Build a Two-Element Array for 40, 30, 20, and 17 Meters Page 34

QST

DIGITAL EDITION

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CYCLE 25

Here Comes Solar Cycle 25

DIGITAL FEATURE

47| See our Video Review of the **RFinder** B1 Dual-Band DMR/FM Transceiver with Android Smartphone

QST Reviews

Yaesu FTM-300DR Dual-Band FM/Digital Mobile Transceiver

Shark RF openSPOT3 Multimode Digital Hotspot

Etón Elite 750 Portable Receiver

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* External Speaker SP-10: Optional

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- Superior Operating Performance by means of the MPVD*3

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FTDX101D 100W

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- IF DSP enables Superb Interference Rejection
- 7-inch TFT Color Touch Panel with 3DSS*1 Visual Display
- Superior Operating Performance by means of ABI*2 & MPVD*3

* Microphone M-1: Optional

* Photo shows the FTDX101MP

*1 3DSS: 3-Dimensional Spectrum Stream *2 ABI: Active Band Indicator *3 MPVD: Multi-Purpose VFO Outer Dial

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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, $579.95. 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, $529.95,** 12/17 M. **30/40 Meter** *add-on kits* available.

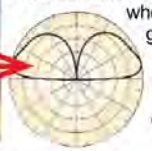
Cushcraft R9...80-6 Meters 80 Meters...No Radials...1500W

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, $569.95. Like R9 antenna but less 75/80 Meters.

R-8TB, $99.95. Tilt-base lets you tilt your antenna up/down easily by yourself to work on.

R-8GK, $79.95. 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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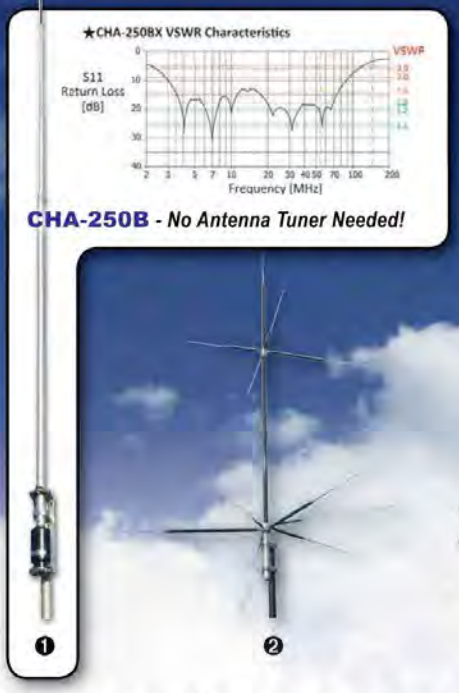

CHA-250B - *No Antenna Tuner Needed!*

❶ ❷ ❸ ❹ ❺ ❻ ❼

Base Antennas

❶ COMET CHA-250B BROADBAND 80M THROUGH 6M VERTICAL ANTENNA
A newly designed broadband vertical with NO GROUND RADIALS. EXTREMELY easy to assemble, requires no tuning or adjustments and VSWR is under 1.5:1 from 3.5-57MHz! • TX: 3.5MHz – 57MHz • RX: 2.0– 90MHz • VSWR is 1.5:1 or less, continuous • Max Power: 250W SSB/125W FM• Impedance: 50 Ohm • Length: 23' 5" • Weight: 7 lbs. 1 oz. • Conn: SO-239 • Mast Req'd: 1" – 2" dia. • Max wind speed: 67MPH

❷ Maldol HVU-8 ULTRA-COMPACT 8 BAND HF/VHF/UHF VERTICAL ANTENNA
80/40/20/15/10/6/2M/70cm Only 1/2 the traditional size and weight of vertical HF antennas, and it includes 2M/70cm! Unique radial system rotates for balcony installations, the radials can all be rotated to one side. • Wavelength: HF and 6M: 1/4 wave • 2M: 1/2 wave • 70cm: Two 5/8waves in phase • Impedance: 50 Ohm • Max Power: HF 200W SSB • 6M–70cm: 150W FM• Conn: SO-239 • Height: Only 8'6" • Weight: 5lbs. 7ozs.

❸ COMET GP-3 DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA
Wavelength: 146MHz 6/8 wave • 446MHz 5/8 wave x 3 • Max Pwr: 200W • Length: 5'11"• Weight: 2lbs. 9ozs. • Conn: Gold-plated SO-239 • Construction: Single-piece fiberglass

❹ COMET GP-6 DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA
Wavelength: 146MHz 5/8 wave x 2 • 446MHz 5/8 wave x 5 • Max Pwr: 200W • Length: 10'2"• Weight: 3lbs. 8ozs. • Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

❺ COMET GP-9 / GP-9N DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA
BEST SELLER! • Wavelength: 146MHz 5/8 wave x 3 • 446MHz 5/8 wave x 8 • Max Pwr: 200W• Length: 16' 9"" • Weight: 5lbs. 11ozs. • Conn: GP-9 Gold-plated SO-239 • GP-9N Gold-plated N-type female • Construction: Fiberglass, 3 Sections

❻ COMET CX-333 TRI-BAND 146/220/446MHZ BASE REPEATER ANTENNA
Wavelength: 146MHz 5/8 wave x 2 • 220MHz 5/8 wave x 3• 446MHz 5/8 wave x 5 • Max Pwr: 120W • Length: 10'2" • Weight: 3lbs. 1oz.• Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

❼ COMET GP-15 TRI-BAND 52/146/446MHZ BASE REPEATER ANTENNA
Wavelength: 52MHz 5/8 wave • 146MHz 5/8 wave x 2 • 446MHz 5/8 wave x 4 • Max Pwr: 150W • Length: 7'11" • Weight: 3lbs. 1oz. • Conn: Gold-plated SO-239• 2MHz band-width after tuning (6M) • Construction: Single-piece fiberglass

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Write for *QST*

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Our Cover
Solar Cycle 25 has officially begun — here comes the sun! It will take a few years for the cycle to hit its peak, but the excitement starts now, with *QST* content that will help you plan for what's ahead. Beginning with this issue, look for the Cycle 25 logo that calls out special content related to the solar cycle.

CYCLE 25

Look for this logo on content that pertains to the new Solar Cycle 25

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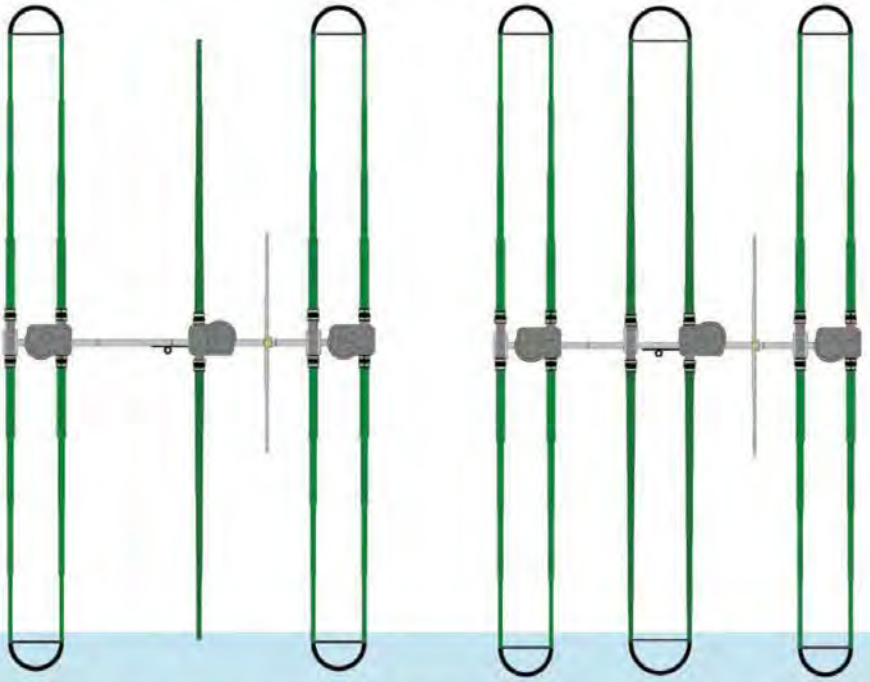

YAGI ANTENNAS 3 3 ELEMENT

What's the difference? DB18 VS DB18E

DB18 or DB18E? Both antennas cover 6.8-54 MHz continuous. The difference between these models is on 30m (10 MHz), the DB18E is configured as a 3 element Yagi, and on 30m the DB18 functions as a 2 element, wide spaced Yagi – solid performance, but not as good as on the DB18E. With the exception of 30m / 10 MHz, the two antennas are identical in performance. The DB18 and DB18E both have a 19ft (5.79m) boom, and maximum element length is 39 ft (11.9m) – compact in size... big in performance!

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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

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David A. Minster, NA2AA, ARRL Chief Executive Officer, na2aa@arrl.org

Second Century

The Idea Behind *Ideation*

A few columns ago, I asked for you to light up the CEO mailbox here at HQ with your thoughts and ideas. And you responded! Thank you for that. The emails I have received can generally be categorized as Pleasantries, Complaints, and Opinions.

The Pleasantries have been fantastic. There is so much passion and enthusiasm for our hobby. I truly believe there has never been a better time to be a ham radio operator. Especially through the pandemic restrictions that we have all had to deal with, our hobby has endured and thrived. Community has never been more important. I have enjoyed reading your stories and kind words. These have become a source of daily fuel for me, reading all the great things members have done, and are doing! So, please, keep your emails coming.

Next are Complaints. Some truly are complaints I want to hear, so improvements can be made. The worst make demands or threats. One of the similarities among many Complaint emails is that they are based on bad information. These emails say, "ARRL did this, and I don't like it," or "ARRL didn't or won't do that, and I don't like that," and in many of those cases I find that the Complaint is based not in fact, but rather an Opinion or piece of conjecture that was said or written someplace — likely an internet or Facebook group — and the author is reacting, and reacting strongly, without finding out the facts first.

I've mentioned that ARRL looks at things through the lens of, "Is this good for amateur radio?" A public attack or a Complaint that includes a threat to leave ARRL has no positive effect on the hobby, and certainly does nothing to further an interest or cause. Taking an extreme position leaves little room to translate Complaint feedback into an idea. More about ideas in a minute.

Last, but not least, are Opinion emails. Some people think they've communicated ideas in their emails to me, but in many cases, they haven't. I work very hard to read through these emails, trying to determine exactly what it is the author is trying to achieve. These emails tend not to ask questions or make demands, but they often judge whether something related to amateur radio is good or bad, from the author's perspective — they're offering an Opinion.

Sometimes the ARRL staff can translate an Opinion into an idea! One example is the COVID accommodations made to the rules for ARRL Field Day. That idea came from an Opinion email, and participation during Field Day was spectacular! We expect it to be even better this year. So, translating Opinions into ideas is a worthy pursuit. Perhaps if there was a process for creating an idea, we could build better collaboration between members and HQ!

The common bond that exists between the Complaints and Opinions: Members want to be heard. But to what end? One would hope that the time and effort members put into writing these emails would lead to action at ARRL HQ! When you receive hundreds of emails a week, and some include strong opinions from both sides of an issue, how do you decide which action to take? This also requires a process.

Ideation is a formal process of brainstorming: collecting ideas, evaluating them, prioritizing them, and then implementing them. Ideas can be simple or sophisticated. By creating a funnel through which all ideas can flow, ARRL can support the "Culture of Yes" we are striving for. The final decision may end up being a "No," but every idea has merit, and will have a place at HQ for consideration.

Ideas create the fuel that drives ARRL. To get this process started now, rather than waiting for a system to manage it, we have established a page at **arrl.org/ideas**. There you'll see a briefing on how to translate your idea into a submission. You can click the button to launch your email client, manually cut and paste into an email, or into a word processor if you want to submit via regular mail. We are excited to see your ideas! We will work on ways to make you aware of the status of your idea (just acknowledgment is a start). And there may be ways to create working groups that include *you* as we move forward with implementation.

Your ideas, small and big ones, will inspire a culture of improvement and innovation. So, get involved, be a connector, stay radio active, and see you on the air!

