076. Certificate & QSL. Steve Szabo, WB4OMM, 536 Central Park Blvd., Ponce Inlet, FL 32127. **www.n4dab.com**

Feb. 15 – Feb. 24, 0000Z – 2359Z, N6E, Healdsburg, CA. Will Pattullo. **80th Anniversary of the Opening of the Golden Gate International Exposition, San Francisco, 1939**. 21.265 14.265 7.265 3.815. QSL. N6E — Will Pattullo, 161 Presidential Cir., Healdsburg, CA 95448. **www.qrz.com/db/ae6yb**

Feb. 16, 1400Z – 2200Z, W0EBB, Leavenworth, KS. Kickapoo QRP Amateur Radio Club. **15th Annual *Freeze Your Keys* Winter Operating Event**. CW: 14.058 7.035 SSB: 14.325 7.240; if bands are open, 30, 17, 15, 12, and 10 meters. QSL. Gary Auchard, W0EBB, 34058 167th St., Leavenworth, KS 66048. **w0ebb@juno.com**

Feb. 16 – Feb. 18, 1600Z – 2300Z, W0JH, Stillwater, MN. Stillwater Amateur Radio Association. **Ice Station W0JH — Frozen Lake Portable**. 21.360 14.260 7.260 3.860. Certificate. Shel Mann, N0DRX at **IceStationW0JH2019@radioham.org**. *Operating portable from a frozen lake in Washington County, Minnesota (Grid Square EN34). Certificates will only be sent via email in PDF format.* **www.qrz.com/db/w0jh** *or* **www.radioham.org**

Feb. 16 – Feb. 18, 2300Z – 2300Z, W8QLY, Youngstown, OH. Mahoning Valley Amateur Radio Association. **100th Anniversary**. 14.220 7.220 3.922. Certificate & QSL. Request your certificate or QSL at: **https://goo.gl/forms/2uNZfO6zRx1YPoWw2**. **www.qrz.com/db/w8qly** *or* **www.mvara.org**

Feb. 16 – Feb. 17, 1700Z – 0900Z, K4US, Alexandria, VA. Mount Vernon Amateur Radio Club. **George Washington's Birthday**. 14.260 14.074 7.040. QSL. MVARC, P.O. Box 7234, Alexandria, VA 22307. **www.mvarc.org**

Feb. 17, 1400Z – 2100Z, N4HLH, Charleston, SC. Trident Amateur Radio Club. **SES *H. L. Hunley* Commemorative Station, N4HLH**. 28.462 14.262 7.262 7.117. QSL. John Satterfield, KN4MBK, P.O. Box 60732, Charleston, SC 29416. **tridenthams.org/hunley.htm**

Feb. 22, 1600Z – 2100Z, W5BMC, Morgan City, LA. Bayouland Emergency Amateur Radio Service. **14th Annual EagleExpo**. 14.280 14.265 7.280 7.265. QSL. Jackie Price, 708 Front St., Morgan City, LA 70380.

Feb. 22 – Feb. 23, 1600Z – 1800Z, WS7G, George, WA. Columbia Basin DX Club. **President George Washington's Birthday**. 14.322 7.222 3.855. QSL. Brian Nielson, 11650 Road 1 SE, Moses Lake, WA 98837. **cbn.homestead.com/WS7G.html**

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 email. Offline completed forms can be mailed, faxed (Attn: Special Events), or emailed.

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**.

Ada Lace, Take Me to Your Leader

Emily Calandrelli, KD8PKR (illustrations by Renée Kurilla)

Reviewed by Rick Lindquist, WW1ME

Ada Lace, Take Me to Your Leader is one in a series of Ada Lace adventures by Emily Calandrelli (with Tamson Weston), aimed at the age 6 – 10 crowd and delightfully illustrated by Renée Kurilla. Ada Lace is a third-grade inventor who has a ham radio license, but has not been terribly successful at working anyone, despite some effort.

The short story centers largely on Amateur Radio. This is not a science textbook, however, so the author does take some liberties. She also manages to weave in various mentions of natural science — birds, sea life, and even meteor showers. The book includes "Behind the Science" appendices, which cover some aspects in greater detail.

Some strange signals heard on Ada's ham radio lead her friend, Nina, to believe she may have heard extraterrestrials. A voice says, "Take me to your leader," and later, ominously, "Release the swarm." Ada doesn't believe her friend until she hears another transmission for herself.

With the help of her ham mentor, Mr. Peebles, Ada manages to make her radio capable of transmitting. Now she can talk with other stations in her area (it's clear that Ada is using a VHF transceiver and not operating on HF — something the author clarifies in an appendix).

Included too is some typical interaction among family members, including Ada's brother, Elliott, who sometimes "borrows" Ada's gear.

The culmination of the plot occurs when Ada, Nina, and their schoolmate, Milton, are able to arrange a chat with an astronaut named Sandy on the International Space Station via Amateur Radio, in a question-and-answer format like the one that Amateur Radio on the International Space Station (ARISS) school participants use in contacts with crew members.

In the flyleaf to *Ada Lace, Take Me to Your Leader*, we learn that Calandrelli, who has worked in the space industry, holds mechanical and aerospace engineering degrees from West Virginia University (she's a West Virginia native) and Master's degrees in aeronautics and astronautics and in technology policy from the Massachusetts Institute of Technology, and of her deep passion for inspiring girls to get more excited about science, technology, engineering, and mathematics (STEM).

This book might inspire a young reader to consider a future in science and technology and, perhaps, even to obtain an Amateur Radio license.

Simon & Schuster Books for Young Readers, New York City, 2018. ISBN: 978-1-4814-8604-0, softcover, with illustrations, 7⅝ × 5⅛ inches, 93 pp. Available from the publisher, softcover, $6.99 (also available in hardcover, $16.72). Kindle edition available from **Amazon.com**, *$5.99.*

W1AW Schedule

W1AW's schedule is at the same local time throughout the year. From the second Sunday in March to the first Sunday in November, UTC = Eastern US time + 4 hours. For the rest of the year, UTC = Eastern US time + 5 hours.

PAC	MTN	CENT	EAST	UTC	MON	TUE	WED	THU	FRI
6 AM	7 AM	8 AM	9 AM	1400		FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
7 AM-1 PM	8 AM-2 PM	9 AM-3 PM	10 AM-4 PM	1500-1700 1800-2045	VISITING OPERATOR TIME (12 PM-1 PM CLOSED FOR LUNCH)				
1 PM	2 PM	3 PM	4 PM	2100	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
2 PM	3 PM	4 PM	5 PM	2200	CODE BULLETIN				
3 PM	4 PM	5 PM	6 PM	2300	DIGITAL BULLETIN				
4 PM	5 PM	6 PM	7 PM	0000	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
5 PM	6 PM	7 PM	8 PM	0100	CODE BULLETIN				
6 PM	7 PM	8 PM	9 PM	0200	DIGITAL BULLETIN				
6:45 PM	7:45 PM	8:45 PM	9:45 PM	0245	VOICE BULLETIN				
7 PM	8 PM	9 PM	10 PM	0300	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
8 PM	9 PM	10 PM	11 PM	0400	CODE BULLETIN				

♦ Morse code transmissions: Frequencies are 1.8025, 3.5815, 7.0475, 14.0475, 18.0975, 21.0675, 28.0675, 50.350, and 147.555 MHz.
Slow Code = practice sent at 5, 7½, 10, 13, and 15 WPM.
Fast Code = practice sent at 35, 30, 25, 20, 15, 13, and 10 WPM.
Code bulletins are sent at 18 WPM.

♦ W1AW Qualifying Runs are sent on the same frequencies as the Morse code transmissions. West coast qualifying runs are transmitted by various west coast stations on CW frequencies that are normally used by W1AW, in addition to 3590 kHz, at various times. Underline 1 minute of the highest speed you copied, certify that your copy was made without aid, and send it to ARRL for grading. Please include your name, call sign (if any), and complete mailing address. Fees: $10 for a certificate, $7.50 for endorsements.

♦ Digital transmissions: Frequencies are 3.5975, 7.095, 14.095, 18.1025, 21.095, 28.095, 50.350, and 147.555 MHz.

Bulletins are sent using 45.45-baud Baudot, PSK31 in BPSK mode, and MFSK16 on a daily revolving schedule.

Keplerian elements for many amateur satellites will be sent on the regular digital frequencies on Tuesdays and Fridays at 6:30 PM Eastern time using Baudot and PSK31.

♦ Voice transmissions: Frequencies are 1.855, 3.99, 7.29, 14.29, 18.16, 21.39, 28.59, 50.350, and 147.555 MHz. Voice transmissions on 7.290 MHz are in AM double sideband, full carrier.

♦ Notes: On Fridays, UTC, a DX bulletin replaces the regular bulletins. W1AW is open to visitors 10 AM to noon and 1 PM to 3:45 PM Monday through Friday. FCC-licensed amateurs may operate the station during that time. Be sure to bring your current FCC amateur license or a photocopy. In a communication emergency, monitor W1AW for special bulletins as follows: voice on the hour, teleprinter at 15 minutes past the hour, and CW on the half hour.

W1AW code practice and CW/digital/phone bulletin transmission audio is also available real-time via the *EchoLink Conference Server* W1AWBDCT. The conference server runs concurrently with the regularly scheduled station transmissions. The W1AW Qualifying Run texts can also be copied via the EchoLink Conference Server.

During 2019, Headquarters and W1AW are closed on New Year's Day, Presidents Day (February 18), Good Friday (April 19), Memorial Day (May 27), Independence Day (July 4), Labor Day (September 2), Thanksgiving and the following day (November 28 and 29), and Christmas (December 25). For more information, visit us at **www.arrl.org/w1aw**.

Convention and Hamfest Calendar

Abbreviations

Spr = Sponsor
Tl = Talk-in frequency
Adm = Admission

SOUTHWESTERN DIVISION CONVENTION

February 15 – 16, Yuma, AZ
D F H Q R S T V
Friday noon – 5 PM, Saturday 8 AM – 5 PM. *Spr:* Yuma AR Hamfest Organization. Yuma County Fairgrounds, 2520 E. 32nd St. *Tl:* 146.78 (103.5 Hz). *Adm:* $5. **www.yumahamfest.org**.

ARKANSAS SECTION CONVENTION

February 16, Hoxie, AR
D F H R S V
Saturday 8 AM – 3 PM. *Spr:* Lawrence County ARC. Hoxie Service Center, 500 SW Lawrence St. Winter-Fest. ARRL forum at 10 AM, VE testing at 11 AM. *Tl:* 147.045. *Adm:* $5. **www.w5wra.org**.

Arkansas (Russellville) — Mar. 2
D F H Q R S T V
9 AM – 2 PM. *Spr:* Arkansas River Valley AR Foundation. Boys and Girls Club, 600 E. 16th St. *Tl:* 146.82, 146.22 (131.8 Hz). *Adm:* $5. **www.arvarf.com**.

Colorado (Brighton) — Feb. 17
D F H R V
9 AM – 1 PM. *Sprs:* Aurora Repeater Assn., Cherry Creek Young ARC, Rocky Mountain Ham Radio. Adams County Fairgrounds, 9755 Henderson Rd. *Tl:* 147.15 (100 Hz). *Adm:* $5. **n0ara.org**.

Florida (Brooksville) — Feb. 16
D F H R S T V
8 AM – 4 PM. *Spr:* Hernando County ARA. Sand Hill Scout Reservation, 11210 Cortez Blvd. (Hwy. 50). *Tl:* 146.715. *Adm:* $6. **www.hcara.org**.

Florida (Orlando) — Mar. 2 F R T
7 – 11 AM. *Spr:* Stanley Korzep, W8NNX, Stanley Winston of ESRC1. ESRC1, 6264 Pinecastle Blvd. *Tl:* None. *Adm:* Free. **www.esrcvacuumtubes.com/index.html.**

Florida (Punta Gorda) — Mar. 2
F H R S T V
8 AM – 2 PM. *Spr:* Peace River Radio Assn., Punta Gorda Boat Club, 802 W. Retta Esplanade. *Tl:* 147.255. *Adm:* $5. **prra.club**.