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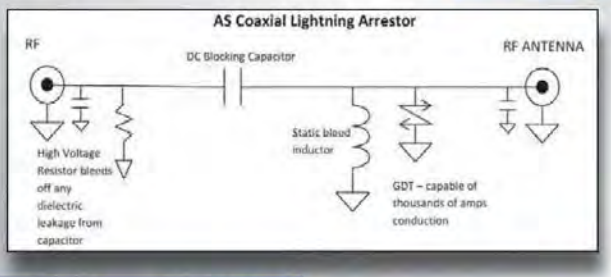

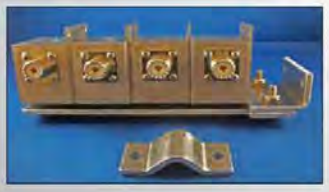

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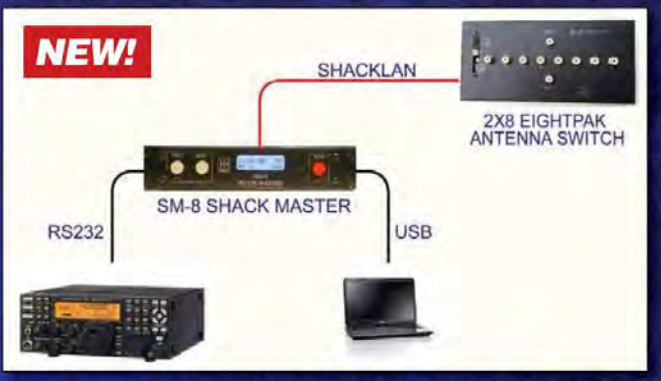

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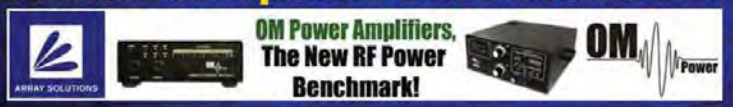

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Leanna Zwiebel, lzwiebel@arrl.org

Member Spotlight

Jason Oleham, KM4ACK

From April 10 – 11, 2009, much of the southern US was struck with a devastating series of 85 tornados. It was during these events that Jason Oleham, KM4ACK, discovered the importance of emergency preparedness, as his hometown in Rutherford County, Tennessee, was among the affected areas. This life-changing event exposed Jason to amateur radio, leading him to create his own YouTube channel focused on portable communications and the possibilities of operating with Raspberry Pi microcomputers.

The Importance of Emergency Preparedness

During the 2009 tornadoes, Jason was unfamiliar with emergency preparedness. "I didn't even own a generator," he said. An EF4-level tornado passed within 1,000 yards of his home, damaging nearly 850 homes in its 23-mile path. Cell phone towers were down for nearly 24 hours.

Immediately following the tornado strike, Jason purchased a generator. It wasn't until a few years later that he began looking into emergency communications. "Should that same storm hit today, I would have no issue sending a text or email to loved ones in other parts of the country to update them," he shared.

Along with Jason's emergency preparations came a desire to earn his ham radio license, thanks to a conversation he had with his brother-in-law, Rick White, W4RPW, in 2014. "An hour into that conversation, I knew I needed to find out more about this ham stuff," Jason said. Not long after that, he earned his amateur radio license. Having been interested in computers for most of his life, connecting a computer to a radio came naturally to him, as well as using digital modes. Winlink and JS8 (which uses the *JS8Call* software) are his favorite digital modes.

Becoming a YouTube Mentor

During his radio journey, Jason needed some guidance when trying to install PAT (a cross-platform Winlink client). After searching the internet, and **www.youtube.com** in particular, he couldn't find any help. So, after some trial and error, he figured it out on his own. Realizing he couldn't be the only ham having difficulties with the installation, Jason decided to create his own instructional video and upload it to the video-sharing platform, YouTube, in hopes of helping others. Shortly after, he became involved with beta testing *JS8Call*. With a new beta version being released every 2 weeks, there was a constant need for learning new features. "Myself and a few others would play with each new version and I started making videos explaining the new features," he explained.

What started out as a few instructional videos has grown into a successful YouTube channel. Jason's channel, *KM4ACK*, has nearly 12,000 subscribers. Along with his videos explaining the possibilities of Raspberry Pi, his channel also covers portable operations. He challenges his subscribers to take their radios into the field at least once a month. "There are lots of [events] in the hobby that encourage us to be portable," Jason said. "Not only can we have a ton of fun participating in these events, but they also teach us about operating in the field and that can be vital during an emergency."

Build-a-Pi

During the COVID-19 pandemic, Jason's business was forced to close. This left him with enough time to revisit an abandoned project that he calls "Build-a-Pi" (BAP). "BAP is a bash script (**https://github.com/km4ack/pi-build**) that allows each operator to choose what ham software they want installed on their Raspberry Pi," he explained. "The BAP script will do most of the heavy lifting and install the applications you chose, as well as do a lot of the behind-the-scenes configuration of your Pi."

The original version of BAP was released on Jason's channel in January 2020 (see **https://youtu.be/gBokG9FI-NM** for more information). Jason shared that "it was a great start, but lacked a lot of features that the users wanted." A few months later, he posted a video explaining what went wrong, which can be viewed at **https://youtu.be/6XdZI6t_Y_s**.

In addition to his YouTube channel, Jason still stays involved with emergency communications. He's a member of his local Amateur Radio Emergency Service (ARES) group and participates in several Winlink nets every week. He said, "I am constantly testing various types of digital communications to figure out what might work best during an actual emergency."

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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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The 15 Divisions of ARRL are arranged into 71 administrative *Sections*, each headed by an elected *Section Manager* (SM). Your Section Manager is the person to contact when you have news about your activities, or those of your radio club. If you need assistance with a local problem, your Section Manager is your first point of contact. He or she can put you in touch with various ARRL volunteers who can help (such as Technical Specialists).Your Section Manager is also the person to see if you'd like to become a Section volunteer. Whatever your license class, your SM has an appointment available. Visit your Section page at **www.arrl.org/sections**.

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Up Front

Snow-Covered Mobile Station

After a December 2020 snowstorm in Meredith, New Hampshire, Doug McBride, N1DPK, was only able to spot his Toyota RAV4 from the HF and VHF/UHF antennas visible through the 3 feet of snow. His RAV4 is his mobile station with a Yaesu FT-857 inside, so he got creative, named his station "SnowJack," and got ready to make some contacts despite the snow.

Successful Application of a *QST* Project

Al Helfrick, K2BLA, built the Tuna Tin "S" QRPp transmitter from the December 2020 issue of *QST*. Al used author Bob Fontana's, AK3Y, design as the starting point for a 50 W semi-break-in transmitter to use with a 1960 Collins 75S3. Bob was very gracious and modified the Tuna Tin "S" software for Al to add 30 meters and two other tuning rates. In addition to adding a power amplifier, Al also designed and built an Arduino-based keyer that provides T/R switching and delays the actual keying of the transmitter to prevent hot-switching of the antenna changeover relay.

The exciter part of Al Helfrick's, K2BLA, QRPp transmitter. The power supply and power amplifier are in another cabinet.

Starting the New Year with CW and Family

For Aaron Ray, N4ARY, the highlight of January 2021's Straight Key Night was his daughter, Amelia, joining him while he operated. She learned some new characters and had fun pounding brass. Read more about Aaron, Amelia, and other participants in the Straight Key Night Results in this issue.

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Correspondence

Letters from Our Members

Affordable Microcontrollers

I've read many *QST* articles involving the use of the Arduino microcontroller. I was introduced to the Arduino system about a year ago and want to encourage readers to experience the fun of these microcontrollers. They combine some basic electronics with a little bit of programming to provide a wealth of excitement to amateur radio operators in our digital age, and are inexpensive. By downloading free software, hams can also access many already-developed programs, and can easily learn object-oriented programming from online videos.

Many people start with a basic Arduino Uno R3 board, which costs $20, but excellent clones exist for under $10 and include a half-size breadboard and mounting on a piece of clear acrylic. Additionally, kits including the Uno R3 and an assortment of resistors, capacitors, LEDs, switches, and sensors can be bought online for less than $20. You don't need to spend upwards of $100 to get involved in the digital amateur radio experience.

Don Pearson, KE5GJ
Gig Harbor, Washington

A Future Ham

Over the holidays, my 8-year-old granddaughter picked up the December 2020 issue to read "January 2021 Kids Day," as well as "Sled Dogs and Ham Radio in the North Maine Woods," by Derrick Ouellette, KW1A. She enjoys ham radio, and wants to begin long-distance learning so she can take her Technician-class license exam.

Thank you for encouraging youth to become ham radio operators!

Brian Rohde, KC6LDN
San Diego, California

A Family Affair

I recently purchased an Icom IC-9700 and am having a great time working the satellites. When my daughter was home from college for winter break, she wanted to work some satellites with me. Now she's talking about footprints, azimuth, elevation, and doppler. It's so much fun to see her light up when talking about radio!

Mike Mona, KD0ZW
West Des Moines, Iowa

Stale Bread and Vintage VFOs

I enjoyed reading the "Classic Radio" column titled, "Advancements in Receiver Technology," in the January 2021 issue, especially because I was around when some of those receivers first appeared on the market. It's noted that the SB-300 had "a stale VFO with 1.0 kHz readout..." Those vintage VFOs really were like bread! If they got too hot, they were toast.

Wayne Covington, KD0EA
Loveland, Colorado
Life Member

Praise for the *ARES Letter*

As an Emergency Coordinator and active ham, I receive a lot of digests and publications across all relevant subjects.

When I receive the *ARES Letter* from ARRL, I know it'll include valuable information that's not only timely, but important to my responsibilities. The contents have immediate value to ARES (Amateur Radio Emergency Service) leadership and members. Thank you for this benefit!

Tom Seeley, W4FLL
Carson City, Nevada

Experimenting with Arduino

I recently finished building the project Bob Fontana, AK3Y, described in his article, "The Tuna Tin 'S' — A Bare-Bones Synthesized QRPp Transmitter," from the December 2020 issue. It was my first Arduino project and has sparked an interest in learning more about Arduino — a new facet of ham radio. The little radio gets great reports on the air and is quite easy to replicate.

I made a few changes by using silver mica capacitors in the output filter and iron powdered toroids for the inductors. I'm getting about 1 W output with 16 V. The little radio drives an IRF531 homebrew amplifier to 35 W output.

I recommend this project to encourage using Arduino, as well as building a fun piece of ham gear to get on the air with. Thanks again to the author and to *QST*!

Marty Harpen, KK4RF
Suffolk, Virginia

Celebrating Ham Radio

With all that's been going on in the world, I've taken refuge in the benefits of amateur radio. Instead of going on social media platforms, I prefer a contact with a fellow amateur in Germany about propagation conditions, or a long conversation with an Italian amateur about life in the wine country.

Amateur radio operators have a strong fellowship. It has been tested through years of war and history. We have something that's rare in today's world: friendship across the divide. And that is something to celebrate.

Terry Hursh, W9CQG
Mississauga, Ontario

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

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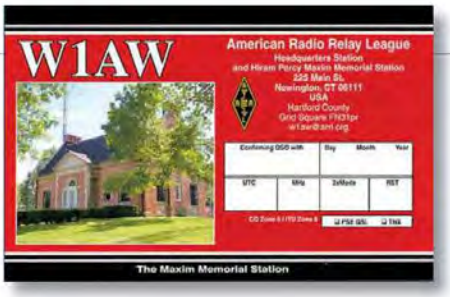
W1AW's QSL File

Every month, W1AW receives hundreds of QSL cards from hams all over the world, confirming contact with the Hiram Percy Maxim Memorial Station at ARRL Headquarters. Maybe you'll recognize an on-air friend — or even yourself — among these cards.



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Solar Cycle 25 Is Finally Here

An overview of what we know from Cycle 23 and 24, and some theories as to what we might see from Cycle 25.

Carl Luetzelschwab, K9LA

Set off the fireworks! Solar Cycle 25 is finally here, so now is a good time to review some basics, including what solar minimums and sunspots are, and why they're important for amateur radio. After reviewing what we know so far, we'll be able to make some predictions about what we can expect from Solar Cycle 25. Be sure to read Steve Ford's, WB8IMY, article and Bernie McClenny's, W3UR, "How's DX" column in this issue for more on Solar Cycle 25.

Observing and Measuring the Sun

Sunspots are the oldest direct record of the activity of the sun. A *solar cycle*, or sunspot cycle, starts at *solar minimum* (when there are few sunspots), goes through *solar maximum* (when there are many sunspots), and then ends up at solar minimum again.

Sunspots are the darkened regions of reduced surface temperature that are caused by the sun's magnetic fields rising up from below the sun's surface and poking through. The term "surface" is somewhat of a loose term, as the sun is not a solid.

Sunspots are a subjective parameter, because visual counting by humans is required, and there can be an unintentional bias in the counting process by the observer. This, in fact, was the main reason why the old sunspot data set was reviewed in the last decade. The new data set was created in 2015, and that is believed to be a more accurate representation of past solar activity.

In 1947, to achieve a more objective parameter of solar activity, scientists starting using radar receivers from World War II to measure the radiation from the sun at a wavelength of 10.7 centimeters (2800 MHz). Although the data doesn't extend back in time like sunspots, the 10.7-centimeter solar flux parameter is preferred over the more subjective sunspot data because the solar flux measurement is the output from a calibrated antenna/receiver system. In this process, there is no need for human interpretation.