Florida (Sebring) — Feb. 16 D H R T
8 AM – 1 PM. *Spr:* Highlands County ARC. First Baptist Church of Lake Josephine, 111 Lake Josephine Dr. *Tl:* 147.045 (100 Hz). *Adm:* $5. **highlandsamateurradio.org**.

WEST CENTRAL FLORIDA SECTION TECHNICAL CONFERENCE

February 22 – 23, Tampa, FL
H S
Friday 1 – 5 PM, Saturday 9 AM – 5 PM. *Spr:* ARRL West Central Florida Section. Hillsborough County Emergency Operations Center, 9450 E. Columbus Dr. 5th Annual TechCon. *Tl:* 147.105 (146.2 Hz). *Adm:* Free. **www.arrlwcf.org**.

Florida (Zephyrhills) — Mar. 3 H R T
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**.

Georgia (Dalton) — Feb. 23
D F H R S T V
8 AM – 3 PM. *Spr:* Dalton ARC. North Georgia Agricultural Fairgrounds, 500 Legion Dr. *Tl:* 145.230. *Adm:* $5. **www.w4drc.com**.

Indiana (Brazil) — Mar. 9 D F H R
8 AM – noon. *Spr:* Wabash Valley ARA, Inc. Clay County 4-H Fairgrounds, 6550 N. State Road 59. *Tl:* 146.685 (151.4 Hz). *Adm:* $7. **https://www.w9uuu.org/**.

Indiana (Dugger) — Feb. 23 D F H V
8 AM – noon. *Spr:* Dugger ARC. City Park Community Bldg., 840 Hicum St. *Tl:* 146.775 (136.5 Hz). *Adm:* $8.

Indiana (La Porte) — Feb. 23 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. 2 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**.

Kentucky (Cave City) — Mar. 2
D F H R S T V
7:30 AM. *Spr:* Mammoth Cave ARC. Cave City Convention Center, 502 Mammoth Cave St. *Tl:* 146.94. *Adm:* $6. **www.ky4x.org**.

Maine (Augusta) — Feb. 16
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:* $2. **www.w1tlc.org**.

Massachusetts (Chicopee) — Mar. 9
D F H R V
8:30 AM – 4 PM. *Spr:* Mt. Tom Amateur Repeater Assn. Castle of the Knights, 1599 Memorial Dr. *Tl:* 146.94 (127.3 Hz). *Adm:* $5. **www.mtara.org**.

Massachusetts (Marlborough) — Feb. 16 D F H R V
9 AM – noon. *Spr:* Algonquin ARC. Marlborough Middle School, 25 Union St. *Tl:* 147.27 (146.2 Hz). *Adm:* $5. **n1em.org**.

Michigan (Livonia) — Feb. 17 D F H R
8 AM – noon. *Spr:* Livonia ARC. Civic Park Senior Center, 15218 Farmington Rd. 49th Annual Swap & Shop. *Tl:* 145.35 (100 Hz). *Adm:* $5. **www.livoniaarc.com/index.php?page=swapshop**.

NEBRASKA STATE CONVENTION

March 9, Lincoln, NE
D F H R S V
8 AM – 3 PM. *Spr:* Lincoln ARC. Lancaster Event Center, 4100 N. 84th St. *Tl:* 146.76. *Adm:* LARC member $5, non-member $9. **www.lincolnhamfest.org**.

New Jersey (Annandale) — Mar. 9
D F H R S V
8 AM. *Spr:* Cherryville Repeater Assn. II. North Hunterdon High School, 1445 State Rte. 31. *Tl:* 147.375 (151.4 Hz). *Adm:* $5. **www.qsl.net/w2cra**.

NEW MEXICO TECHFEST CONVENTION

February 23, Albuquerque, NM
H R S
8 AM – 5 PM. *Spr:* Rocky Mountain Ham Radio, New Mexico. NM Veterans' Memorial Event Center, 1100 Louisiana Blvd. SE. *Adm:* $10. *Tl:* None. **www.rmham.org/wordpress/new-mexico-techfest**.

New York (Big Flats) — Feb. 23 F 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. 24
D F H Q R S V
9 AM – 1 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 8 – 9, 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 $9, door $11. **charlottehamfest.org**.

North Dakota (Bismarck) — Feb. 23
F R S V
7 AM – 1 PM. *Spr:* Central Dakota ARC. St. Mary's Grade School, 807 E. Thayer Ave. *Tl:* 146.85 (107.2 Hz). *Adm:* Advance $6, door $7. **www.cdarcnd.com**.

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

Ohio (Elyria) — Mar. 3 D F H
8 AM – noon. *Spr:* Northern Ohio ARS. Lorain County Community College, 1005 N. Abbe Rd. *Tl:* 146.7 (110.9 Hz). *Adm:* $7. **www.noars.net/hamfests/noarsfest**.

Ohio (Mansfield) — Feb. 17 D 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:* $7. **www.iarc.club**.

Oregon (Rickreall) — Feb. 16 D F H R
9 AM – 3 PM. *Spr:* Salem Repeater Assn. Polk County Fairgrounds, 520 S. Pacific Hwy. *Tl:* 145.33 (186.2 Hz). *Adm:* Advance $8, door $10. **www.w7sra.org**.

Pennsylvania (South Park Township) — Feb. 24 D H Q R V
8 AM – 3 PM. *Spr:* Wireless Assn. of South Hills ARC. Home Economics Bldg., 3735 Buffalo Dr. *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., 29 Fireman Drive. Warren County Hamfest. *Tl:* 145.11 (186.2 Hz). *Adm:* $5. **www.kb3bsa.com**.

Texas (Irving) — Mar. 2 D F H R
8 AM – 1 PM. *Sprs:* Irving ARC, Inc. Betcha Bingo Hall, 2420 W. Irving Blvd. *Tl:* 146.720 (110.9 Hz). *Adm:* $5. **https://irvingarc.org/**.

Tennessee (Tullahoma) — Mar. 9 D F H Q R S T V
8 AM – 2 PM. *Spr:* Middle Tennessee ARS. First United Methodist Church, 208 W. Lauderdale St. NWS Weather Spotter Classes. *Tl:* 146.7 (114.8 Hz). *Adm:* $5. **www.qsl.net/mtars**.

Texas (Orange) — Feb. 23 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**.

VERMONT STATE CONVENTION

February 23, 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. *Tl:* 145.15 (100 Hz). *Adm:* Advance $6, door $9. **www.ranv.org/hamcon.html**.

Washington (Puyallup) — Mar. 9 D F H R V
9 AM – 3 PM. *Spr:* Mike and Key ARC. Exhibition Hall, Washington State Fairgrounds, 110 9th Ave. SW. 38th Swapmeet. Overnight RV parking, snack bar, consignments. *Tl:* 146.82 (103.5 Hz). *Adm:* $10 **www.mikeandkey.org/flea.htm**.

Wisconsin (Eau Claire) — Mar. 9 A H R
8 AM – 2 PM. *Sprs:* Eau Claire ARC, Saving Grace Lutheran Church, 2124 Eastridge Center St. *Tl:* 146.91 (110.9 Hz). *Adm:* $5. **https://www.ecarc.org**.

2019 ARRL NATIONAL CONVENTION AT DAYTON HAMVENTION®

May 17 – 19, Xenia, OH
D F H Q R S V
Fri. 9 AM – 5 PM, Sat. 9 AM – 5 PM, Sun. 9 AM – 1 PM.
Spr: Dayton ARA. Greene County Fairgrounds of Expo Center, 120 Fairgrounds Rd. *Tl:* 146.940 (123 Hz). *Adm:* Advanced $22, At-door $27. **www.hamvention.org** and **www.arrl.org/expo**.

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 ARRL's toll-free number at 1-800-243-7768, or email **ads@arrl.org**.

February 2019 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 6 (0000 UTC on February 7) and at 4 PM EST on Thursday, February 21 (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 27 at 9 PM PST (0500 UTC on February 28) on 3590 and 7047.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 35 WPM.

Strays

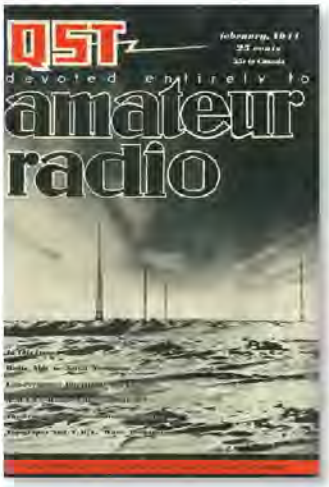
QST Congratulates...

Tucker Dunham, KD2JPM, on becoming an Eagle Scout. He is shown here at his Eagle Scout Honor Court with Rob Roschewsk, KA2PBT, the ARRL Northern New Jersey Section Manager. Rob was asked to speak about Tucker's Amateur Radio accomplishments, including Tucker's presentation at the 2018 Dayton Hamvention Youth Forum, where he talked about his project, "A Data Network for Emergency Communication."

Al Brogdon, W1AB

75, 50, and 25 Years Ago

February 1944



- The cover photo shows an antenna field of the Army Airways Communications System.
- The editorial urges us to continue our participation in the War Emergency Radio System.
- Clinton B. DeSoto, W1CBD, presents Part I of "The Army Airways Communications System," explaining how the organization relays all necessary information to keep the road ways of the sky safely operational.
- Peter Onnigian, W6QEU, gives us a description of modern airline equipment, in "Radio Aids to Navigation," following the growth of navigational communication systems over the past decade.
- In "Topography and V.H.F. Wave Propagation," Hollis French, W1JLK, discusses using contour maps as guides in the selection of V.H.F. transmitter sites.
- "In the Services" continues to report on our hams in the military, with a photo of Signal Corpsman W2CTO in a foxhole in Tunisia, and another of HQ's own Lt. Col. Ed Handy, W1BDI, now serving in the USAAF.

Febuary 1969

- The cover photo shows some of the circuitry of W6FFC's "A.F.S.K. for RTTY" box described in the issue.
- The editorial discusses "Conversation Discipline" on the air, suggesting some dos and don'ts to avoid controversial topics.
- In "A.F.S.K. for RTTY," Irvin Hoff, W6FFC, introduces his Mainline AK-1 audio frequency-shift keyer.
- The "T-Notch Filter for the HBR," by Jay Helms, W6HHT, provides a way to selectively reject unwanted heterodynes in receivers.
- Lewis McCoy, W1ICP, gives us some practical information on "Limited-Space Antennas and Methods of Coupling" for ham novices.
- In "Bridge Break," Mark Pearson, W0ZJY, describes his all-electronic break-in system for c.w.
- "225 Miles on 2300 MHz" reports on the new DX-record-breaking contact between K1DRB in Maine and W1QMN in Massachusetts.

February 1994

- The cover photo shows a Land Rover crossing an improvised log bridge during the Camel Trophy expedition, which was supported by G4CVI's communications team.
- The editorial announces the FCC's proposed vanity call sign program.
- "California's Burning," a compilation of reports from the field by Rick Palm, K1CE, tells us how hams provided much-needed radio communication during the devastating California wildfires of 1993.
- R. Dean Straw, N6BV/1, and Fred Hopengarten, K1VR, present a thorough analysis of "Stacking Tribanders: A Super Station — Sorta" as a way to enhance contest performance without needing acres of land for antenna setup.
- ARRL Field Organization official Jim Altman, N4UCK, tells us how to advocate for antenna builds in "Toppling Restrictive Tower Zoning Ordinances."
- Robert Capon, WA3ULH, tutors us on "Working Satellite RS-12 – The Ultimate Satellite Primer."
- Because, home telephones were very prone to RFI, Roger Buffington, AB6WR, provides helpful tips in "Real Fun Interference (RFI)."