It is difficult to determine the best correlation between sunspots and 10.7-centimeter solar flux, given that they are from two different processes in the sun. Those two parameters are indeed correlated, but unfortunately not on a daily basis, because a daily 10.7-centimeter solar flux value does not map to a unique daily sunspot number.

The next logical step was to look at monthly averages (also known as monthly means) of both parameters. This helped a lot, but still the correlation was just not good enough. The next step was to average 12 months of monthly mean data — these are called *smoothed values*. The correlation is very high doing it this way, and that's how sunspots and 10.7-centimeter solar flux values are best correlated.

Observing and Measuring the Ionosphere

Propagation on our HF bands is influenced by the *ionosphere* — the portion of our atmosphere in which solar radiation at various wavelengths ionizes neutral atmospheric constituents resulting in electrons and positive ions. The electrons are the important factor in propagation.

For our radio endeavors on the HF bands (3 – 30 MHz), we are interested in the three regions, or layers, of the ionosphere: the D region, the E region, and the F region, which is further divided into the F1 region and the F2 region (see Figure 1).

We measure the ionosphere with an instrument called an *ionosonde*, which is a swept-frequency radar looking straight up. From the resulting data, the maximum electron density in the E region, the

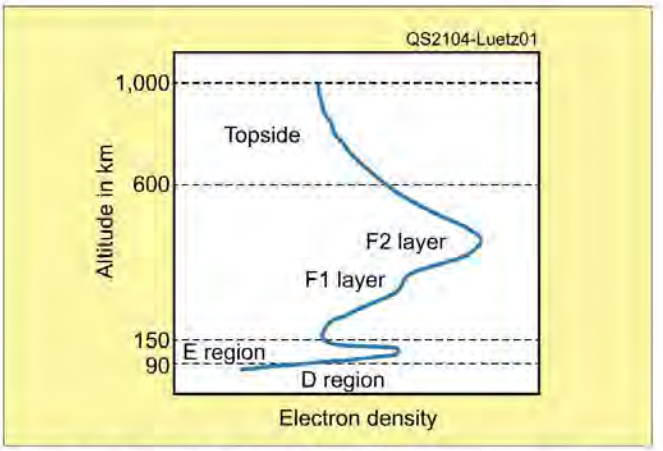

Figure 1 — A typical electron density profile as a result of the ionization process. Note that the electron density profile is a continuous function versus altitude. There aren't any thin layers as the name "layer" suggests. Also note that the E region and the F2 region have very distinct maximums, whereas the D region and the F1 region do not.

Space Weather and Assessing the Ionosphere

For a broad assessment of HF propagation and what is important for our amateur radio endeavors, we can simplify all that data to just the sunspot number and the K index.

Sunspot Number

When the sunspot number is consistently at or above 70 for a couple months, 10 meters should offer consistent worldwide openings. For 15 meters, a sunspot number at or above 50 will offer good propagation. Those sunspot numbers for 10 meters and 15 meters correspond to 10.7-centimeter solar flux values of 100 and 90, respectively.

K Index

This parameter varies from 0 to 9, and is reported every 3 hours. It is a measurement of the activity of the Earth's magnetic field. As the K index increases, the Earth's magnetic field becomes more disturbed. In general, the MUFs in the F2 region of the ionosphere become lower, possibly causing a radio amateur to lose propagation on the band they are on, and have to move down in frequency to continue the contact. For best propagation, we would like to see a K index of 3 or lower.

maximum electron density in the F1 region, and the maximum electron density in the F2 region can be calculated.

This calculation allows us to determine the highest frequency, also known as the *maximum usable frequency* (MUF), which allows a contact over a given path at a given time. Propagation usually consists of our radio wave going up to the ionosphere and being bent, or refracted, enough to return it back to Earth. A frequency higher than the MUF is not refracted enough and goes off into space.

Correlating Propagation to the Sun and the Ionosphere

Now we're back to another correlation issue between the state of the ionosphere and what the sun is doing. Before proceeding, we should realize that 10.7-centimeter solar flux and sunspots are *proxies* for the wavelengths of radiation involved in the ionization process. We use these as stand-ins, due to the fact that before the space age, we had no way of measuring radiation at extreme ultraviolet (EUV) wavelengths (the true F2 region ionizing radiation) because its energy is used up in the ionization process and nothing gets to ground level for measurement. Now that we have satellites above the atmosphere, we can measure EUV. But our propagation predictions were developed before the space age and had to be correlated to sunspots (later, they could also be correlated to the 10.7-centimeter solar flux).

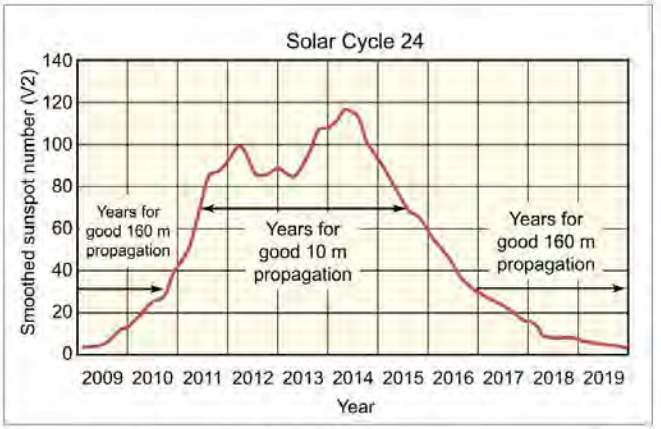

Figure 2 — During Solar Cycle 24, there were some years that were good for 160 meters and 10 meters.

EUV is the most important ionizing wavelength for our amateur radio endeavors. The discovery that more radiation at EUV wavelengths improved propagation on the higher HF bands gave us the correlation we needed to understand why more contacts were possible on the higher frequencies as more EUV impinged on our atmosphere. At solar minimum, the ionosphere can't refract the higher HF bands (15, 12, and 10 meters) back to Earth, because there isn't enough ionization.

Around solar maximum, the ionosphere can refract the higher HF bands back to Earth. On the other hand, the lower HF bands (160, 80, 60, and 40 meters) are generally best around solar minimum, because less ionization means there is less *ionospheric absorption* — loss that reduces the signal strength (see Figure 2).

Where Cycle 25 is Headed

Figure 2 is good history, but it is not enough to determine when 160 meters and 10 meters will be good during Solar Cycle 25. It all depends on how big Cycle 25 will be. As Steve Ford mentions in his article, there are pessimistic forecasts for Cycle 25 (a small cycle), and there are optimistic forecasts (a big cycle) for Cycle 25. Unfortunately, most of the forecasts are for a small cycle. But remember these are forecasts, not concrete truths.

If Cycle 25 is similar to Cycle 24, the good years for 160 meters are roughly for another year from now and toward the end of Cycle 25. The good years for 10 meters will be roughly 2023 through 2027. A bigger Cycle 25 will shorten the 160-meter lengths and extend the 10-meter lengths.

Further Resources

Resources including websites and books are available for monitoring the status of Cycle 25 or for more information about the ionosphere and HF propagation. Recommended resources include:

- Daily 10.7-centimeter solar flux (along with other parameters) at **www.solen.info/solar**
- **www.spaceweather.com**
- **www.swpc.noaa.gov/products/solar-cycle-progression**
- **www.solarham.net**
- Propagation and information about who is working who on a given band is available at **www.dxmaps.com/spots/mapg.php?Lan=E**
- **https://pskreporter.info/pskmap.html**
- **www.wsprnet.org/drupal**
- **www.reversebeacon.net**
- For an assessment of the ionosphere itself, **http://prop.kc2g.com** shows worldwide MUFs for a 3,000-kilometer path using ionosonde data.
- Robert Brown's, NM7M (SK), *The Little Pistol's Guide to HF Propagation*, available for free at **https://k9la.us**
- Chapters on "Propagation" in *The ARRL Antenna Book* and *The ARRL Handbook*
- *The CQ Shortwave Propagation Handbook – 4th Edition* by Carl Luetzelschwab, K9LA; Theodore Cohen, N4XX; George Jacobs, W3ASK; Robert Rose, K6GKU (SK), from CQ Communications.

Be aware that the sun can hiccup, as seen by big spikes in the 10.7-centimeter solar flux and sunspot number. This can give us good propagation on the higher HF bands for a short time. This happened recently at the end of 2020. Read the "How's DX" column in this issue for more details on this. Always watch for a big spike in the 10.7-centimeter solar flux (and sunspot number), and head to the higher HF bands if it happens.

Carl Luetzelschwab, K9LA, started his radio career as a shortwave listener in the late 1950s, using a National NC-60 receiver. After discovering amateur radio, he received his Novice license in 1961. He selected K9LA as his call sign in 1977. Carl enjoys propagation, DXing, contesting, playing with antennas, and fixing/using vintage equipment. Carl is a graduate of Purdue University (where he earned his Master's degree in electrical engineering) and worked for Motorola (in Schaumburg, Illinois, and Fort Worth, Texas), and for Magnavox in Fort Wayne, Indiana (now Raytheon), as an RF design engineer. He retired in October 2013. Carl is currently the ARRL Central Division Vice Director. You can contact Carl at **k9la@arrl.net**.

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

All ARRL members can now enjoy the digital edition of *QEX* as a member benefit. Coming up in the March/April 2021 and future *QEX* issues are articles and technical notes on a range of amateur radio topics. These are at the top of the queue.

- Hidetsugu Yagi and Shintaro Uda, in this reprint of their 1926 article, describe their classic Yagi-Uda array antenna.
- Robert J. Zavrel, W7SX, extends the Yagi-Uda array concept to the "W7SX Array" by not restricting element lengths to a half wavelength.
- In his essay series, Eric Nichols, KL7AJ, discusses electro-mechanics and control theory.
- Jerry Spring, VE6TL, discusses the onset of Solar Cycle 25 and the MG II index.
- Phil Salas, AD5X, describes his method and fixtures for measuring antenna tuner loss.
- Peter DeNeef, AE7PD, addresses RF exposure from a 70-centimeter band collinear dipole array.
- Kai Siwiak, KE4PT, describes lightning-induced electromagnetic pulse effects.

QEX, a forum for the free exchange of ideas among communications experimenters, is edited by Kazimierz "Kai" Siwiak, KE4PT, (**ksiwiak@arrl.org**) and is published bimonthly. All ARRL members can enjoy the digital edition of *QEX* as a member benefit. The printed edition annual subscription rate (six issues per year) for members and non-members 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; see **www.arrl.org/qex**. Would you like to write for *QEX*? We pay $50 per published page for full articles and *QEX* Technical Notes. Get more information and an Author Guide at **www.arrl.org/qex-author-guide**. If you prefer postal mail, send a business-size self-addressed, stamped (US postage) envelope to: *QEX* Author Guide, c/o Maty Weinberg, ARRL, 225 Main St., Newington, CT 06111.

The W7SX (Zavrel) Array

A new parasitic element design improves gain over the Yagi-Uda array in this center-fed two-element array.

Robert J. Zavrel, W7SX

This article presents an overview of a two-element W7SX array for four bands — 40, 30, 20, and 17 meters (see the sidebar, "The W7SX Array Builds on the Yagi-Uda Array Concept"). The W7SX, or Zavrel, array differs from a conventional Yagi array in that the element lengths are not restricted to around a half wavelength. Table 1 shows a gain comparison of the W7SX array with the equivalent gain of full-size Yagi-Uda arrays.

Since its inception in 1926, Yagi designs have concentrated on making all the element lengths close to a half wavelength, with the driven element at resonance, the reflector a bit longer, and the director(s) a bit shorter. Only a small deviation from the resonant length causes the phase of re-radiated (scattered) power to create reinforcement and/or cancellation of power in the desired direction. This creates the unidirectional directivity of the Yagi array.

The W7SX Array Builds on the Yagi-Uda Array Concept

The full description is in the companion article, "A Four-Band Two-Element W7SX (Zavrel) Array," in the March/April 2021 issue of *QEX*. Conventional Yagi designs make all the element lengths close to a half wavelength with the driven element at resonance, the reflector a bit longer, and the director(s) a bit shorter. This creates the unidirectional directivity of the Yagi array. The W7SX antenna described here uses a conventional Yagi design for the lowest frequency 40-meter band, where the elements are close to a half wavelength long; on 30 meters, the elements are about ¾ wavelength long; on 20 meters, elements are about 1 wavelength long, and on 17 meters, elements are 1¼ wavelength long. Because the full element length is used, the broadside gain of the W7SX array increases until the maximum is reached at 1¼ wavelength, where the gain is about 3 dB higher than for the conventional Yagi.

Lead photo — The W7SX array. The open-wire transmission line is seen on the right.

Table 1 — Gain Comparison of a Multiband W7SX Array with Equivalent Monoband Yagi Array

Band	W7SX element length	Equivalent Yagi elements
40 meters	0.50 wavelengths	2
30 meters	0.75 wavelengths	2
20 meters	1.00 wavelengths	3
17 meters	1.25 wavelengths	3

There is no reason to limit the length of a parasitic element to near a half-wavelength resonance, other than being able to feed the driven element directly with coaxial line. However, in most cases some form of matching is needed anyway along with a balun function, because the driven element is balanced, and the feed impedance is usually lower than the 50 Ω coaxial feeder. With the introduction of computer-controlled automatic tuning equipment, an open-wire feeder could connect the antenna to the tuner at the base of the tower. Such a tuner could be custom designed for the bands covered by the antenna, with fixed elements achieving a basic tuning and then perfect tuning accomplished by an autotuner. This would permit a perfect match at the antenna for a single 50 Ω lead. Therefore, the tuner could be specially designed for a given multiband array. This array has two elements. This technique can also be used to create director elements as well for complex multielement multiband arrays.

In multiband Yagi designs, much of the length of elements is wasted by the mantra of limiting the electrical lengths to near a half wavelength on the higher frequencies by using traps and/or a variety or techniques to limit the electrical length to the precious half wavelength. The possible effective lengths for straight, unloaded elements to be used effectively ranges from a bit shorter than a half wavelength to 1¼ wavelengths — the length of an extended double Zepp.

The W7SX antenna described here uses a conventional Yagi design for 40 meters (the elements are close to a half wavelength long); on 30 meters, the elements are about ¾ wavelength long; on 20 meters, elements are about 1 wavelength long (two-element co-linear, with a two-element co-linear reflector), and on 17 meters, elements are 1¼ wavelength long (extended double Zepp).

Any element length in this range can be made into a parasitic element by placing an appropriate reactance at the center of the element. For example, it is a well-known technique to place an inductor at the center of an element shorter than a half wavelength to create a director or reflector. Little known among Yagi designers is that if the element is too long, it can also be configured as a parasitic element. It is well known that increasing an element length more than a half wavelength, the broadside gain increases until the maximum is reached at 1¼ wavelength (the double extended Zepp), where the gain is about 3 dB higher than the standard half-wave design. This starting point is a great advantage, because the maximum gain from a full-size two-element Yagi is about 5 dBd. Consequently, the maximum gain from a two-element W7SX antenna using 1¼ wavelength elements is about 8 dBd, which is close to the gain of a standard four-element Yagi.

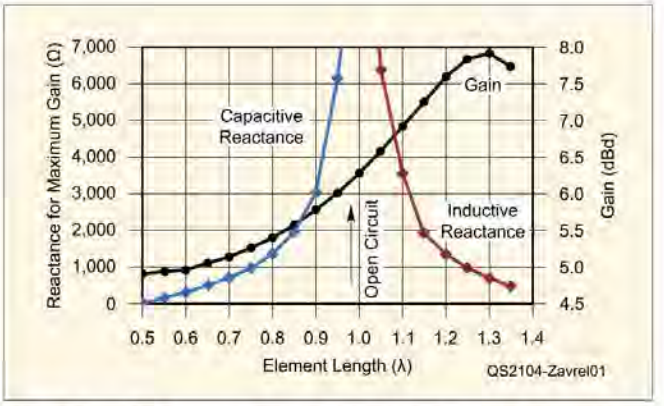

Figure 1 — Reactances needed to make a parasitic element from elements half to 1¼ wavelengths long, and the increase in gain for an increase in element lengths.

Figure 1 shows the approximate reactances needed to create a parasitic element from elements that are half to 1¼ wavelengths long and also plots the increase in gain for an increase in element lengths. This is for a two-element antenna with the driven and reflector elements fixed at ⅛-wave spacing. The element lengths are the free space fractions of a wavelength. Small changes in the center reactive load will change the parasitic effect from a reflector to a director — similar to small changes in a half-wavelength parasitic element's length.

In Figure 1, we see that by using the exact length of slightly longer than a half wave, no reactance is needed. As the element is made longer, a reactive value is needed to create the optimum parasitic configuration. The element separation also affects this parasitic value, so ⅛-wavelength separation is used for this data. Also, the driven element uses the same length as the reflector. The lead photo shows a picture of the array. The driven element is fed with

Table 2 — W7SX Array Performance in Free Space

Frequency, MHz	Max gain, dBd	F/B, dB	Beamwidth
7.1	4.78	5.81	64.4°
10.1	4.87	6.36	58.4°
14.1	5.53	6.83	45.8°
18.1	6.75	4.75	28.6°

homebrew open-wire line that runs to the shack about 500 feet down the mountain.

Design Methodology

If we want to create a multiband antenna from a single-band Yagi, the first step can be very simple if the bands of interest are harmonically related. This simple idea drove the author to first create a 40/20-meter W7SX array. The two sides of the reflector's center are simply shorted for 40-meter operation, creating a simple two-element Yagi. On 20 meters, the center is opened to create two co-linear half-wave reflectors. The driven element also becomes a two-element co-linear configuration. This results in a four-element co-linear array. The equivalent gain is comparable to a full-size three-element Yagi, because the spacing between the elements in a co-linear array is very small. If the reflector element lengths are set for maximum gain on 20 meters, the length for 40 meters (when shorted) is slightly short for best performance when using a relay. I simply place a 1 to 2 μH inductor across the gap and achieve near-optimum performance on both bands.

Figure 2 illustrates the simple method for band switching — a DPDT switch. On 20 meters, it opens the center, and on 40 shorts the center through a small value inductor. This could also be a DPST switch.

On both 30 and 17 meters, the reflector is considerably off resonance. Figure 1 shows the basic relationships between the length of the reflector and the necessary reactance to form an effective reflector. For detailed designs, it is best to model the antenna for specific dimensions and then empirically determine the best reactive value(s). There will be a small variation to optimize the element for maximum forward gain or maximum front-to-back ratio similar to the common practice of fine adjustment of the length of the reflector.

On my array, I used *EZNEC* modeling to derive the optimum capacitor and inductor values for 30 and 17 meters. It is also possible to place a reactive value on the physical antenna and simply tune for maximum gain. The details are in my companion *QEX* article, in the March/April 2021 issue.

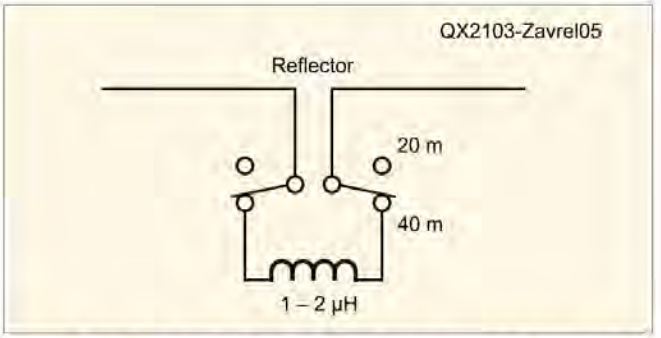

Figure 2 — One method for band switching uses a DPDT switch.

Similar to almost any antenna design, the exact capacitance and inductance values may be a bit different than the modeled values. In this case, for maximum performance, you can check for maximum gain (or maximum F/B ratios) by adjusting the *C* or *L* on each band. Then calculate the revised reactive values and use those values in the standard equations. However, the modeled values will most likely be fairly close to optimized values for a given antenna design, tower, height, and the usual variables for a given site.

W7SX Array Performance

The response on the four bands for this antenna is summarized in Table 2. The data were computed in free space at 0-degree-elevation angle. The dBd gain is referenced to a half-wave dipole. For dBi, simply add 2.15 dB. This W7SX array antenna was designed for maximum forward gain; better front-to-back ratio designs are also possible.

Bob Zavrel, W7SX, was first licensed in 1966. He has worked in RF engineering for his entire career, working primarily in RF semiconductors and antennas. He published the first block diagram of an SDR system in 1987, invented the eight-circle antenna array, has published over 100 papers and articles in both professional and amateur publications, and has seven patents. He has achieved DXCC Honor Roll (mixed and CW) and 5BWAZ (200), using only tree-supported wire antennas. He is an RF business and technical consultant, a volunteer technical advisor to ARRL, an ARRL Life Member, an adjunct engineering professor at Gonzaga University, an author of the ARRL publication *Antenna Physics: an Introduction*, and a Senior Member of the IEEE. Bob has a BS in physics from the University of Oregon. You can reach Bob at **w7sx@yahoo.com**.

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Mark J. Wilson, K1RO, k1ro@arrl.org

Product Review

Yaesu FTM-300DR Dual-Band FM/Digital Mobile Transceiver

Reviewed by Steve Ford, WB8IMY
wb8imy@arrl.net

The latest entry in the Yaesu System Fusion lineup boasts two completely independent receivers. With the FTM-300DR, you can monitor two separate VHF frequencies, two UHF frequencies, or whatever combination you like. This includes the ability to monitor two C4FM digital signals simultaneously, or listen to an analog FM signal with one receiver and a C4FM signal with the other. Extended receive coverage is split among several bands from 108 MHz to 999.99 MHz.

Yaesu packs all this functionality into a compact package. The control head is detachable so that you can install the body of the transceiver out of sight. In fact, the radio includes a 20-foot cable to connect the two units. The transceiver body houses the top-firing speaker, so if you place it in a location where you can't hear it, you'll need to attach an external speaker that you can mount near your operating position. Unless you are using a wireless headset, you will also need to attach an extension cable, such as the 10-foot Yaesu MEK-2, between the microphone and the transceiver body. The rear panel sports a single antenna jack with an SO-239 connector, two external speaker jacks (one for each receiver), a data jack for remote operation or connection to other devices, and an extremely quiet fan.

Bottom Line

Packed with features for analog FM and C4FM System Fusion operation, the FTM-300DR offers two completely independent receivers that can monitor two separate VHF or UHF frequencies simultaneously. A GPS receiver, APRS capability, and colorful display are standard.

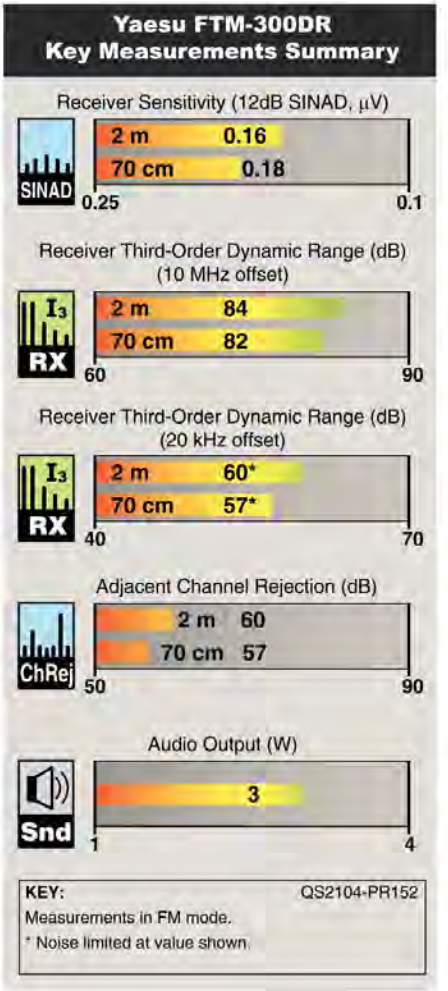
Table 1
Yaesu FTM-300DR, serial number 0G020476

Manufacturer's Specifications	Measured in ARRL Lab
Frequency coverage: Receive, 108 – 999.999 MHz (cellular blocked); transmit, 144 – 148, 430 – 450 MHz.	Receive: 108 – 823.995, 849.1 – 868.995, 894.1 – 938.295, 965.2 – 983.295 MHz. Transmit: as specified.
Modes: FM, FM-N (FM-Narrow), C4FM digital voice, data, AM (receive only).	As specified.
Power requirements: transmit, 11 A at 50 W RF output; receive, 0.5 A at 13.8 V dc.	At 13.8 V dc: Receive, no signal, max. audio and backlights, 500 mA; standby, 275 mA. Power off, 3 mA. Transmit (hi/med/low): 146 MHz, 8.25/5.17/2.67 A; 440 MHz, 10/6.2/3.03 A.
Receiver	**Receiver Dynamic Testing***
Sensitivity: FM 12 dB SINAD: 137 – 150 MHz, 0.2 µV; 150 – 174 MHz, 0.25 µV; 174 – 222 MHz, 0.3 µV; 222 – 300 and 336 – 420 MHz, 0.25 µV; 420 – 520 MHz, 0.2 µV; 800 – 900 MHz, 0.4 µV; 900 – 999.99 MHz, 0.8 µV. AM: 10 dB S/N, 108 – 137, 300 – 336 MHz, 0.8 µV.	FM, 12 dB SINAD, 146 MHz, 0.16 µV; 223 MHz, 0.18 µV; 440 MHz, 0.18 µV; 902 MHz, 0.22 µV. AM, as specified.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset: 146 MHz, 60 dB,† 440 MHz, 57 dB;† 10 MHz offset: 146 MHz, 84 dB, 440 MHz, 82 dB.
FM two-tone, second-order IMD dynamic range: Not specified.	146 MHz, 92 dB; 440 MHz, 108 dB.
Adjacent-channel rejection: Not specified.	20 kHz offset: 146 MHz, 60 dB; 440 MHz, 57 dB.
Squelch sensitivity: Not specified.	At threshold: 146 MHz and 440 MHz, 0.11 µV. Maximum, 0.28 µV.
S-meter sensitivity: Not specified.	For S-9 signal, 2.24 µV.
Audio output power: 3 W into 8 Ω at 10% THD.	As specified. THD at 1 V_{RMS}, 2.4%.
Transmitter	**Transmitter Dynamic Testing**
Power output: High/medium/low power, 50/25/5 W.	At 13.8 V dc, high/medium/low power: 146 MHz, 50/25/4.9 W 440 MHz, 52/26/4.8 W.
Power output at minimum specified operating voltage: Not specified.	At 11.7 V dc, high power: 146 MHz, 48 W; 440 MHz, 49 W.
Spurious signal and harmonic suppression: ≥60 dB.	146 MHz and 440 MHz, >70 dB. Meets FCC requirements.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Squelch on, S-9 signal: 146 MHz, 278 ms; 440 MHz, 268 ms.
Receive-transmit turnaround time (TX delay): Not specified.	146 MHz, 50 ms; 440 MHz, 42 ms.