Field Organization Reports

November 2018

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.**

613
WA7PTM

545
WS6P

420
W0KCF

412
W7PAT

326
KI6LNB

300
WB7OSC
WM2C

292
N3KRX

240
KC5ZGG

260
KW9EMG

233
KK7TN

230
KD2LPM
WA3EZN

225
WC9CW
KT2D

224
W0PZD

210
K7WXW

206
NI2W

200
W0DSF
N2WGF

199
KB1TCE

195
N1XFC

190
N8SY
K0IBS
KK4PUX

183
KD8TTE

180
K8LPC

175
WB9WKO
WK4WC
WB8RCR

173
KB3YRU

166
WA2CCN

165
KV4LY

160
WB9QPM

155
K2TV

151
KF4DVF

150
WD8MWD

147
WA2BSS

146
KB3KYH

145
W5DY

141
K2RMF

140
WB6OTS
WB3FTQ
KK3F
WB2FTX
W4DNA
WO2H
W2PH
WD8USA

135
W3YVQ
KE5YTA
W3GWM

130
NA7G
AA7BM
N3JET
K4IWW
N2JBA
WB4ZIQ

129
KE8CYC

125
AG9G
KI4UDZ

124
K8RDN

120
N7IE
WA4VGZ
KA2HZP
WM3G
W0LAW
KI0JO
AC0KQ

118
K4ETN

117
W3CB

115
K9LGU
K0PTK
KC8WH
WB8YYS

110
W4NWT
WB4FDT
K3IN
KA5AZK
KC5OZT
KF5IOU
KY2D
K4GK
W8CPG
K6HTN
AF4NC
W1KX
WC4FSU
WB8YLO
KA2ZNZ
WA3QLW
N5MKY
WB8TQZ

109
K3JL

107
KA5DON
N3SW

106
W4CMH

105
WB8QLT

104
KE4AHC

100
N9VC
NX9K
KN9P
AA3SB
KD2MDV
W4TTO
WB4RJW
KZ8Q
KB8MAF
N8CJS
AC8RV
KB2YAA
NN7H
K0VTT
KE8BYC
KE8CEH
WB6UZX

99
KB5PGY

97
KT5SR
K6JGL
W2CTG

95
KC8YVF

94
N3RB
KD2MEN

93
KW4GU
AD3J

92
KA8ZGY

90
KG5NNA
WD8DHC
WD0BFO
AA3N
KM4VTK
KM4WHO
K8KRA

WD8Q
KD2HYA
KD4EAQ
WB0B
K0CY
WB8WKQ
K8ED

89
KB1NMO
KE5HYW
AD5CQ

85
K8AMH
K3YAK
KA0DBK

84
W7PHX
WB6YJJ

83
KD2IWN

81
KC7ASA
KD7OED
KD8ZCM

80
KF7GC
KB2QO
WX4J

79
K1HEJ
KA9IKK
ND0CW
WA0UIG

78
AA4XZ

76
KA2GQQ

75
N2PQJ
WS6P

74
KB3IN
KN4AAG

70
W5XX
K6JT
K3MIY
K6RAU
KL7RF

The following stations qualified for PSHR in previous months but were not reported in this column: (Oct.) W0KCF 420, W7PAT 412, KC5ZGG 350, KK7TN 233, K7OAH 230, K7WXW 210, W0DSF 200, W0PZD 150, K2RMF, WB6OTS 140, N2JBA, AA7BM 130, WB4ZIQ 120, K4GK, KA2ZNZ 110, KB2YAA 100, KD2IWN 106, WA0UIG 105, K0VTT 100, WD0BFO, K0PTK 90, KA0DBK 83, WS4P 82, KD7OED 81, KF2GC 80, KC2SYL 77. (Sept.) KW9EMG 360, WB4ZIQ 120, WS4P 88.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AL, AZ, CO, CT, DE, EB, ENY, EPA, GA, IA, IL, LA, LAX, MDC, ME, MI, MN, MS, MT, NC, ND, NE, NFL, NLI, NNJ, NTX, OH, OR, SC, SD, SFL, SJV, STX, TN, UT, VA, WI, WNY, WPA, WV, WWA, WY.

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: AR, CT, DE, ENY, EPA, EWA, GA, IA, ID, IL, IN, KY, LA, MDC, MI, MO, MS, NFL, NM, NNJ, NNY, NV, OH, OR, PAC, SFL, SJV, STX, SV, VI, WCF, WNY, WV, WWA, WPA.

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.

WB9WKO 959, K6HTN 937, WS6P 886, N9VC 866, KK3F 574, KI0JO 553.

Silent Keys

It is with deep regret that we record the passing of these radio amateurs:

K1EHJ **Hutchinson**, Robert O., Duxbury, MA
W1IRQ **Klinedinst**, Kenneth B., Warner Robins, GA
KA1IUJ **Martin**, David E., Jefferson, ME
•K1LMJ **Bineau**, Gilbert A., Gorham, ME
•N1QJ **Childs**, Walter J., Baconton, GA
K1WSN **Zwirko**, Phyllis G., Amissville, VA
K2BLP **Ainsworth**, Richard A., Wappingers Falls, NY
WB2CMD **Loder**, James R., Clarksville, NY
KA2DRR **McNeill**, Hugh R. "Richie," Lake Ronkonkoma, NY
N2FG **Salmonsen**, Andrew R., Cherry Hill, NJ
KB2FPP **Robb**, Theodore M. "Matt," Haddonfield, NJ
WB2FXK **Slocum**, Jack M., Horseheads, NY
W2GCK **Keiser**, George, Fairport, NY
•KA2HOU **Di Giulio**, Louis R., Naples, FL
N2KTY **Sehne**, Gerhard F. "Gary," Austin, TX
N2LID **Colvin**, David E., Corning, NY
K2LOT **Peters**, John S., Edgecomb, ME
WE2M **Rankin**, Paul M., Bennington, VT
NR2P **Claprood**, Michael A., Elmira, NY
•K2PAB **Rosivach**, Edward S., Manlius, NY
WA2PRY **Pagan**, Jesse B., Pleasantville, NJ
WA2PYM **Collins**, Paul R., Fairport, NY
K2QHA **Kinsella**, John J., Rochester, NY
AE2RB **Besemer**, Richard R., Caroline, NY
W2ROG **Gibney**, Robert C., Churchville, NY
KC2RCS **Tompkins**, Gerald B., I, Big Flats, NY
W2RN **Marrin**, Thomas, Wood Ridge, NJ
K2RVP **Van Pelt**, Russell E., Beacon, NY
N2SEW **Reinke**, Robert, Penfield, NY
N2SQU **McCarty**, Christopher A., Nassau, NY
♦K2SR **Renswick**, Ernest B. "Skip," Jr., Bemus Point, NY
KB2TRZ **Graham**, Richard W., Malta, NY
KA2UOL **Rozanski**, Adam W., Carteret, NJ
N2WKW **Taggart**, Edward B., Syracuse, NY
W2ZV **Greene**, Gary R., Waxhaw, NY
W3AJF **Ferraro**, Anthony J., State College, PA
•K3CHM **Mathews**, Charles H., Jr., Scranton, PA
♦WB3DQD **Nasatka**, Conrad E., Manheim, PA
♦WA3ED **Buck**, Edward E., Fruitland, MD
K3GHT **Kampmeyer**, Roy A., Lansdale, PA
KC3HYH **Gazarik**, Joseph L., Apollo, PA
♦W3U **Schultz**, Henry L., Jr., Erie, PA
KB3YKF **Parker**, June M., Gilbert, PA
KM4BHK **Kimsey**, Robert A., Lithonia, GA
♦WA4BIM **Baisch**, Charles, Vestavia Hills, AL
KB4BQH **Yuspeh**, Harold David, Snellville, GA
KK4CMC **Dickey**, Robert, Fort Walton Beach, FL
KM4EOY **Furlong**, Donald A., Gainesville, FL
AF4FC **Wilson**, Ralph Z., Brooksville, FL
K4GBG **Blackburn**, William J., Lynchburg, VA
KF4HUY **Fuller**, Katona S., Madisonville, KY
KA4IMX **Evans**, Donald V., Walkersville, MD
W4KDX **Cave**, George H., Jr., Longwood, FL
K4KI **Carlson**, Don G., Hilton Head Island, SC
KE4KOH **Mardis**, Richard E., New Albany, KY
WB4KUZ **Wimberly**, Dwayne A., Hoover, AL
•KE4LY **Taylor**, Stephen C., Sr., Metter, GA
KK4NOF **Mann**, Alan D., Lake Wales, FL
♦K4OAC **Parker**, John C., Murphy, NC
KI4QQM **James**, Ricky J., Wetumpka, AL
WB4REC **Conrad**, Roger E., Bradenton, FL
•KG4SAK **Norman**, King W., Pilot Mountain, NC
WA4TSC **Boxwell**, Wesley W., Middleburg, VA
K4TV **Horton**, Edward T., Saint Augustine, FL
•WB4USJ **Daniel**, Hubert L. "Sonny," Gallant, AL
N4WVR **Dagley**, Cecil G. "Glen," Bradenton, FL
KG4WZI **Whaley**, Dwight O. "Otis," Kingsport, TN
WK4Y **Davis**, Roy D., Jr., Henrico, VA
KB4YAJ **Adams**, Bertha J., Trenton, NC
KG4YWA **Straight**, Dennis C., Lancaster, SC
NV4Z **Tomlinson**, Mary, Naples, FL
KE4ZZ **Thigpen**, Richard C., Vidalia, GA
WB5ASP **Richardson**, Homer L., Jr., Brookhaven, MS
N5AX **McDonald**, Hilary C. "Mac," Barstow, CA
KC5ELQ **Hildebrand**, Charles A. "C.A.," Odessa, TX
K5FNN **Winder**, Charles P., Jr., Houma, LA
W5GCB **Smith**, Martin L., Las Cruces, NM
K5IHK **Green**, Jerry, Magnolia, TX
K5JBE **Earthman**, Jim B., Dallas, TX
•K5JFV **Zubiate**, Richard A., Bellingham, WA
KK5JQ **Hightower**, Royce, Abilene, TX
AB5K **Gerdes**, Terry, Austin, TX
N5KKM **Ellis**, Ben F., Dallas, TX
♦K5MA **Carman**, R. Jan, West Falmouth, MA
KB5MOK **Bowen**, George L., Amory, MS
•KA5NIV **Brandt**, Wilfred V., Conway, AR
♦KE5RRR **Matherne**, Marvin L., Jr., Dallas, TX
N5TZA **Stewart**, Raymond B., Fort Smith, AR
AD5VL **Sieber**, Paula E., Oklahoma City, OK
WA5YWC **Gormley**, Robert J., Plano, TX
K5YYA **Hollahan**, Edward L., Corinth, TX
♦N5ZR **Jakubec**, Thomas S., Lubbock, TX
KF6AAT **Schulman**, Harold E., Loleta, CA
NH6AH **Oliver**, Robert E., III, Hilo, HI
KD6BIT **Reinhardt**, Melissa S., Agoura Hills, CA
WA6CAW **Marvin**, Louis A., Highland, CA
K6DHG **Nettekoven**, John L., Westlake Village, CA
KF6DZY **Vipond**, Marvin H., Sacramento, CA
WB6EDD **Presley**, Eldred R., Hollister, CA
♦N6EHA **Petty**, Marion Alfred, Exeter, CA
•WD6GYU **Young**, Gary L., Manton, CA
AG6IM **Wilson**, Lawrence H., Monte Sereno, CA
KC6IML **Hartl**, Richard J., San Juan Capistrano, CA
K6KAA **Abreu**, Michael F., Tustin, CA
KJ6KLA **Zornes**, Hy H., Fallbrook, CA
♦W6OGC **Allen**, James M., Sr., New Braunfels, TX
•K6QDC **Lindquist**, Arnold S., Davis, CA
KC6WZK **Lones**, Dain B., Palos Verdes Estates, CA
WA6YJR **Eddy**, Jack H., La Honda, CA
♦•W6ZW **Jones**, Harold R., San Mateo, CA
N7AQX **Van Orden**, Daniel C., Emporia, KS
KI7BP **Hollingsworth**, Ted I., Caldwell, ID
K7CI **Gardner**, Joe V., Fishertown, PA
KD7DDU **Pisarek**, Nancy J., Beavercreek, OR
K7DRA **Allman**, David R., Sr., Rock Springs, WY
•KD7FM **Pound**, Earl F., North Logan, UT
NH7GA **Henley**, Charles D., Sr., North Canton, OH
N7GDM **McLaughlin**, Tarrence L., Bozeman, MT
•W7GGU **Keene**, Bruce C., Bellingham, WA
N7HKF **Ray**, Carl E., Spokane, WA
KC7KMR **Sheldon**, Raymond K., Yuma, AZ
K7MCX **Pollock**, John, Seattle, WA
NW7O **Frye**, James R., Great Falls, MT
W7SVM **Hotchkiss**, Vernon L. "Bob," Jr., Spokane Valley, WA
N8AW **Wyatt**, Arnold G., Jackson, MI
W8BMA **Rinker**, Jack, Fort Myers Beach, FL
•W8CWH **Fonner**, William F., Sr., Wellsburg, WV
K8GHE **Allen**, John R., Poland, OH
KB8ILX **Sciarini**, Michelle R., Akron, OH
NR8J **Lester**, William W., Darien, CT
W8JO **Parker**, Sherry J., Arcanum, OH
W8LUM **McKendry**, Wayne E., Cary, NC
WB8MHE **Blaney**, Richard L., Circleville, OH
W8NGV **Smith**, William W., Dayton, OH
♦W8NRE **Liebler**, Edward, Lansing, MI
WD8PLI **Wengrow**, David, Grand Blanc, MI
W8QAJ **Roberts**, Lewis H., Portage Lakes, OH
KD8RW **Wilson**, Russell, Corning, OH
K8SWF **Shirko**, Roger P., Winter Haven, FL
K8TQJ **Springer**, Alva E., Tipp City, OH
♦K8VFV **Crawford**, Robert C., Davisburg, MI
♦K8VXD **Jernigan**, Daniel D., Findlay, OH
KW8Z **Cassale**, Kenneth L., Roseville, MI
W8ZRF **Place**, Roger F., Ypsilanti, MI
W9AKN **Estis**, Frank W., Jr., McHenry, IL
WB9AOV **Trobaugh**, John W., East Peoria, IL
K9GEI **Fishelson**, Robert "Fish," Fond Du Lac, WI
KC9GKZ **Collins**, Garland, Knox, IN
♦•K9JKZ **Dorsett**, Darrel M. "Doc," San Francisco, CA
K9LSU **Asscherick**, Odie D., Houston, TX
♦K9LTL **Schroedel**, Martin R., Hermitage, MO
KC9NSR **Johnson**, Jeremy T., Galesburg, IL
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♦WB9RZA **Reynolds**, Robert L., Woodruff, WI
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W9WOD **Henning**, Elmer, Northbrook, IL
•KA9WRL **Howe**, William G., Grafton, WI
KB9YIP **Prokop**, Ralph C., Sturgeon Bay, WI
W9ZSC **Worthington**, Raymond O. "Gene," New Castle, IN
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WD0DTS **Hefley**, Steve M., Pittsburg, KS
KE0EBP **Mengel**, John T., Englewood, CO
♦K0FYJ **Smith**, Robert G., Overland Park, KS
KC0GLU **Lilleston**, Mary L., Paola, KS
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N0IRV **Roach**, Wesley G., Jr., Bertrand, NE
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K0JDB **Polley**, Raymond T., Overland Park, KS
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AB0LE **Martin**, Edward L., Neodesha, KS
•WB0MEW **Pitt**, Carroll I. "Bud," Bettendorf, IA
KE0MQQ **Miller**, Mark D., Pittsburg, KS
WB0OOH **Volle**, Norman C., Valley Park, MO
W0QUF **Smith**, Ralph L., Atlantic, IA
KE0UU **Wolfers**, Charles V., Canon City, CO
•W0VAA **Oltmanns**, Alvin G., Wisner, NE
WJ0W **Stevens**, Frederick E., Rochester, MN
W0WGZ **Bucksbaum**, Arnold M., Cedar Rapids, IA
K0YCR **Watterson**, Carl E., Kansas City, MO
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KD0ZNZ **Harris**, Bob, Salina, KS
VA3WIDYYB0SWI/AB1XM **Widajat**, Sukwan, Ontario, Canada