Size (height, width, depth): Control head: 2.6 × 5.6 × 0.7 inches, including protrusions. Radio body: 1.7 × 5.6 × 5.2 inches, without fan.

Weight 3.9 pounds (radio body and control head with microphone and power cord).

*Receivers A and B tested identically. Test results shown are for standard FM mode. Sensitivity and adjacent channel selectivity increased by 1 dB in FM narrow mode.
†Measurement was noise limited at the value indicated.



The control head offers a 2-inch color TFT display that can be read even in bright daylight (see Figure 1). At either side of the screen are separate audio and frequency controls for each receiver.

There isn't a dedicated squelch knob, but this adjustment is easy. You simply tap the **SQL** button and the two right-hand knobs become squelch controls for the individual receivers. Within a couple of seconds after you've made your adjustments, they revert to being frequency controls again.

With a maximum 50 W output power, the FTM-300DR is ideal for either mobile or fixed station applications. And like all Yaesu System Fusion radios, the FTM-300DR will automatically switch from analog FM to digital C4FM according to the nature of the received signal thanks to its automatic mode selection (AMS) function. You can also elect to operate analog or C4FM exclusively with a push of a button.

An Abundance of Standard Features

The FTM-300DR comes with so many standard features, several of which are optional on other pieces of equipment, that it isn't practical to

Figure 1 — The FTM-300DR's colorful display is readable even in bright daylight.

discuss them all in a single review. Instead, I'll touch upon the ones I found particularly intriguing.

Bluetooth

In many transceivers, the ability to use a Bluetooth wireless headset is an option you must purchase separately, but not with the FTM-300DR. It can be paired with nearly any Bluetooth audio device for hands-free operating. The Bluetooth function includes a VOX (voice-operated switch) in case your chosen headset lacks a transmit/receive switch.

I didn't have a Bluetooth headset to fully test this feature, but I do own Bluetooth headphones. Following the instructions in the manual, I paired the headphones with the FTM-300DR without difficulty. Once the device successfully pairs, the FTM-300DR's speaker goes silent, and all audio is directed to the headphones. You need only go through the pairing steps once for each device.

It was fun to walk around the house with my headphones while listening to activity on the bands. I set up the FTM-300DR's scanning function and busied myself with other things while monitoring the local fire dispatch channel and the UNICOM frequency of a nearby airport. I even managed to pair the FTM-300DR with my Apple Air Pods.

Memory Channel Grouping

All transceivers these days have frequency memories, and the FTM-300DR is no exception, with more than 1,000 memories available. What's interesting about the way the transceiver handles memories is in its memory channel grouping function.

I found that I needed to experiment with this feature to fully understand and appreciate it. The short explanation is that it allows you to assign memory channels to specific groups of your choosing and then recall them for operating or scanning as the need arises. It is somewhat analogous to memory blocks familiar to scanner owners. For instance, you can place all the repeaters you normally use for your local area into one group, but then create another group for, say, the city where you work. The FTM-300DR makes it easy to switch from one group to another as you travel from place to place.

You can also segregate memory groups according to function. If you have several repeaters in your area dedicated to ARRL Amateur Radio Emergency Service (ARES®) activities, you can place all those repeaters into one memory group for easy access during deployments. The function is highly flexible for memory monitoring when necessary.

GPS and APRS

A sensitive Global Positioning System (GPS) receiver is standard in the FTM-300DR. Thanks to the FTM-300DR's crisp display, you can use the GPS receiver directly for real-time navigating. It even includes a backtrack feature to help you retrace your route back to a given location.

The GPS receiver is quite sensitive. From within my car, it had no trouble locking onto several satellites and determining a position fix within seconds after I powered up the radio. Even when I operated the transceiver indoors — inside my aluminum-sided home — the receiver still managed to acquire the needed satellites.

Of course, GPS and the Automatic Packet Reporting System (APRS) go hand in hand, which is why the FTM-300DR also includes a 1,200/9,600-baud packet modem as standard equipment. When operating APRS, the FTM-300DR will use its own screen to display information, but it also makes the AX.25 packet data available at the rear-panel data port. This means you can attach a computer and use your own APRS software or grab the modem data for other applications.

To activate the APRS function, you must first go into the menu system and turn on the modem. You also must input your APRS call sign, beacon message, and other parameters. Fortunately, the FTM-300DR's menu system is well designed, and I found it easy to navigate from the front-panel screen. Unlike some transceivers, menu choices are displayed in plain English rather than cryptic abbreviations. It is a matter of using a VFO knob to select what you want (the screen highlights your selections with red backgrounds) and then giving the knob a brief push.

With the APRS properly configured, I selected 144.39 MHz and the FTM-300DR began displaying decoded APRS data. The information is easy to read and includes a compass heading to the station in question (see Figure 2).

If you are new to APRS, it is best to download the FTM-300DR's dedicated APRS manual. Despite not having done this at first, I found it straightforward to pick my way through the menus and set up all the necessary parameters.

Snapshot

One clever feature that I didn't have an opportunity to try was the Snapshot function. This allows you to send and receive images using the optional MH-85A11U camera microphone. This ability has been present in Yaesu System Fusion radios for years, but not all transceiver models can support it. The FTM-300DR's high-resolution display is ideal for this, albeit with small images. Still, it is a cool function to have available, especially when you're doing public service work with other System Fusion users with compatible displays.

Band Scope

When the band scope is active, it sweeps above and below the midpoint of the signal frequencies being received by the receiver and displays the results as a sea of flickering pixel blocks. I found the band scope to be most useful when the receiver was in memory mode rather than free-tuning VFO mode. In VFO mode, there was simply too much to see, and the result was somewhat incoherent.

However, in memory mode, the band scope shows activity on programmed channels rather than a range of frequencies. This gives you a convenient visual sense of the activity. Twisting the upper VFO knob slides the pixel display right or left until you position a signal spike beneath the downward-pointing arrow at the top center of the band scope.

MicroSD Storage

The FTM-300DR offers a slot on the control head for inserting a microSD memory card (not included). The card has several applications in this transceiver. You can record received and transmitted audio, which can be useful in several situations. You can also back up the FTM-300DR's memory information to the card.

Naturally, you'll need to purchase a microSD card, but these are inexpensive. You'll also need a memory card reader to access the card with your PC or laptop.

Figure 2 — Monitoring APRS activity with the FTM-300DR.

These are also inexpensive and simply plug into an available USB port.

Memory Programming with External Software

Yaesu offers free software for Windows that you can use to conveniently manage the contents of the FTM-300DR's many memory channels. This is my preferred method of management just because it is so much easier to do from my desktop or laptop.

To access the FTM-300DR memories directly you must purchase an SCU-20 data cable. Yaesu used to sell this cable separately, but now it is only available as part of the SCU-40 kit that allows the FTM-300DR to be connected to external WIRES-X node hardware. Selling at about $70, this is a pricey way to obtain a single cable.

The cost-saving alternative is to use the microSD card instead. You can write the transceiver's memories to the card, move the card to your computer, and then read its contents into the software. When you're finished, write the data back to the card, place the card into the transceiver, and then load the information to transceiver's memory.

I happened to have an SCU-20 on hand, so I used it instead. The software worked perfectly, making it a pleasure to input new memory information, or delete and modify existing information. I simply used the **READ** function to grab the data from the FTM-300DR and then wrote it back to the radio when I was finished.

On the Air

The FTM-300DR's 50 W output is ideal for solid mobile coverage. You can set it to lower output levels, but I enjoy operating simplex, and with my little mag-mount antenna on the car, I needed all the help I could get.

Speaking of simplex, the ARRL Lab was made aware of a quirk concerning 70-centimeter operation. In the

Figure 3 — Connecting to a System Fusion repeater, and then connecting to the America Link group on the Yaesu WIRES-X network.

US, 446.0 MHz is the national simplex calling frequency. However, when the FTM-300DR's automatic +/– frequency shift function is enabled, it insists on regarding this frequency as a repeater channel and shifts the transmit frequency accordingly. I verified that it will indeed recognize 445.0 MHz as a simplex frequency, but not 446.0 MHz. The workaround is to temporarily deactivate the auto-shift feature if you need to operate simplex on 446.0 MHz. Yaesu indicates that they will correct this issue in a future FTM-300DR firmware update. I checked my Yaesu FTM-7250DR transceiver and discovered the same behavior.

I'm fortunate to have Yaesu System Fusion activity in my vicinity, and most of it is connected via the internet to the Yaesu WIRES-X network. If you haven't tried operating through a linked network, it can be a blast. Thanks to a couple of local repeaters and nodes, I chatted with hams in Europe and Japan while driving around town with the radio. The FTM-300DR's screen displayed the other station's call signs and link/reflector information (see Figure 3). If you want to get the most out of WIRES-X, download the FTM-300DR WIRES-X manual from the Yaesu website.

The cost of the FTM-300DR may make some amateurs a bit hesitant, but it is important to consider what you're receiving for your investment. Yaesu has packed a remarkable number of features and performance into the FTM-300DR — so many that it may not be an exaggeration to call it the ultimate C4FM radio. If you have System Fusion activity in your area and want the ability to enjoy digital and analog operating to the fullest, the FTM-300DR is a serious contender.

Manufacturer: Yaesu USA, 6125 Phyllis Dr., Cypress, CA 90630; **www.yaesu.com**. Price: $450.

SharkRF openSPOT3 Multimode Digital Hotspot

Reviewed by Pascal Villeneuve, VA2PV
va2pv@arrl.net

In the past few years, the digital voice modes have rapidly grown to be popular on the VHF/UHF bands. It would be nice if radio manufacturers had all chosen the same digital voice mode, but that is not the case. On the other hand, for many hams, this is part of the fun because it gives them the opportunity to experiment with different approaches, and to meet the challenge of bridging together certain modes with virtual repeaters (called *reflectors*) that are accessed via the internet. This brought the introduction of multimode digital hotpots, and the openSPOT3 is one of the latest models. Basically, the openSPOT3 is a digital radio internet gateway with a low-power (20 mW) 70-centimeter transceiver to communicate with an amateur radio digital-mode transceiver.

There are several general concepts that are important to understanding the key differences between the

Bottom Line

Building on the previous model, the openSPOT3 multimode digital hotspot offers improved transcode performance for seamlessly allowing operators using different digital modes to talk with each other.

openSPOT3 and other hotspots. When choosing a digital mode to invest in, there are three simple things to consider:

1) Who do you want to talk with? (In other words, which mode is used by your friends?)
2) What types of digital repeaters are available in your region?
3) What is your budget? Can you afford a radio and a hotspot, or many radios plus a hotspot?

For new hams, the available choices can be overwhelming because this represents the unknown. It's a critical choice, as their experience with the new radio and new mode may impact their first impressions of the hobby. Many hams choose DMR as their first digital radio because these radios are usually less expensive. DMR can be the most complicated mode to program and operate, but fortunately setting up a DMR radio for a hotspot is easy.

I often suggest buying three radios, one DMR, one D-STAR, and one C4FM (Yaesu System Fusion, YSF), but the cost adds up very quickly. The openSPOT3 from SharkRF may help hams in their decision making and save some money at the same time.

There are two previous hotspot versions from SharkRF, the openSPOT and the openSPOT2. I reviewed the original openSPOT in the October 2017 issue of *QST*, and the openSPOT2 in the June 2019 issue. SharkRF has added features and improvements with each version, and in the openSPOT3, they achieved a serious milestone: the newest SharkRF hotspot has the ability to do hardware *transcode* between all digital modes without losing any quality. (For example, the hotspot hardware allows a ham using a DMR radio to talk to one using D-STAR.) See the sidebar, "Supported Digital Modes."