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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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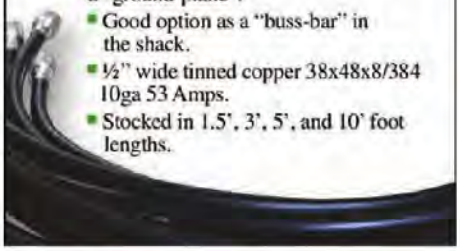

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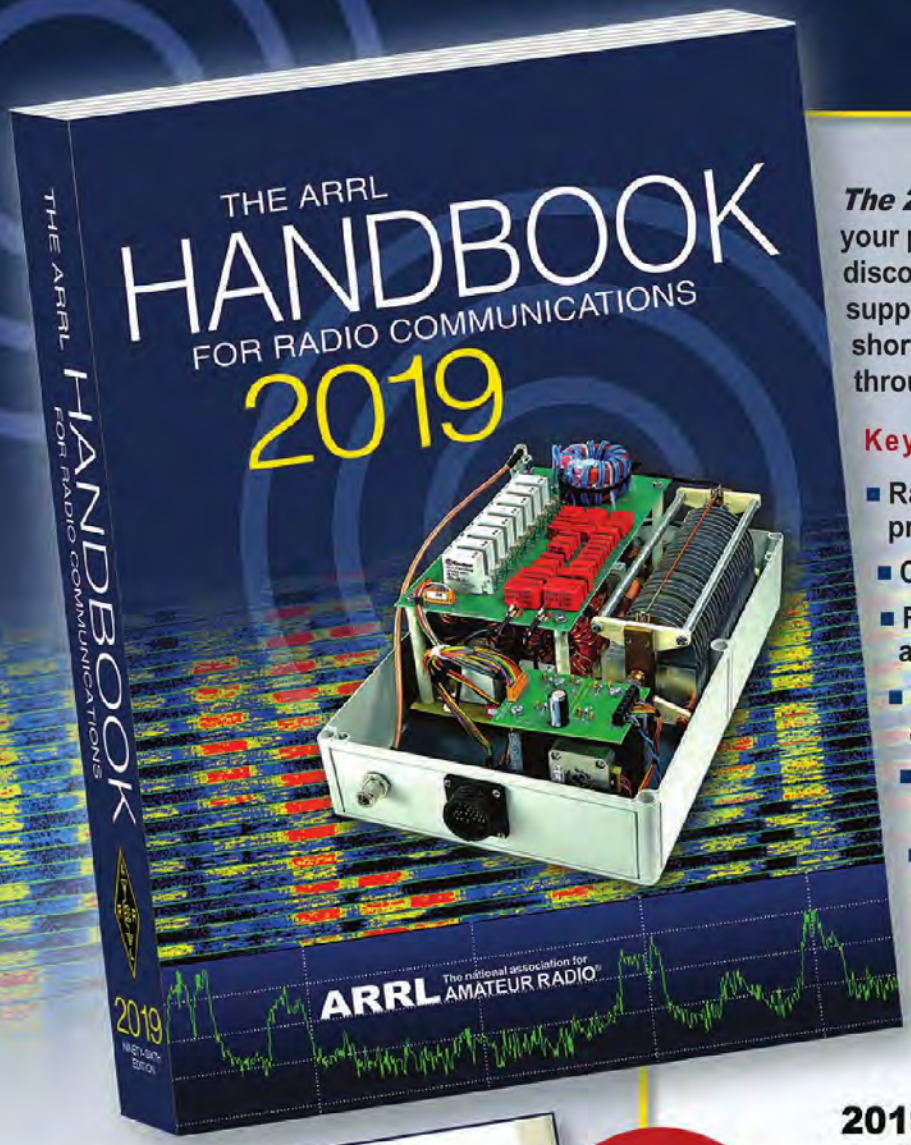

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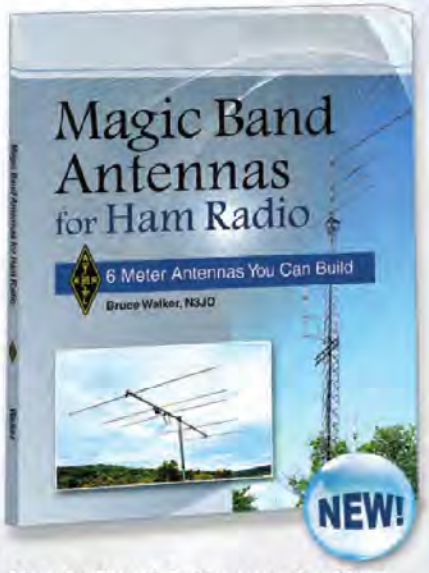

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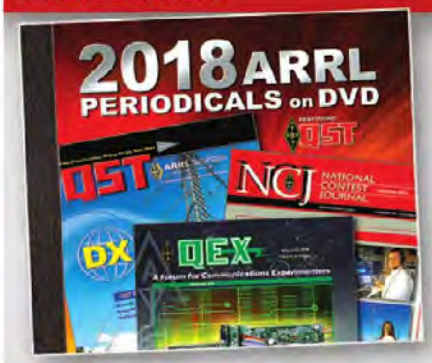

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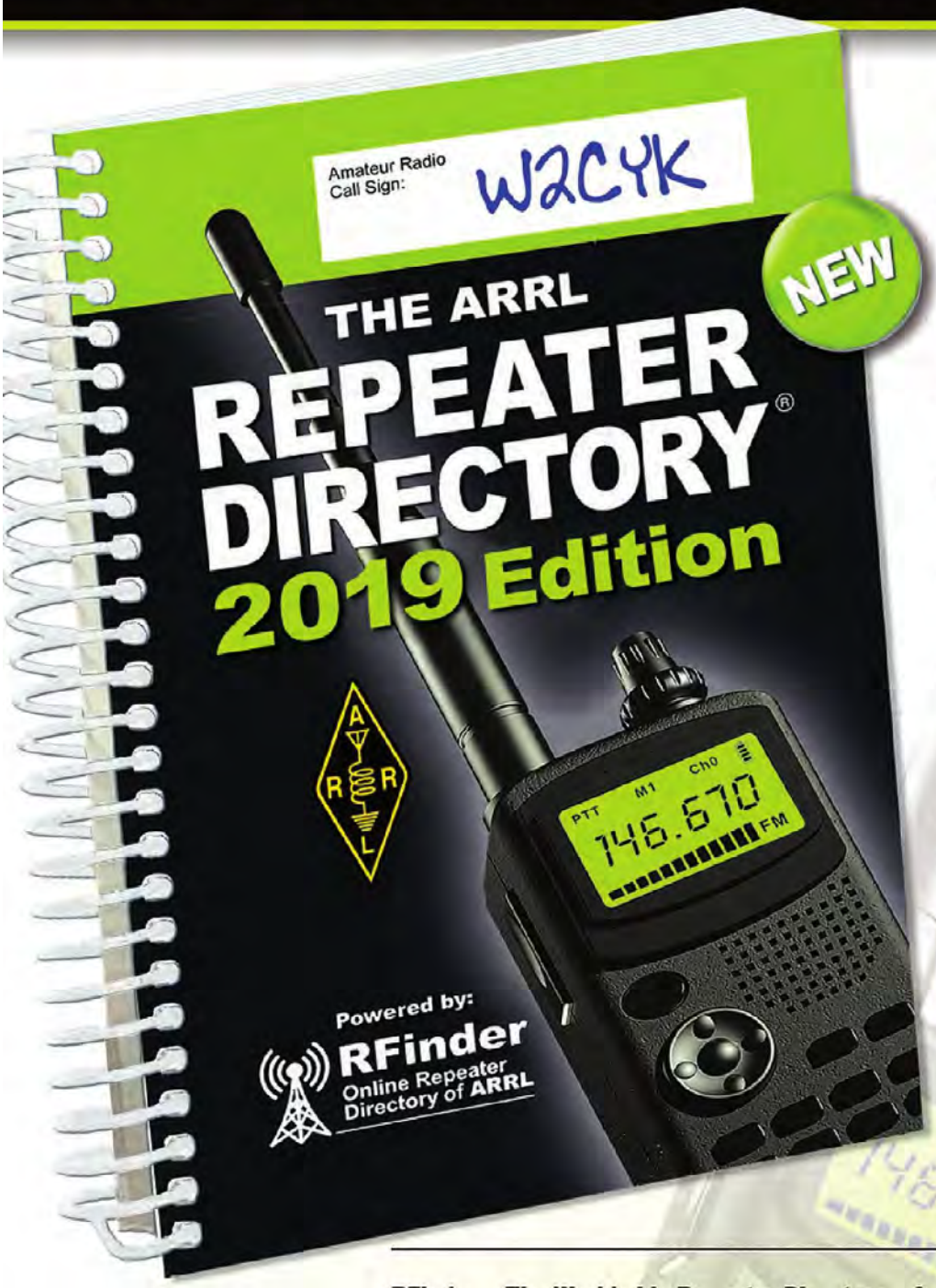