Overview

The first thing I noticed is the quality of the packaging and the hardware. The openSPOT3 still has no ethernet RJ-45 jack and no external antenna port — features that were on the first version but were removed in version 2. Physically, the new version looks like the openSPOT2, but it's bigger and heavier because of new hardware additions. The power connector is a USB-C which, in my opinion, is the best solution.

There are now two buttons on top. One is for Wi-Fi, and when you hold it for more than 3 seconds, the openSPOT3 switches into Wi-Fi AP (access point) mode. If you hold the Wi-Fi button for more than 30 seconds, it will do a full factory reset of all the settings and configuration profiles.

The second button turns the power on and off, because this version has an internal rechargeable Li-ion battery. The glowing LED indicator near the power button shows the battery and power status with different colors and blinking speed indications, fully described in the manual. As an example, when the power cable is connected, a green light means the battery is fully charged and red mean it's charging. If you hold the power button more than 7 seconds, the device reboots.

Like the openSPOT2, there are five profiles you can save with mode and reflector preferences. If you press the power button three times quickly, it will transmit Morse code for the letter P, followed by the current active profile number and name.

Just like the previous version, you won't see any obvious operating status LED indicators, as they are hidden inside the white plastic enclosure. When you

Supported Digital Modes

The openSPOT3 supports multiple digital modes and reflectors (a reflector is the equivalent of a digital voice mode repeater and is accessed via the internet).

DMR (digital mobile radio) — Originally a commercial protocol, adapted for ham radio. The popular DMRplus, DMR-MARC, and BrandMeister reflector networks are all supported by the openSPOT3, along with Phoenix, XLX, and TGIF.

Yaesu System Fusion (YSF, C4FM) — Developed for ham radio by Yaesu, there are three different reflectors/networks. YSFReflector and FCS are both supported by the openSPOT3. Yaesu's Wires-X network is not supported by hotspots like the openSPOT.

D-STAR — Developed by the Japan Amateur Radio League and supported by Icom and Kenwood transceivers. There are many networks, including DCS, REF/DPlus, XRF/DExtra, and XLX, all supported by the openSPOT3.

NXDN — Kenwood's commercial digital mode. Only one ham network exists, NXDNReflector, which is supported by the openSPOT3.

P25 — Another commercial digital mode. Only one ham network exists, P25Reflector, supported by the openSPOT3.

POCSAG (DAPNET) — An amateur radio paging system used in Europe and supported by the openSPOT3.

APRS (Amateur Packet Reporting System) — APRS messaging and location data forwarding (APRS-IS) are supported.

turn on the unit, the status LED glows through the case. Many colors are used to indicate the current status, and it's very intuitive. For example, when the openSPOT3 receives a signal, the LED turns green. When it transmits, the LED turns red. Other status indications are described in the well-illustrated, online manual.

Setting Up the Device

To set up the openSPOT3, you can use any PC, tablet, smartphone, or other device with an internet browser and Wi-Fi capability. When you first receive the openSPOT3, by default it will be in Wi-Fi AP mode. Turn on the hotspot and scan for a new Wi-Fi network called **openSPOT3 AP** with your device, just like you would when you want to connect to any new Wi-Fi network. Once connected to the openSPOT3, you can do the initial setup via its web interface and then connect the device to your home Wi-Fi network and the internet. (Remember, without internet access, the openSPOT3 is useless.)

After the initial setup, if you move out of range of your initial Wi-Fi network, simply press the Wi-Fi button for more than 3 seconds to switch the openSPOT3 back into its AP mode. Then again, connect into the web interface directly, and select a new Wi-Fi network. Doing this does not affect your hotspot configurations, and you won't lose the other Wi-Fi setup as long as you do not hold the button more than 30 seconds and trigger a factory reset.

Once the Wi-Fi setup is complete, use the very intuitive web interface to enter your call sign, IDs, digital ham radio mode, and reflector you want to operate.

Web Interface

The web interface is almost identical to the one used with the previous openSPOT model. We have the same top tabs: **STATUS, CONNECTORS, MODEM, SETTINGS,** and **NETWORK** (see Figure 4). The left menu is for **QUICK SETUP**, a link to the online manual, and for **SHARKRF LINK** setup. On the right menu, you have **POCSAG/DAPNET** setup, the DMR ID database lookup, and the **UPGRADE** button. Upgrading this device is easy — just click **UPGRADE** and the rest is automatic.

There is an **ADVANCED MODE** option that you can select to add advanced settings in almost every tab. This device can be amazingly easy to operate, but you can still do complex configurations if you're an advanced user, an important advantage that SharkRF implemented in all their devices. At the upper left, they added a battery indicator.

The center of the screen shows the reflector in use, the modem mode, and other information. In Figure 4, you can see that the **MODEM MODE** is D-STAR, but the **ACTIVE CONNECTOR** is System Fusion/FCS. With the openSPOT3, you can communicate with a System Fusion reflector using a D-STAR radio, and the other way around is also possible.

Figure 4 — The openSPOT3's web interface, with the **CONNECTORS** tab selected.

Figure 5 — A portion of the transcode gain settings screen, which is an Advanced Option in the web interface.

New Hardware

The openSPOT3 offers a good solution for those wondering which mode to choose. This new third generation of the openSPOT hotspot benefits from all the improvements made in the previous devices. To that, they have added new hardware components, such as an AMBE vocoder, which is the same chip that digital radio manufacturers use to encode digital communications.

The AMBE vocoder allows the openSPOT3 to transcode perfectly (no glitches) between modes. This means that you only need one digital radio to access most of the digital mode reflectors. In **ADVANCED MODE**, you can adjust the gain used during transcoding to correct the volume difference between systems (see Figure 5). This ensures top-quality audio in every mode.

With the previous model, it was possible to transcode between certain modes, but this was achieved with software, and it was not perfect. Cross mode with D-STAR was not possible, as it uses a different protocol that needs to be re-encoded. Now you can operate cross mode with all modes, including D-STAR because the openSPOT3 can decode and re-encode into another mode using the AMBE chip. This is a major improvement. Note that to operate cross mode with C4FM, you need to be in DN (digital narrow, 6.25 kHz), as it will not work when you used VW (voice wide, 12.5 kHz).

Just like the openSPOT2, the new model boots very quickly, and it's ready for operation in less than 10 seconds. You can also program multiple Wi-Fi networks, and it will connect automatically to the first one available. I programmed my home network and my iPhone Wi-Fi hotspot (tethering). If I ever want to take the unit mobile, I just have to share my cellular connection, and I'm ready to go.

They also added a 1,200 mAh Li-ion battery, allowing the hotspot to be autonomous up to 10 hours without any external power. The new version also has a built-in beeper for audio status tone and CW profile announcement.

Operation on the Air

The openSPOT3 operates exactly like the openSPOT2. It is easy to configure, and it's very stable.

The big improvement in the openSPOT3 is the hardware transcoding capability. Figure 6 shows simultaneous reception on two radios from the same C4FM reflector (FCS003/90), but from two different hotspots. The Yaesu radio on the left is set to the openSPOT2 frequency in C4FM. On the right, the Kenwood D-STAR radio is set to the frequency of the openSPOT3, which is connected to the same C4FM reflector, but with the modem in D-STAR mode for transcoding. The call sign of the received station (2E0SEI) is shown on both radios.

In this simultaneous receive test, I noticed that the signal from the openSPOT3 was slightly delayed before reception in the D-STAR receiver. This is due to the manipulation of the data in the transcode process, because the source is a C4FM signal. On a busy reflector where people come back very quickly, you may have to call a few times before you can be heard in between transmissions. This is also true if you are far away (in the IP world) as the number of internet hops can also add some delay. This phenomenon is not new in digital modes and is the reason operators are asked to leave a pause after each transmission.

Conclusion

The openSPOT3 is an excellent portable/mobile hotspot. It is more expensive than some other hotspots, but you can use it to operate the most popular digital modes with just one transceiver. The

Visit https://youtu.be/GJaftUiMGc0 to see our review of the SharkRF openSPOT3 Multimode Digital Hotspot on YouTube.

Figure 6 — The simultaneous reception of the same C4FM reflector using two different digital radios with two hotspots. On the left is a Yaesu System Fusion radio connected through an openSPOT2, and on the right is a Kenwood radio in D-STAR mode using the openSPOT3. The received signal from the reflector is transcoded from C4FM to D-STAR by the openSPOT3, and the received signal sounds the same on both radios.

openSPOT3 software and hardware is robust and very stable. It's also very easy to use, it boots up very quickly, and it's completely standalone.

The SharkRF website offers extensive documentation for setting up and using this device with the various digital modes and reflectors. Additional support is available from the online SharkRF Community Forum, accessed via their website. Check out my companion video overview to hear the openSPOT3 in operation. For more information about digital modes and hotspots, see my YouTube channel, **Laboenligne.ca** (or search YouTube for "VA2PV").

Manufacturer: SharkRF, Tallinn, Estonia; **www.sharkrf.com**. Available from **shop.sharkrf.com**. Price: about $300 depending on exchange rate.

Etón Elite 750 Portable Receiver

Reviewed by Steve Ford, WB8IMY
wb8imy@arrl.net

Those familiar with shortwave receivers may notice something familiar in the Etón Elite 750. In its previous life it was the Grundig Satellit 750, manufactured by the Chinese company Tecsun. It underwent a bit of a metamorphosis and emerged in China as the Tecsun S-2000 and was known elsewhere as the Etón Satellit 750.

The Satellit 750 was discontinued and the shortwave listening community assumed that was the end of the line, but this was not the case. In 2020, the Tecsun S-2000 returned in China, and for the rest of the world, it reappeared as the Etón Elite 750.

A Hefty Portable

At a little more than 14 × 7 × 5 inches and weighing more than 5 pounds, the Elite 750 is one of the larger receivers in its class that can still be called portable. Like its Grundig predecessor, the Elite 750 sports the side-mounted rack handles, which gives the Elite 750 an industrial profile. While you can certainly carry the 750 by the rack handles, there is a more conventional handle that folds out of the top of the case.

Bottom Line

The Etón Elite 750 portable receiver covers all of the popular longwave, mediumwave, and shortwave bands, as well as the FM broadcast band and air band. It works well with the built-in antennas and the audio quality is good. Its SSB and CW capability is fine for casual listening in the ham bands.

Figure 7 — The Elite 750 S-meter and display.

The sizeable tuning knob has a smooth, competent feel, as do all the knobs and buttons. The illuminated LCD is large enough to be easily readable, yet small enough to avoid stealing ergonomic space from the other controls (see Figure 7). To help conserve battery power, the display backlighting automatically comes on when you turn the tuning knob or adjust some of the controls, and then turns off after about 5 seconds. You can keep the illumination on continuously by pressing and holding the **LIGHT/SNOOZE** button.

I am so accustomed to seeing graphical signal-strength indicators that I was pleasantly surprised to find a real meter in the Etón Elite 750. The circular meter is recessed and illuminated by a single, amber LED. However, as useful as the meter is, I often found it difficult to read in less than optimal lighting. Improved illumination would be a welcome addition.

Beneath the sizeable speaker, and adjacent to the separate bass and treble controls, you'll find an earphone/headphone jack and a **LINE IN** jack. The **LINE IN** jack is intended for those times when you might want

Table 2
Etón Elite 750, serial number n/a

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: Receive only, 0.1 – 0.519, 0.52 – 1.710, 1.711 – 29.999 MHz (SSB, AM), 88 – 108 MHz (FM broadcast), 117 – 137 MHz (AM).	As specified.
Power requirement: External 6 V dc supply or four D cells. 80 mAh w/o backlight, 90 mAh with backlight.	At maximum volume, battery power: backlights on, 462 mA; backlights off, 450 mA. With external 6.3 V dc supply: at max volume, backlight on, 540 mA.
Modes of operation: SSB, AM, wideband FM (FM broadcast band only, stereo reception).	As specified.
Receiver	**Receiver Dynamic Testing**
Sensitivity: Not specified.	Noise floor (MDS), narrow filter, attenuator off: 475 kHz, –129 dBm; 3.5 MHz, –127 dBm; 7 MHz, –130 dBm; 14 MHz, –127 dBm; 28 MHz, –122 dBm.
AM sensitivity: Not specified.	10 dB (S+N)/N, 1 kHz tone, 30% modulation, narrow filter: 0.198 MHz, 1.0 µV; 1.020 MHz, 0.94 µV; 3.885 MHz, 0.90 µV; 6.160 MHz, 0.90 µV; 7.490 MHz, 1.0 µV; 15.1 MHz, 0.75 µV; 120.0 MHz, 1.46 µV.
FM sensitivity: Not specified.	For 12 dB SINAD, 15 kHz deviation: 100 MHz, 1.57 µV.
S-meter sensitivity: Not specified.	For S-9 (50 µV) signal at 14.2 MHz: Narrow, 3.93 µV; Wide, 1.74 µV.
Blocking gain compression dynamic range: Not specified.	At 14 MHz, 20 kHz spacing: 97 dB.
Reciprocal mixing dynamic range: Not specified.	At 14 MHz, 20 kHz spacing: 79 dB.
Two-tone, third-order intermodulation distortion dynamic range: Not specified.	At 14 MHz, 20 kHz spacing: 82 dB.
Two-tone, second-order intermodulation distortion intercept point: Not specified.	At 14 MHz: +29 dBm.
Squelch sensitivity: Not specified.	At threshold: 7.42 µV.
IF/audio response: Not specified.	Range at –6 dB points, (bandwidth)* SSB Narrow: 290 – 2390 Hz (2100 Hz) SSB Wide: 290 – 2340 Hz (2050 Hz) AM Narrow: 290 – 3560 Hz (3270 Hz) AM Wide: 330 – 2910 Hz (5160 Hz).