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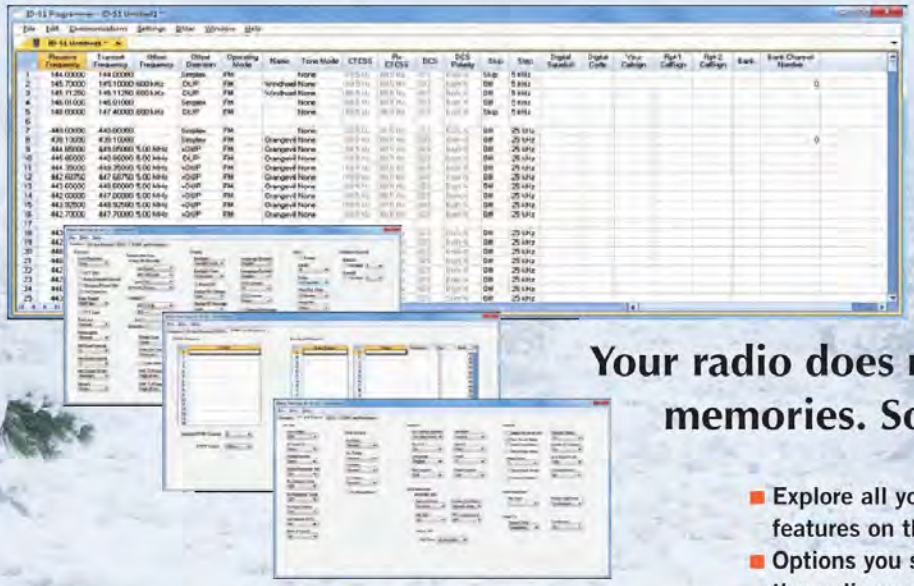

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HAM-VI – $749.95 with DCU-2
HAM-VII – $799.95 with DCU-3

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**

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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**
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Effective Moment (in tower)	**3400 ft.-lbs**

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CD-45D2 – $549.95 with DCU-2
CD-45D3 – $599.95 with DCU-3

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**
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Effective Moment (in tower)	**1200 ft.-lbs**

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DCU-3 – $449.95

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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.

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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".

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DCU-2 Digital Rotator Controller – $399.95
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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**

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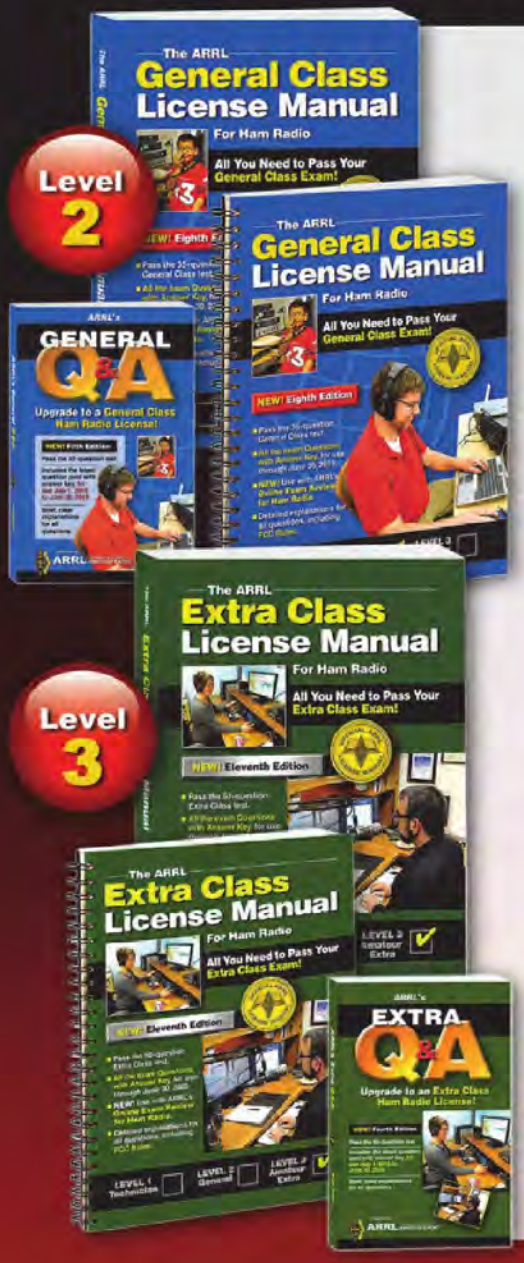

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40-6 METER Cobweb Super Heavy-Duty, 1.5 kW

New! Super heavy-duty 40-6 Meter Cobweb Antenna. 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.

MFJ 20/17/15/12/10/6 Meter *Hexbeam*

New MFJ HexBeams deliver solid gain and directivity on 20/17/15/12/10/6 Meters with two elements on each band.

MFJ uses an updated G3TXQ element configuration for excellent gain, improved bandwidth, superior front-to-back ratio and low SWR!

MFJ takes the HexBeam`s unique balanced-tension framework to a new level with rugged mounting hardware, exceptionally durable spreaders and sliding antenna-wire guides – designed to ensure years of reliable service.

MFJ-1846, $499.95. 6 Bands: 20/17/15/12/10/ 6M, 2-elements per band, full 1500W. 25 lbs. 11 ft.turning radius.

MFJ-1848, $699.95. 8 Bands: 20/17/15/12/10/ 6M, 2-elements per band; 40/30M, single elements, full 1500W. 28 lbs. 14 ft. turning radius.

www.mfjenterprises.com

3-Element Hexbeam

MFJ-1856 is ***six*** individually stacked monoband yagis!

6 Bands: 20/17/15/12/10/6M. Full 1500 Watts.

Three *full-size* elements on each band gives high gain, high front-to-back ratio and wide bandwidth. Works great at 20 feet. 30lbs. 17 feet turning radius. Ideal for a small rotator like hy-gain's CD-45II, $449.95.

MFJ Isolator and 1:1 Balun

MFJ-915, $29.95 Stop *RF* traveling down coax line, painful RF "bites" and erratic operation. 1.5 kW 1.8-60 MHz. 2W x 5H". SO-239s.

MFJ-918, $29.95 True 1:1 Current balun & center insulator forces equal antenna currents in dipole elements.

MFJ Dry Dummy Load

MFJ-260C, $39.95. Air-cooled, 300 Watt dry dummy load with a noninductive resistor in a perforated metal housing. SO-239 connector. Full load 30 seconds. Silk-screened derating curve to 5 minutes. SWR below 1.1:1 to 30 MHz, 1.5:1 from 30 to 650 MHz.

MFJ 2-Pos. Antenna Switch

MFJ-1702C, $39.95. 2-position antenna switch has center ground, auto grounding of unused position, handles 2.5 kW PEP and works to over 500 MHz. Lightning surge protection. Quality SO-239 connectors, heavy duty diecast.

MFJ-1704, $79.95. Like MFJ-1702C but has 4 positions.

MFJ G5RV Antenna

MFJ-1778, $49.95. G5RV antenna covers 160-10 Meters with antenna tuner. 102 ft. long. Inverted vee or sloper. Use on 160 Meters as Marconi. 1500 Watts. Super-strong fiberglass center/feedpoint insulators. Glazed ceramic end insulators. Hand-soldered. Add coax, some rope and you're *on the air!*

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MFJ_1836_021417_QST_091418DS

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 through December 1, 2018.

Get on the web and vote today at **www.arrl.org/quickstats**!

Is it becoming more difficult to find hams willing to engage in real conversations on the HF bands?

Yes. **56%**
No. **44%**

How active are your local digital or analog repeaters?

Pretty dead most of the time. **27%**
Active only during commuting times, or during nets and other scheduled activities. **47%**
Busy almost all the time. **3%**
I don't monitor local repeaters. **23%**

Do you think CW activity has increased or decreased on the HF bands?

Increased. **14%**
Decreased. **21%**
About the same as always. **33%**
I don't operate CW, so I'm not sure. **32%**

Are you active on 160 meters?

Yes, it is one of my favorite bands. **8%**
Yes, I get on the band occasionally. **21%**
Yes, but only during contests. **5%**
No, I'm not interested in the band. **4%**
No, I don't have an antenna for 160 meters. **57%**
No, other. **5%**

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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 wide-band SDR dongle receiver lets you see an entire band on a frequency/waterfall computer display! 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! While receiving on your transceiver, MFJ-1708SDR switches your SDR to your antenna showing the entire band. 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.

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 ⅝ 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.

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Dummy Loads

World's most popular Dry 300 Watt HF/VHF Dummy Load

Air-cooled, non-inductive resistor in a perforated metal housing; Has SO-239 connector. Full 300W for 30 seconds. Derating curve to 5 minutes. SWR below 1.1:1 to 30 MHz, 1.5:1 30 to 650 MHz. Compact 2¼ x 2¼ x 7 inches. **MFJ-260CN, $49.95.** With type "N" connector.

MFJ-260C
$39.95

Dry 1.5 kW HF/VHF/UHF Dummy Load

Ham radio's most versatile 1.5 kW 50 ohm *dry* dummy load covers DC through 650 MHz. SWR 1.1:1 to 30 MHz and 1.3:1 to 650 MHz. Handles 1500 Watts for ten seconds, 100 Watts for 10 minutes. 3W x 3H x 9D in. SO-239 connector. **MFJ-264N, $84.95.** With type "N" connector.

MFJ-264
$74.95

Oil-Cooled 1 kW CW, 2 kW SSB 50-Ohm VersaLoad™

Run 1kW CW or 2 kW PEP for 10 minutes. Run *continuous duty* with 200 Watts CW or 400W PEP. Transformer oil included. SWR 1.2:1 to 30 MHz. Low SWR to 400 MHz. SO-239 connector. Safety vent with cap, carrying handle. 7½H x 6⅝D in. **MFJ-250X, $49.95.** No transformer oil.

MFJ-250
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500 MHz, 100 Watt Dummy Load

Connects directly with built-in PL-259. Finned aluminum air-cooled heatsink. 15 Watts continuous, 100W peak. SWR <1.5:1, DC-500 MHz. 15/8 inch round by 3 inches long. **MFJ-262B, $59.95.** PL-259. 35 Watts continuous, 200W for 5-seconds. SWR< 1.2;1 DC-1 GHz.

MFJ-261
$27.95
with PL-259
DC to 500 MHz

MFJ 2500W *fan-cooled* Dry Load

MFJ's 2500 Watt *fan cooled* load handles legal limit amps, 2500W average one minute on, ten minutes off, 300W continuous. DC- 6 Meters. SWR <1.25, 30 MHz; <1.4, 30-60 MHz. Detailed power curve. 12 VDC or 110 VAC. 8¼W x 4H x 9½D in. SO-239s. 5 pounds.