Size (height, width, depth, including protrusions): 4.4 × 7.6 × 1.3 inches; with handle lifted add 2.7 inches.

Antenna length, 38.8 inches. Loop length, 8.2 inches. Weight 6.25 pounds with batteries (4 D cells); 5.55 pounds without.

Second-order intercept point was determined at the S-5 signal level.

*Bass and treble control adjusted for flattest response — bass midway, treble, maximum.

Figure 8 — The Elite 750's built-in ferrite bar antenna works well for AM broadcast band reception.

to connect another audio device and play it through the Elite 750.

You'll find **LINE OUT** ports on the back, and they are a nice feature for those times when you want to make recordings of your listening adventures. The engineers thoughtfully included two line-level ports, one for each audio channel when recording FM stereo broadcasts. Of course, you can also use these ports to connect the Elite 750 to a much larger audio system.

The profile of the Elite 750 is dominated by its rotatable, directional ferrite-bar antenna (see Figure 8). It's one of the reasons the 750 is prized among those who enjoy AM broadcast DXing. Of course, there is also a long telescoping antenna for higher frequencies. The right side of the radio has BNC and terminal jacks for any other external antenna system you might wish to attach (see Figure 9).

You can power the Elite from its 6 V dc power supply, or take it traveling if you install four D cell batteries. (It seems like ages since I've used a radio that accommodated D cells.) If you choose to use an external 6 V dc supply provided by another manufacturer, or perhaps one of your own design, beware. The 750's dc power jack has an unconventional arrangement with negative polarity at the center/tip rather than positive.

The Elite 750 offers wide frequency coverage. It starts in the longwave basement from 100 to 519 kHz and extends all the way to 29.99 MHz. The receiver adds FM stereo broadcast band coverage from 88 to 108 MHz and then continues into the aeronautical band at 117 to 137 MHz.

Mediumwave, Shortwave, and Longwave

My introduction to the Etón Elite 750 occurred right after I pulled it out of the box and deployed the telescoping antenna. I took a cruise through the popular shortwave broadcast hangouts and was fortunate to run into Radio Romania's transmission in English. The signal strength was excellent, despite using the

Figure 9 — The Etón Elite 750's external antenna connectors.

receiver indoors. I wanted to catch a later broadcast using my outdoor antenna, so I added the frequency to one of the radio's 1,000 memory slots. This is easy to do and requires only a few button presses. Recalling memories is even easier.

Frequency memories are grouped into numbered pages for convenience, and the Elite 750 allows you to sort them in various ways. The receiver also includes the ability to scan through the longwave, AM, and FM broadcast bands, automatically storing the strongest signals into Page 0 memories.

Audio quality was excellent with the Elite 750's built-in speaker. The sound is rich and full, especially at lower frequencies. The radio provides separate bass and treble controls, and they make a substantial difference in fidelity, unlike controls on other receivers that only add or subtract muddiness.

The Elite 750 comes equipped with an RF gain control and a switchable two-step attenuator. Both are useful if you encounter strong signals, especially when using an external antenna. For example, I found that the Elite 750 seemed somewhat prone to front-end overload on the HF bands when I connected it to my wire dipole antenna. A quick tap of the **ANT.ATT** button would bring the attenuator into play and the level of attenuation is indicated in the LCD as a vertical bar graph. The bar graph is somewhat counterintuitive until you get used to it. The highest (tallest) bar indicates that the *least* amount of attenuation is being applied.

Another tool is the Elite 750's selectable wide and narrow bandwidth options. The manual does not specify the bandwidths, but the wide selection seemed a bit too wide, and it was problematic in crowded conditions. I found myself using the **NARROW** setting much of the time.

After hunting through the HF bands for a while, I was eager to give the rotatable ferrite antenna a try on medium and longwave signals.

I remember hunting distant AM stations with a portable receiver many years ago and having to endure the hassle of turning the entire radio this way and that, trying to aim its ferrite rod antenna for maximum signal strength. This is not the case with the Elite 750. Its bar antenna turns smoothly with a slight clicking sound, as if it were moving through mechanical detents. Not only could I peak desired signals, I was also able to use the antenna to null interference from stations on adjacent frequencies.

My first test was on 700 kHz. That's the home of the mighty WLW in Cincinnati, Ohio. At first there was little to hear but noise, but as I gently turned the bar the static fell away, and WLW emerged. Reception was surprisingly good considering that the Elite 750 was sitting inside an aluminum-sided house at the time.

Longwave broadcasters are a vanishing breed, but their signals can still be heard when conditions are optimal. Try as I may, I was unable to receive longwave broadcasts during this review, but I was able to spin the bar and isolate some interesting signals from other services, such as aeronautical beacons.

SSB and CW

The Elite 750 is not a replacement for a high-performance ham radio receiver, but it does offer SSB and CW reception. It achieves this with an adjustable beat-frequency oscillator (BFO). The knob is labeled **SSB BFO**, but of course, its use isn't strictly limited to SSB. Tuning is in 1 kHz steps, and the SSB BFO control does an admirable job of tuning in separate CW signals above and below the tuned frequency, as long as the band is not too crowded.

I've often been disappointed with how BFOs are implemented in consumer shortwave radios. Either the BFO control is way too sensitive, or the BFO introduces annoying distortion that can make listening almost painful. I was pleasantly surprised to see that the worst failings of consumer BFOs were avoided in the Elite 750. Yes, the control requires a light touch to tune signals perfectly, but once I had it tuned to my liking, the BFO remained stable and the resulting audio was clean and undistorted.

Even while using just the telescoping whip antenna, I was able to monitor a number of amateur SSB and CW conversations. The radio lacks the ability to create the kind of narrow filtering that is critical when listening to a crowded band, but again, the Elite 750 is a consumer product, not a ham receiver.

With the radio still in the SSB mode, I couldn't resist punching 14.074 MHz into the keypad. That's the 20-meter FT8 watering hole. As the musical cacophony of what sounded like a million FT8 signals erupted from the speaker, I grabbed a microphone headset, plugged it into my computer, and then held the mic close to the radio. I started the *WSJT-X* software and configured the program to select the computer's headset input as its audio source. Within seconds, I was greeted with a waterfall display full of successfully decoded signals. Later I tried again, but this time, I tapped the audio from the Elite 750's **LINE OUT** jacks and, as one would expect, it worked even

Lab Notes: Etón Elite 750 Receiver

Bob Allison, WB1GCM

In testing the Elite 750, I found that the sensitivity is not quite uniform throughout the HF spectrum, like we are used to with amateur transceivers. It's good below 20 MHz and fair at higher frequencies. The aircraft band could use more sensitivity. At less than 4 µV needed for an S-9 reading (normally 50 µV), the signal strength meter is not very accurate.

There are wide and narrow filter settings. In the SSB mode, you will notice that the audio frequency response measured slightly greater with the narrow filter than the wide filter. Audibly, it's hard to tell much difference, but the narrow filter setting eliminates hiss in the audio.

Dynamic range performance looks good at first glance for a portable, consumer-grade receiver, although I could not perform 5 or 2 kHz spacing measurements, as we do with amateur transceivers because there was considerable bleed-through from the adjacent signals. I hooked up an external antenna for the AM broadcast but found that the increased signal levels overloaded the receiver such that I heard a lot of intermodulation distortion. As noted in the review, the ferrite bar antenna does a good job on its own.

better. I have a feeling the designers didn't have HF digital reception in mind for the Elite 750, but this is what happens when you turn a product over to a ham.

FM and Aeronautical Bands

The Etón Elite 750 turned in excellent FM broadcast performance. You can listen in stereo only through headphones or earbuds, but even monaural listening with the internal speaker was impressive. Stereo decoding is selectable, so you can also choose to listen in monoaural, which is useful for weak signals.

It is worth noting that the bandwidth, RF gain, and attenuator controls appear to be disabled when the Elite 750 is used in the FM broadcast band. In addition, the signal strength meter indicates maximum strength regardless of what you may be listening to.

Exploring the aeronautical band, I was relieved to see the bandwidth, RF gain, attenuation, and metering return to normal functioning. I live in an area with a lot of air traffic, but I found that I had to use an outdoor antenna to receive an adequate number of signals. The sensitivity on the air band could be better.

The good news is that the Elite 750 includes a squelch control that works on all frequencies, and it was put to good use on the aeronautical band. It's a well-designed squelch with a sharp, fast cutoff.

I'd be remiss if I didn't mention the Elite 750's clock and timing features. There are two independent alarms that you can set to activate the radio whenever you wish. The Etón manual emphasizes their usefulness as alarms to awaken you from sleep, which is fine, but nothing would prevent you from tuning to a particular frequency — a shortwave broadcast frequency, for example — and using the alarm to switch on the radio at the beginning of a specific broadcast. A voice-operated (VOX) recorder attached to the **LINE OUT** jacks could then record the broadcast while you are away. I tried this using my station computer and the VOX function in my *Audacity* audio-editing software, and it worked perfectly.

Conclusion

The Etón Elite 750 appeals primarily to the consumer market, and it does an outstanding job in that application. With its rotatable ferrite bar antenna, I think it may also be a formidable contender among radios used for AM broadcast DXing.

Amateurs would find it most useful for casual listening, but there are times when it can do double duty as a test receiver. During this review, I needed to compare the transmit audio quality of two microphone/headsets I was using with my HF transceiver. I reduced the transceiver output to just a few watts, turned on the Elite 750, stowed its telescoping antenna, and then kicked in considerable attenuation. Using headphones plugged into the Elite 750, I was able to listen closely and compare the characteristics of the two microphones.

Of course, you wouldn't invest in an Elite 750 just to use it as a test receiver, but it is an extra benefit to consider for those times when you're not hunting longwave, AM broadcast, or shortwave signals, or enjoying your favorite FM stations.

Manufacturer: Etón Corporation, 1015 Corporation Way, Palo Alto, CA 94303, **etoncorp.com**. Price: $449. Available directly from Etón's website or select dealers.

The Best of "The Doctor is In"

While the column undergoes retooling in order to keep bringing you practical technical advice, *QST* presents some of the best questions and answers from past issues, with thanks to the Doctor himself, Joel Hallas, W1ZR.

Q Charlie, KB1KHD, asks: Most near vertical incidence skywave (NVIS) mobile antenna installations show the antenna bent over the top of the vehicle from the rear bumper to achieve horizontal polarization. Would there be any advantage to mounting a pair of loaded mobile whip antennas as a horizontal dipole about the same height above the roof of the vehicle?

A The usual mobile NVIS arrangement makes use of a base tuned vertical whip pulled over the vehicle to also avoid obstructions (see Figure 1). The short-to-medium range HF communication via NVIS was found to be a viable solution for our military's tactical communications in the Balkans, which had mountainous terrain not suitable for the usual tactical VHF vehicle communications.

The whip arrangement has the advantage of being tuned from the base, so it can be easily adjusted to cover multiple frequencies. It also has a major vertically polarized component (much like an inverted L), so it can provide coverage of both medium and long distances. My guess is that a long whip, by virtue of its length, would be about as efficient as the usual loaded mobile dipole, but I would certainly expect either should work. If you have the needed mechanical support arrangement, why not give it a try and see how it plays.

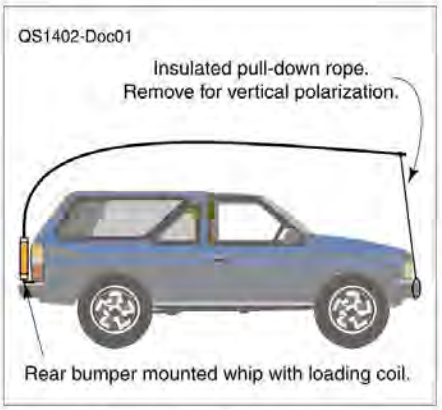


Figure 1 — Vertical HF mobile whip pulled down over the vehicle to result in a horizontally polarized radiation component useful for short-to-medium range NVIS propagation (and to avoid hitting tree limbs and drive-through awnings).