MFJ-265
$219.95

Switchable RF Dummy Load

Select 16.6, 25, 50, 100, 150 Ohm dummy loads. Test/calibrate your wattmeters, SWR accuracy. At 50 Ohms it handles 300 Watts for 30 seconds with SWR < 1.1, 60 MHz. SO-239. 4½W x 2¼H x 6½D in. Optional 12 VDC/110 VAC adaptor, MFJ-1312D, $15.95.

MFJ-251
$149.95

3 GHz, 300 Watts Dry Dummy Load

New high-tech metal film resistor on large heavy-duty air-cooled heatsink. 300 Watts for ten seconds and 125W continuously. SWR < 1.1, 1 GHz; <1.2, 1.5 GHz; <1.5, 3 GHz. N-connector. 10¾W x 2¼H x 5¼D inches.

MFJ-263
$99.95

1.5kW Dry DummyLoad/SWR/Wattmeter

Tune up your transceiver, linear amplifier or antenna tuner into a safe 50 Ohm dummy load at *full power.* Then instantly switch to your antenna and monitor SWR, forward and reflected power on lighted cross-needle meter. 300/3000 Watt ranges. DC-60 MHz.Test/tune Xceivers, amps, tuners, baluns, filters, coax, stubs.

MFJ-267
$159.95

SWR/Wattmeters

Compact Cross-Needle SWR/Wattmeters

Large 3-inch lighted Cross-Needle meter covers 1.8-200 MHz in 30/300W power ranges. Read forward, reflected power, SWR *simultaneously.* 3¼W x 3¼H x 3¼D in. SO-239 connectors. **MFJ-842, $59.95.** 140-525 MHz, 15/150W.

MFJ-822
$59.95

High-accuracy 1.8-60 MHz Digital SWR/Wattmeter

Highly accurate! Auto-ranging select 25W, 250W, 1500W ranges with *full 10-bit* resolution. Frequency compensated data insures highest accuracy. *True peak*/average forward/reflected power, SWR and frequency are *simultaneously* displayed on backlit LCD and large 3-inch lighted cross needle meter. Peak hold. LED, buzzer, amplifier-by-pass alerts and protects your amplifier when SWR is high and toggles extra relay. 6½W x 2⅝H x 6D". **MFJ-826B, $179.95.** No meter, ampr bypass, control relay.

MFJ-828
$229.95

MFJ GrandMaster™ SWR/Wattmeters

GrandMaster™ SWR/Power Meters are the *Cadillacs of ham radio!* Large 3¼ x 1¼ inch precision illuminated meter gives easy wide-angle viewing of SWR, forward or reflected power. 7½W x 3⅛H x 4¼D in. SO-239s. **MFJ-870, $79.95.** 1.6-60 MHz. 30/300/3000 Watt ranges. **MFJ-874, $109.95.** 1.8-525 MHz. 5/20/200 Watt ranges.

MFJ-870
$79.95

MFJ *giant* 6.5 inch SWR/Wattmeter

World's *largest* HF+6M SWR/Wattmeter has giant 6½ inch meter! Extra-long scales gives highly accurate SWR/power 1.8-54 MHz. Huge numbers make reading easy. *True* peak or average forward and reflected power. 20/200/2000 Watt ranges. 9 Volt battery, 12 VDC or 110 VAC with **MFJ-1312D, $15.95.** 7W x 5½H x 5D in. SO-239s.

MFJ-868B
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VHF SWR/Wattmeter plus Field Strength

World's most popular – and most affordable – VHF SWR/ Wattmeter. Read SWR, forward and reflected power over 144-220 MHz in two ranges, 30/300W. Built-in field strength meter for 1-220 MHz. 4½W x 2¼H x 3D".

MFJ-812B
$39.95

Compact Digital SWR/Wattmeters

Displays forward, refelected power, SWR (1.6-60 MHz) and battery *all in a single glance!* Large ½" forward power digits and 5/8" reflected/SWR digits! 0-200W. Power/backlight on/off. SO-239s. **MFJ-847, $99.95.** 125-525 MHz, 0-120W. **MFJ-849, $169.95. Large** 3.5" bright orange LCD displays SWR, forward/reflected power. 1.5-525 MHz, 200W, HF/VHF-UHF switch.

MFJ-845
$99.95

MFJ-849
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MFJ HF *QRP* SWR/Wattmeter

Read forward, reflected power 1.8- 50 MHz, 0-5W. Also reads SWR, relative power 100 mW to 50W. SO-239s. 4½W x 2¼ H x 3D in.

MFJ-813
$39.95

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MFJ-1708B-SDR-S, $104.95. SMA connector for your SDR.

MFJ-1708SDR, $79.95. Original model for HF/VHF.

New B series improvements...
The original MFJ-1708 series used one relay and wires to connect the SO-239s. The new B-series uses four relays and connectors on a *single* pc board. This gives you > 50 dB isolation at 300 MHz and > 68 dB at 50 MHz. SWR < 1.16:1 at 50 MHz and < 1.75:1 at 450 MHz at the transmit port. Mute output is a selectable short or open to ground. Use "boat anchors" or modern receivers or key a linear amplifier. Receiver input protection prevents overload from nearby high power signals and from receive to transmit. A hybrid splitter on SDR models reduces loading effect and gives > 15 dB isolation between the SDR REC and XCVR ports to reduce interference. The original MFJ-1708 series is still available.

MFJ Low Noise VLF/HF Receiving Loop

Pull weak signals out of static crashes, atmospheric, man-made and power line noise!

Hear signals 50 KHz to 30 MHz cleaner, quieter than ever before! Power line noise disappears. Rotate its figure 8 pattern and its extremely deep null to completely eliminate an interfering signal or greatly peak a desired one. Fully protected state of-the-art Gali MMICs in push-pull gives you a preamp with extremely high dynamic range, low IMD and 25 dB of low noise gain. Excellent performance on strong and weak signals without overload. 36-inch dia. loop. 1-in. OD 6061 aluminum.

MFJ *wideband* SDR *Discone* Antenna

Receives 25-1300 MHz

MFJ ultra wide-band *Discone* Antenna receives 25-1300 MHz. Perfect for all band SDR reception. Covers 10, 6, 2 Meters, 220 and 440 MHz and 33/23 CM ham bands and everything in between. It is excellent for monitoring multiple bands simultaneously using multiple SDRs and a multi-coupler. Also test any transmitter 50-1300 MHz using a single discone and single coax. Handles 200W. Includes 50 feet coax, stainless steel elements and mounting hardware.

MFJ-1866, $49.95. Like MFJ-1868 but transmits 144-1290 MHz. Coax and mounting hardware not included.

Tuned Indoor SDR Active Antenna

MFJ-1020C
$99.95

Make your SDR receiver come alive with HF signals, .3-40 MHz, while rejecting interference with MFJ-1020C *tuneable* indoor active antenna! Gain control, telescoping whip.

Untuned Indoor SDR Active Antenna

MFJ-1022, $69.95. Hear weak, noisy VLF to UHF signals. Noise-less feedback gives excellent low noise reception. Handles strong signals.

Active Outdoor Antenna

MFJ-1024
$159.95

World Radio TV Handbook says "MFJ-1024 is a *first rate, easy-to-operate active antenna, quiet, excellent dynamic range, good gain, very low noise factor, broad frequency coverage, excellent choice...*" **Outdoor** mounted 54-inch whip/pre-amp gives maximum signal and minimum noise. Covers .05-30 MHz. **Indoor** unit: 20 dB attenuator, gain control, 2 receiver and 2 antenna switches.

HF SDR Preselector

MFJ-1040C
$119.95

Tuneable MFJ-1040C lets you copy weak, noisy SDR signals from 1.8 to 54 MHz. Greatly tunes out and reject out-of-band interference. Up to 20 dB gain. Has gain control. Cascade FET/bipolar transistor gives low noise, high gain without overloading. Switches for 2 antennas and 2 receivers. SO-239s. Has 20 dB attenuator. Automatically bypasses when transmitting or use PTT. 6½W x 2½H x 4D inches.

MFJ LW/MW/SW SDR Preselector/Tuner

MFJ-956
$69.95

Highly rated series-tuned MFJ-956 boosts your desired signals while greatly rejecting interference and preventing serious overload. **Greatly** improves reception 0.15 to 30 MHz. Incredibly effective below 2 MHz. **Super** easy to operate, select band and tune! **Bypass** tuner and ground receiver switch positions. **Compact** 2 x 3 x 4 inches. SO-239 connectors.

MFJ-1708B, $99.95.

MFJ RF Sense Transmit/Receive Switch

Switches your antenna from receiver to transmitter using a relay. Shorts your receiver to ground during transmit. Use RF sensing with adjustable delay or PTT line. Has selectable open/short mute.

MFJ-1707B, $99.95.

Auto switch XCVR between 2 antennas

Switches switches separate transmit and receive antennas on transceivers with only one antenna port. *Example*: Efficient 75M dipole for XMIT and MFJ-1708B low noise MFJ loop for receive -- *no static crashes*!

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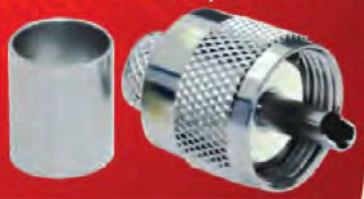
HAMMO-CAN™ Go Box

Ready to go, 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 & Voltmeter included!

Happy New Year!
Best wishes for 2019
from your friends at
Quicksilver Radio

Connectors & Adapters

Excellent quality, no bargain basement stuff here. Adapters & connectors for most types of connections.



Powerpole Mounts

EZ install, just drill a 1-1/8" hole. Great for go-kits, power supplies, and other projects in the shack or on the bench.

Ultimate Crimp Kit™

Ultimate Anderson Powerpole & Coax prep, strip & crimp kit. Crimp 15, 30, 45, 50 & 75A Powerpoles. Works with all popular coax types like RG-213, LMR-400 & 240, RG-8X, etc.

USB Microscopes

Up to 1000X magnification. Capture still images and record live video. Built in LED Lighting. New models available!

Powerpole Connectors

The standard for DC power connections. Power distribution, pre-built cables, mounts & more.

Play-Series™ System

Check out our new Play-Series™ USB modules. New body & LED colors & styles. Aluminum body available. Spruce up your Ham shack, car, etc.

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MFJ... the World Leader in Ham Radio Analyzers!

MFJ Analyzers

MFJ-269C...530 KHz - 230 MHz plus 415-470 MHz, 12-bit A/D

New and improved. Now covers 530 KHz to 230 MHz and 415 to 470 MHz!

Instantly gives you a complete picture of your antenna.

Read SWR, return loss, reflection coefficient, match efficiency at any frequency simultaneously.

Read Complex Impedance (530 KHz to 230 MHz) as series equivalent resistance and reactance (Rs+jXs) or as magnitude (Z) and phase (degrees). Also reads parallel equivalent resistance and reactance (Rp+jXp).

Determine velocity factor, coax loss in dB, length of coax and *distance to short or open in feet (it's like a built-in TDR).*

Coax Calculator™ calculates coax line length in feet given degrees and vice versa for any frequency and velocity factor.

Measure SWR and loss of coax with *any* characteristic impedance (530 KHz to 230 MHz) from 10 to over 600 Ohms.

Measures inductance in uH and capacitance in pF at RF frequencies, 530 KHz to 230 MHz.

High contrast LCD gives precision readings and two side-by-side analog meters make antenna adjustments smooth and easy.

12-bit A/D converter gives much better accuracy and resolution than common 8-bit A/D converters – *MFJ-269C exclusive!*

Built-in frequency counter, battery saver, low battery warning, Ni-Mh/NiCd charge circuit. 4W x 2D x 6¾ inches, 2 lbs. Use ten double A batteries or 110 VAC with MFJ-1312D, $15.95.

MFJ-269C
$399.95

MFJ-269CPRO™ Analyzer

MFJ-269CPro, $429.95. Like MFJ- 269C, but UHF range covers ***430 to 520 MHz*** to include commercial industrial frequencies. Rugged protective shell protects knobs, switches, meters, LCD for industrial/lab work.

MFJ No Matter What™ Warranty

Every MFJ Analyzer is protected by MFJ's famous one year **No Matter What™** limited warranty. We will repair or replace your MFJ analyzer (at our option) for a full year.

More hams use MFJ analyzers than all others in the world!

MFJ-259C

530 KHz - 230 MHz, World's most popular analyzers

NEW!

New and improved. Now covers 530 KHz to 230 MHz!.

All-in-one ham radio test set...

Includes frequency counter, RF Generator, *SWR Analyzer*™, RF Resistance and Reactance Analyzer, Coax Analyzer, Capacitance and Inductance Meter and more!

Large easy-to-read two line LCD screen and side-by-side meters clearly display your information.

MFJ-259C
$299.95

Here's what you can do...

Super easy-to-use – Read antenna SWR, complex impedance, return loss, reflection coefficient. Determine velocity factor, coax cable loss in dB, length of coax and distance to short or open in feet. Read inductance in uH, capacitance in pF at RF frequencies. Large easy-to-see two line LCD screen and side-by-side meters clearly display your information. Built-in frequency counter, signal generator, Ni-Cad charger circuit, battery saver, low battery warning and smooth reduction drive tuning. *More!*

Maritime and 600 Meter Coverage

MFJ-259CM, $299.95. Like MFJ-259C except the bottom band covers 470-940 KHz for Maritime and 600 Meter bands.

MFJ-223

1-60 MHz Color Graphic VNA Analyzer

MFJ-223
$299.95

This *pocket-sized* wonder breaks the mold for analyzer design with user-friendly convenience, top notch accuracy, and a vivid TFT multi-color display. Don't let the size fool you, MFJ-223 is packed with all the VNA features and performance you need!

- **Single-frequency** and *swept-frequency* operating modes
- **Truly accurate** SWR, R, X, and Z measurements
- **Seamless DDS** coverage with 100-Hz resolution from 1-60 MHz
- **Smooth "skip-free"** encoder tunes fast or slow without missing a step
- **Powerful +5-dBm** stimulus generator overrides local interference
- **Field-strength meter** measures local signals, detects potential interference
- **DDS generator** precision signal source
- **Vivid 1600-pixel/inch** color graphics on a 2x2 inch non-glare TFT screen

MFJ-225

1.5-180 MHz *continuous* Two-Port Graphic Analyzer

Out in the field, MFJ-225 is a compact completely *self-contained hand-held graphing analyzer.* On the bench it becomes a full-fledged two-port (S21) desktop machine when teamed up with your PC. Using powerful IG-miniVNA freeware, you'll run detailed data analysis and print out stunning color-graphic plots to document your work!

MFJ-225
$299.95

Built-in back-lighted *3-inch LCD graphic* display. Make fine adjustments using fullscreen easy-to-view SWR bargraph, capture vivid swept displays for SWR, impedance, return loss, phase angle, more. DDS generator.

MFJ-249C Analyzer

MFJ-249C, $279.95

If digital display is all you need MFJ-249C does everything MFJ-259C does without analog meters.

Visit: www.mfjenterprises.com or call toll-free 800-647-1800

MFJ VNA Antenna Analyzer

MFJ VNA Antenna Analyzer covers 1 to 230 MHz, 1Hz resolution.

·Frequency sweep plots: *SWR, Impedance, Resistance, Reactance, Phase Angle, Complex Return Loss, Smith Chart*

·Sign of reactance positively identifies inductive or capacitive reactance ***·Amazing accuracy with OSL (Open-Short-Load) calibration*** – calibrate through feedline/test cable at different frequencies and store in memory. Measure directly or through feedline with exceptional accuracy, correcting for line loss/phase angle. ***Smith Chart*** plots S11 magnitude/phase over any frequency span. ***Capture screens*** in 32 memories to download to PC via USB.

MFJ-226
$339.95

MFJ SWR Analyzer Accessories

- **A. MFJ-29D/MFJ-39D, $24.95.** Carrying Pouch for MFJ-259C/269C.
- **B. MFJ-92AA10, $29.95.** 10-Pack 2500 mAh Ni-MH Supercells.
- **C. MFJ-66, $24.95.** Dip coils, set of two covers 1.8-230 MHz.
- **D. MFJ-731, $99.95.** Tunable Analyzer Filter, 1.8-30 MHz, for strong RF fields.
- **E. MFJ-917, $29.95.** 1:1 Current balun for SWR Analyzers to test balanced line antennas, other loads.
- **F. MFJ-5510, $9.95.** 12VDC cigarette lighter adapter.
- **G. MFJ-7737, $5.95.** PL-259 to BNC Female.
- **H. MFJ-7727, $5.95.** PL-259 to SMA Female.
- **I. MFJ-633, $29.95.** Ultra-fast intelligent charger.

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Phone: (662) 323-5869 ■ **Tech Help:** (662) 323-0549 ■ **FAX:** (662) 323-6551 8-4:30 CST, Mon.-Fri.

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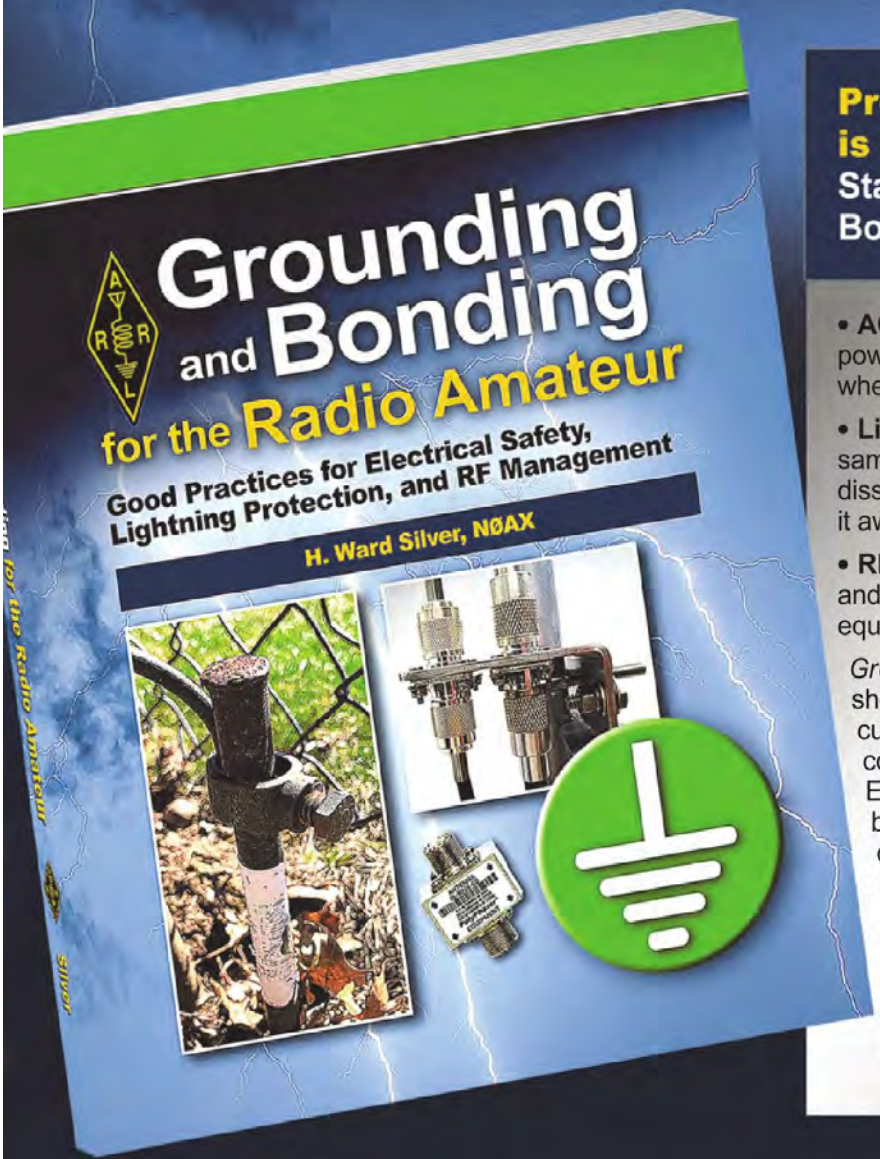
Every Ham Needs This Essential Book!

Grounding and Bonding for the Radio Amateur

H. Ward Silver, NØAX

Good Practices for Electrical Safety, Lightning Protection, and RF Management



Proper Station Grounding is Important!...Build Your Ham Radio Station with Effective Grounding and Bonding Techniques:

- **AC safety:** protects against shock hazards from ac-powered equipment by providing a safe path for current when a fault in wiring or insulation occurs.
- **Lightning protection:** keeps all equipment at the same voltage during transients from lighting and dissipate the lightning's charge in the Earth, routing it away from equipment.
- **RF management:** prevents unwanted RF currents and voltages from disrupting the normal functions of equipment (also known as RF interference or RFI).

Grounding and Bonding for the Radio Amateur shows you how to make sure your station follows current standards for lightning protection and communication systems, not to mention the National Electrical Code. You'll learn effective grounding and bonding techniques for home stations, including condos and apartments, portable and temporary stations, as well as towers and outside antennas.

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MFJ...the World Leader in Ham Radio Accessories!

MFJ *IntelliTuner*™ Automatic Tuners

More hams use MFJ tuners than all other tuners in the world!

World's most advanced Automatic Antenna Tuners feature world renowned MFJ AdaptiveSearch™ and AutomaticRecall™ algorithms -- world's fastest ultra-wide range tuning. Nine World Class models! Choose your features: Digital/Analog/Audio SWR-Wattmeter, Antenna Switch, Balun, Radio Interface, Digital Frequency Readout, Remoteable, Coax/Balanced Lines/Wire Tuning, Field Upgradeable...

MFJ *IntelliTuner*™ Automatic Tuners

The MFJ-993B *IntelliTuner*™ lets you tune any antenna *automatically – ultra fast.*

It's a comprehensive automatic *antenna tuning center* complete with SWR/Wattmeter, antenna switch for two antennas and 4:1 current balun for balanced lines.

MFJ's exclusive *IntelliTuner*™, *Adaptive Search*™ and *Instant Recall*™ algorithms give you *ultra fast* automatic tuning with over 20,000 *VirtualAntenna*™ Memories.

MFJ-993B
$269.95

You get a highly efficient L-network, 6-1600 Ohm matching at 300 Watts SSB/CW or *extra wide* 6-3200 Ohm matching at 150 Watts SSB/CW, 1.8-30 MHz coverage, Cross-Needle *and* digital meters, audio SWR meter, *backlit* LCD, remote control port, radio interface, heavy-duty 16 amp/1000V relays.

The MFJ-993B automatically tunes for minimum SWR and remembers your frequency and tuner settings. The next time you operate on that frequency and antenna, these tuner settings are instantly restored and *you're ready to operate in milliseconds!* 10W x 2¾ H x 9D". Use 12-15 VDC/1 amp or 110 VAC with **MFJ-1316, $21.95**. Radio interface cables, remote control available. See ***www.mfjenterprises.com***

600 Watt MFJ Automatic Tuner

MFJ-994B $359.95

Like MFJ-993B but handles 600 Watts SSB/CW, matches 12-800 Ohms. 10,000 memories. Does not have LCD display, antenna switch, 4:1 current balun, audio SWR meter/feedback. 10W x 2¾H x 9D in.

No Matter What™ Warranty

Every MFJ tuner is protected by MFJ's famous one year ***No Matter What***™ limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

1500 Watt *Legal Limit*

For Ameritron AL-1500/1200/82 amps

MFJ-998 $699.95

Roam the entire HF spectrum 1.8-30 MHz *hands-free* with full *1500 Watt* legal limit on SSB/CW and near-perfect SWR! Lighted LCD/Cross-Needle Meter.

300 Watt *Extra* Wide Range

SWR/Wattmeter, 10000 VA Memories

MFJ-991B $229.95

Extra-wide *matching range at less cost.* Exclusive dual power level: 300 Watts/6-1600 Ohms; 150W/6-3200 Ohms. Cross-Needle SWR/Wattmeter.

200 Watt Compact

Digital Meter, Ant Switch, Wide Range

MFJ-929 $229.95

World's fastest compact auto tuner uses MFJ *Adaptive Search*™ and *InstantRecall*™ algorithms. 132,072 tuning solutions instantly match virtually any antenna with near perfect SWR.

200 Watt *MightyMite*™

Matches IC-706, FT-857D, TS-50S

MFJ-939KIY $159.95

No *extra space needed!* Just set your IC-706/7000, FT-857D, TS-50S on top of this matching low-profile automatic tuner -- it's all you need for a completely automated station using *any* antenna! Just tune and talk!

200W... Weather-sealed

For Remote/Outdoor/Marine

Fully *weather-sealed for remote Outdoor/Marine use!* Tough, durable, built to last the elements for years.

MFJ-926B
$279.95

G5RV Antenna

MFJ-1778 $49.95

Covers all bands, 160-10 Meters with antenna tuner. 102 ft. 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. Halfsize, 52 ft. 40-10M with tuner, 1500 Watts.

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- 10W Amplified DSP base station speaker
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DSPKR
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Boost your radio or extension speaker with one of our audio DSP install modules!

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- 20W modular audio power amplifier with Parametric Equaliser - Four versions available with bhi DSP noise cancelling and Bluetooth connectivity optional

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- Improved noise cancelling!

Compact In-Line
- Use in-line with your radio and phones
- Latest bhi DSP noise cancelling
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MFJ...the World Leader in Ham Radio Tuners!

MFJ Tuners

New, Improved MFJ-989D 1500 Watt legal limit Antenna Tuner

World's most popular 1500 Watt Legal Limit Tuner just got better -- much better -- gives you more for your money!

New, improved MFJ-989D legal limit antenna tuner gives you better efficiency, lower losses and a new true peak reading meter. It easily handles full 1500 Watts SSB/CW, 1.8 to 30 MHz, including MARS/WARC bands.

New, dual 500 pF air variable capacitors give you twice the capacitance for more efficient operation on 160 and 80 Meters.

New, improved AirCore™ Roller Inductor gives you lower losses, higher Q and handles more power more efficiently.

New, TrueActive™ peak reading Cross-Needle SWR/Wattmeter lets you read true peak power on all modes.

MFJ-989D $409.95

Includes six position ceramic antenna switch, 50 Ohm dummy load, indestructible multi-color Lexan front panel with detailed logging scales and legends.

The MFJ-989D uses the superb time-tested T-Network. It has the widest matching range and is the easiest to use of all matching networks. Now with MFJ's new 500 pF air variable capacitors and new low loss roller inductor, it easily handles higher power much more efficiently.

New, high voltage current balun lets you tune balanced lines at high power with no worries.

New, crank knob lets you reset your roller inductor quickly, smoothly and accurately.

New, larger 2-inch diameter capacitor knobs with easy-to-see dials make tuning much easier.

New, cabinet maintains components' high-Q. Generous air vents keep components cool. $12^{7}/_{8}$W x 6H x $11^{5}/_{8}$D inches.

No Matter What™ Warranty

Every MFJ tuner is protected by MFJ's famous one year **No Matter What™** limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

More hams use MFJ tuners than all other tuners in the world!

MFJ-986 Two knob Differential-T™

MFJ-986 $369.95

Two knob tuning (differential capacitor and AirCore™ roller inductor) makes tuning foolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 kW PEP SSB amplifier input power (1.5 KW output). Gear-driven turns counter, lighted peak/average Cross- Needle SWR/Wattmeter, antenna switch, balun. 1.8 to 30 MHz. 15W x $4^{1}/_{2}$H x $10^{3}/_{4}$D in.

MFJ-962D compact kW Tuner

MFJ-962D $319.95

A few more dollars steps you up to a KW tuner for an amp later. Handles 1.5 kW PEP SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H! AirCore™ roller inductor, gear-driven turns counter, pk/avg lighted Cross-Needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8-30MHz. $10^{7}/_{8}$W x $10^{3}/_{4}$H x $4^{1}/_{2}$D in.

MFJ-969 300W Roller Inductor Tuner

Superb, AirCore™ Roller Inductor tuning. Covers 6 Meters thru 160 Meters! 300 Watts PEP SSB. Active true peak reading lighted Cross-Needle SWR Wattmeter, QRM-Free PreTune™, antenna switch, dummy load, 4:1 balun, Lexan front panel. $10^{1}/_{2}$W x $3^{1}/_{2}$H x $9^{1}/_{2}$D inches.

MFJ-969 $229.95

MFJ-949E deluxe 300 Watt Tuner

More hams use MFJ-949s than any other antenna tuner in the world! Handles 300 Watts Full 1.8 to 30 MHz coverage, custom inductor switch, 1000 Volt tuning capacitors, full size peak/average lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, dummy load, QRM-Free PreTune™, scratch proof Lexan front panel. $10^{5}/_{8}$W x $3^{1}/_{2}$H x 7D inches. MFJ-948, $159.95. Economy version of MFJ-949E, less dummy load, Lexan front panel.

MFJ-949E $189.95

MFJ-941E Super Value Tuner

Most for your money! 300 Watts PEP, 1.8-30 MHZ, lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, 4:1 balun, 1000 volt capacitors, Lexan front panel. $10^{1}/_{2}$W x $2^{1}/_{2}$H x 7D in. **MFJ-941EK, $129.95.** Tuner Kit -- Build your own!

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 $6^{1}/_{2}$W x $2^{1}/_{2}$H 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 $4^{1}/_{2}$W x $2^{1}/_{4}$H 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. $7^{1}/_{4}$W x $2^{3}/_{4}$H x $2^{3}/_{4}$D 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-9201 QRPocket™ Tuner

80-10 Meters, 25 Watts. 12 position inductor, tune/bypass switch, wide-range T-network, BNCs. 4W x $2^{5}/_{8}$H x $1^{1}/_{2}$D inches. **MFJ-9201, $49.95**

MFJ-9201 $49.95

MFJ-921/924 VHF/UHF Tuners

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8W x $2^{1}/_{2}$H 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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- Convenient - No annoying jumpers!

New! PK-PakRatt Terminal Program for Windows

Run your Timewave / AEA data controller or TNC with a terminal program designed for Windows 10. One-click mode and PTT buttons, macros & more!

Tailored for:
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- PK-96
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PK-232SC+

Multimode Data Controller*

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**Upgrade any PK-232 to the PK-232SC with New Lower Combo Pricing for SC & DSP Upgrade!*

Customize your PK-232 installation with our complete line of upgrades, accessories and cables.

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- Computer isolated from radio
- Real FSK & AFSK
- keyboard CW - send and receive
- Dual Port - two radios at same time!

ANC-4 Antenna Noise Canceller

See & hear a demo on YouTube!

Kill Noise before it reaches your receiver!
Great for supressing power line noise, plasma TV noise & many other local electrical noises.

PK-96/100 USB Packet TNC

1200/9600 bps AX.25 Packet
Available with USB or RS-232 connection

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Portable, telescoping high-strength fiberglass masts extend way up into the sky! Just pull out sections and lock.

Choose Lightweight-Light-Duty or Super-Strong Thick-Wall models -- 10 to 50 feet long. Each collapses to an easy-to-carry size for true portability.

For quick put-up and take-down, light-duty models have Twist & Lock sections and heavy-duty thick wall models use military style *QuickClamps*™ or stainless steel hose clamps.

Use them for traveling, camping, at hotels, hamfests, field day, DX-peditions. Put up full size full performance inverted Vee, dipole or vertical antenna in minutes at heights that will snag you real DX.

Use multiple telescoping masts to make loops, quads, rotatable dipoles even beams.

← *Light Duty Lightweight Fiberglass Masts*

So lightweight you can take them anywhere!

MFJ's most popular MFJ-1910 is 33 feet long, 3.3 lbs.

MFJ-1910, $79.95. 33 ft., light duty w/top tie ring.
MFJ-1911, $89.95. 20 ft., light duty w/top tie ring.
MFJ-1913, $89.95. 28 ft., lightweight w/top tie ring.
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Standard Models: H models have QuickClamps™

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Left: *Stainless Steel Hose Clamps* recommended for permanent installations. Fiberglass is slotted.

Right: UV protected Military grade *QuickClamps*. Guy 2 levels when fully extended.

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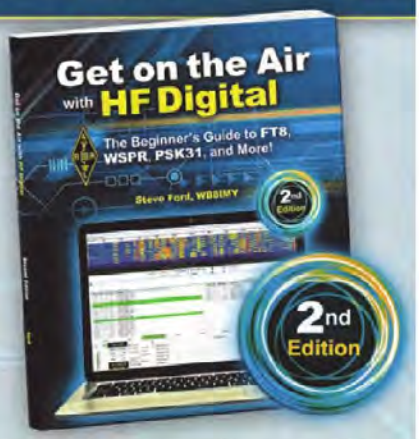

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by Steve Ford, WB8IMY

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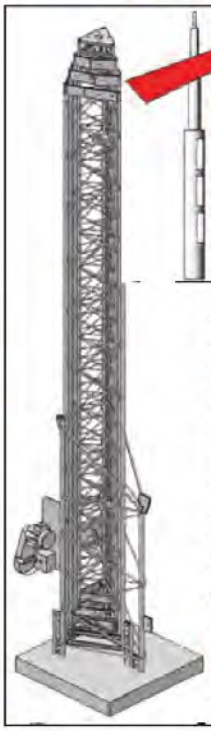

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LM-237	20	$2,550
LM-354	18	$4,150
LM-354 HDSP	45	$8,250
LM-584	13	$13,850
LM-470	24	$10,450
DX-70	45	$14,950
DX-70 HD	80	$18,800
DX-86	26	$15,295
DX-86 HD	38	$22,300
DX-100	24	$28,500
DX-100 HD	40	$31,500
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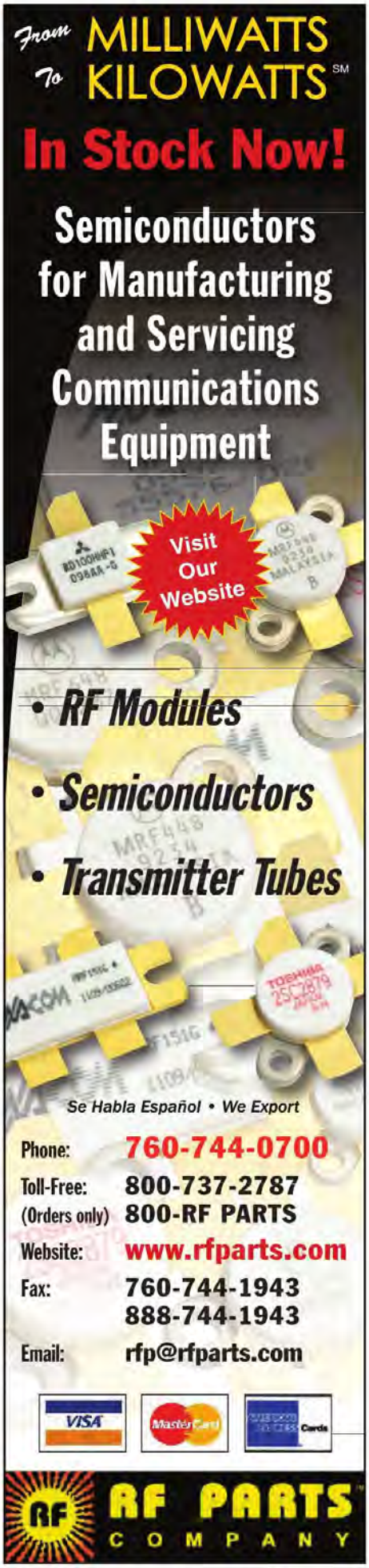

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