Q David, KF7JCK, asks: In considering the connectivity within my fixed, portable, and mobile stations, I find a wide variety of electrical connections — ac and dc power, transmission line terminations, control cables, antenna joints, and ground connections, to name a few.

I am aware of three treatment options — leaving the connections dry, coating the connection surfaces with conductive grease, or using non-conductive grease (often on vehicle battery terminals). Are there rules about the best practice?

A The first rule, in my opinion, is to seek guidance from the manufacturer of the commercial equipment on either side of the connection. If there is no information in the supplied documentation, an email to each customer service department is not out of order.

In the absence of specific instructions, I doubt that we can boil this down to a few simple rules. However, I am happy to share my personal opinions and an indication of my practices.

First, conductive grease should never be across, nor even near, any insulation between connections — that's an invitation for a short or undesired leakage.

All of my indoor connections are dry, and that works well, in my experience, unless it is a very humid or salt air environment. Even on my salt-water sailboat, I just use dry connections. I did have an occasion in which a BNC connector pair on an extension of my depth sounder transducer cable near the bilge, where saltwater accumulates, had to be replaced. I've avoided any recurrences of that by thoroughly taping the new connectors with good-quality plastic electrical tape. If the connectors are properly connected, I don't find much can get into the metal-to-metal connections.

The one precaution I do take is that when I button up the boat for in-water winter storage, I remove the electronics (including HF and VHF ham radios) from the craft and put the boat-side connectors in plastic sandwich bags sealed with rubber bands to keep salty air out. An alternative is to sacrifice an unused mating connector — although some types are hard to find. Many of these coax, power, and signal connections have been unchanged in the 30 years since this boat was new. So, while I can't say they will last forever, I can say they will keep going for a long time.

I always use conductive grease on sliding tubing connections that are part of antennas. I expect that the points of contact under the clamps would stay connected even without such grease; however, the grease makes it possible to change adjustments later without having to clean up the surface. It also helps keep the aluminum from getting stuck and hard to move. The grease manufac-

turers suggest using the conductive grease on grounding and power conductors in outdoor environments.

I believe that the use of grease on lead-acid battery terminals is mainly intended to provide a barrier to the acid that can seep out along the terminals and cause corrosion. If the grease is kept near each terminal, I would think it wouldn't matter much whether it were conductive or nonconductive. The tight battery clamps squeeze the grease from between the contact surfaces in either case.

Q Marshall, KL7EU, asks: Virtually all HF beams are installed level and parallel to the ground. Nearly all DX signals, however, arrive from elevation angles somewhat above the horizon, perhaps from 3 to 15°. Do you think there would be any improvement in signal strength to orient an HF beam so it would point at some arbitrary value above the horizon, perhaps 10°, to better align it with incoming DX signals?

A In theory, your suggestion could work. The problem is that for most of us who have relatively low towers, we are getting as much radiation into that sector as the out-of-phase ground reflection will allow. Raising the elevation angle of the Yagi will actually reduce the gain a bit without changing the elevation lobe, at least for HF antennas at reasonable heights. Figure 2 shows the elevation pattern of a three-element 20-meter Yagi at a height of 45 feet above typical earth. Figure 3 shows the elevation pattern of the same antenna tilted up by 10°. Even at greater heights, there is nothing much to be gained. Figures 4 and 5 move to perhaps the HF extreme, showing the elevation patterns of a 10-meter three-element Yagi raised to 200 feet with tilt angles of 0 and 15°. Note that even at this height, the first elevation lobe is only raised by 0.5°.

Towers that are multiple wavelengths high can indeed have radiation angles for mid-distance paths that are lower than desired, as well as nulls at some useful intermediate angles. In that case, increasing the elevation angle can help. Serious contesters usually do this with multiple Yagis, such as one at 60 feet and another at 100.[1] By feeding them in phase, they get about 3 dB gain at a sharper elevation lobe corresponding to the effective height of the array center (80 feet in this case). By using just one or the other Yagi, they can select different peak elevation angles, and by feeding the two Yagis 180° out of phase, they get a broadside null and radiation at high angles for close-in contacts. The switching arrangements are generally faster and less expensive than a heavy-duty elevation rotator.

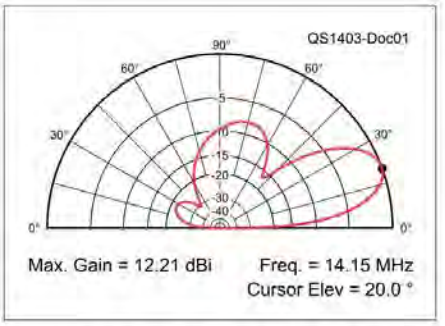


Figure 2 — *EZNEC* elevation plot of three-element 20-meter Yagi 45 feet above typical (conductivity 0.005 S/m, dielectric constant 13) ground at 0° tilt angle.

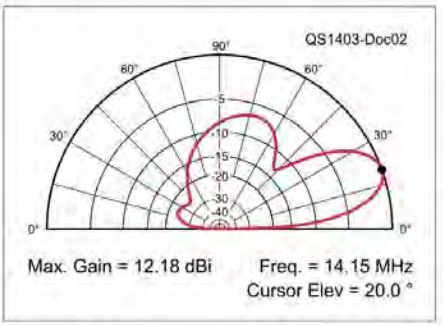


Figure 3 — Elevation plot of three-element 20-meter Yagi of Figure 1 tilted 10° above horizontal. Note the peak of the elevation lobe is unchanged, while there is a small reduction in forward gain.

There are exceptions, such as the antennas used by serious 6-meter weak-signal enthusiasts, whose antennas are usually many wavelengths above ground, and who often use azimuth/elevation rotators to allow raising their elevation angle for meteors, some near-in E-layer skip, as well as moonbounce contacts.

[1]M. Gruber, W1MG, "Your Portable Generator to the Rescue," *QST*, Nov. 2013, pp. 44 – 49.

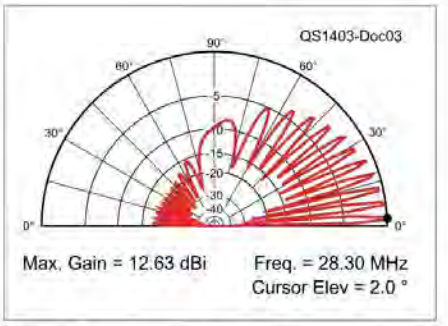


Figure 4 — Elevation plot of three-element 10-meter Yagi 200 feet above typical ground at 0° tilt angle.

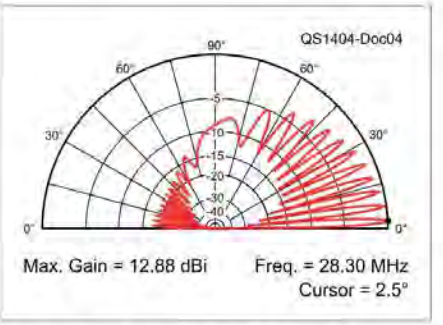


Figure 5 — Elevation plot of three-element 10-meter Yagi of Figure 3 tilted 15° above horizontal. Note that the peak of the first elevation lobe is only 0.5° above the horizontal array, even at this height.

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**.

Listen to the archives of the *ARRL The Doctor is In* podcast on iTunes, Blubrry, Stitcher, or on the ARRL website at **www.arrl.org/doctor**.

Hints & Hacks

Wireless Audio Where You Need It; Easy Replacement Chokes, and Readable Tool Markings

Remote Audio

I can't always bring my ham gear when I'm working on other projects, like yard work or car maintenance. However, with a bit of creativity, I can at least listen to my favorite frequencies. The key player in this scheme is a low-power FM stereo transmitter (see Figure 1), of the type that were popular before CD players were installed in car stereos. These battery-powered devices, still offered today by retailers like Amazon, are plugged into portable CD players and can easily transmit from anywhere in the car to the vehicle's FM broadcast receiver, and probably a few yards further (especially when not shielded by the metal body of a car).

Instead of plugging a CD player into the transmitter, however, I used a cable to connect the transmitter input to the external speaker jack of a ham transceiver. Because these FM units transmit in stereo, I can get creative by separating the right and left audio input lines and routing one cable to, for example, a 2-meter rig, and another to an HF radio. Now I can simultaneously listen to both devices with the FM receiver of my choosing.

Many of these inexpensive transmitters operate on battery power. I chose to power my setup with a wall wart. Because these are Part 15 low-power transmitters, it helps to maximize their coverage. The antenna adage "height is might" applies here. If your ham station is on the upper floor of your home, you're covered. Otherwise, discreet audio wires may need to be routed upstairs to where this stereo transmitter is located. Following the path of telephone lines from an operating position on the lower level of the house to a room upstairs is safer than other possible options.

Figure 1 — You can repurpose a low-power FM stereo transmitter to rebroadcast audio from your station. You can even re-transmit two audio sources at once. [Klaus Spies, WB9YBM, photo]

Once you've located the stereo transmitter on an upper floor, or as high as you can get it, tape the transmitter's wire antenna onto a wall, but make sure there isn't metal conduit behind it. Taping the antenna to a window will likely provide the best coverage, but pick a window facing the direction where you'll do most of your listening (like the back yard or driveway). Some windows have metal screens, so tape the antenna on the glass above if you can't move the screen out of the way.

If you own wireless Bluetooth headphones, ear buds, or portable speakers, consider using a Bluetooth transmitter instead. They're available from several retailers and also have the capability to transmit in stereo. They are the modern-day functional equivalents of low-powered FM stereo transmitters and will serve the same purpose. — *73, Klaus Spies, WB9YBM,* **wb9ybm1@yahoo.com**

Building Plate Chokes

Lately, I've been rebuilding an old Heathkit SB-200 amplifier. One problem I ran into was the discovery that the original plate choke was broken at the base. I knew getting a replacement was unlikely, so I decided to create my own substitute.

I decided to use ⅜-inch fiberglass rod, because it's drillable and easy to work with. All I needed was a 4-inch-long rod, some enameled #28 wire-wrap wire, some heat-shrink tubing, and a variable-speed electric drill (see Figure 2).

I began by drilling a small hole ½ inch from one end of the rod along the shaft. At the other end, I drilled a small hole so I could screw in a ¼-inch 4-40 screw to hold the choke to the chassis.

I inserted one end of the fiberglass rod into the drill and an end of the wire

Figure 2 — The new plate choke was created from a 4-inch rod. [Clint Millett, VE3CMQ, photo]

Figure 3 — Testing the 5.9 mH choke. [Clint Millett, VE3CMQ, photo]

into one of the holes. With a bit of tension on the wire, I started up the drill and within a minute I had 3 inches or so of perfectly wrapped wire on the rod. I put the remaining wire end through the other hole, then I covered the coil with the heat-shrink tubing. If you use the heat-shrink tubing with glue inside, the coil will never unwrap on you.

The result was a choke that was 5.9 mH — exactly the same as the original! That may have been a fluke, but I'll take it.

I then tried the same technique using a 4-inch ferrite rod. However, ferrite rod is difficult to drill, so I skipped that step. I first covered the rod with heat-shrink tubing, because it's pretty sharp and I didn't want to damage the wire. Three inches of coil later, I had another 5.9 mH choke (see Figure 3). It only took 5 minutes to build these.

I installed the 5.9 mH choke in the SB-200 and it worked very well. I'll probably use the other 5.9 mH choke in my next linear amplifier. Both chokes are good for at least 1A.
— 73, Clint Millett, VE3CMQ,
ve6cmm@secrs.com

Make Tool Markings Easier to Read

Sometimes I need to use a metal tool with stamped-in titles, numbers, or settings that are difficult to read. I found a neat way to make those characters much easier to see.

Wite Out® is a correction fluid product that has been used for many years to cover errors on printed material, especially those made on manual or electric typewriters. As seen in Figure 4, the stamped-in numbers on my wire-stripping tool are hard to read on the tool's left arm. I tried to bring them into better view with the correction fluid on the tool's right arm.

To do this, I applied a small amount of the liquid across the characters with the bottle's brush and immediately wiped the area with a lint-free tissue to remove the excess. The material dries very quickly when you do this, so the result may not be perfectly clean around the imprinting, but you'll be able to read the text. You can remove most of the excess around the characters with a cotton swab dipped in isopropyl alcohol or with a sharp pick.

Figure 4 — The stamped-in numbers on this wire-stripping tool are difficult to read on the tool's left arm. The author attempted to enhance them with correction fluid on the tool's right arm. [Dino Papas, KLØS, photo]

Now all the wire gauge markings are much easier to see (see Figure 5).
— 73, Dino Papas, KLØS,
kl0s@cox.net

Figure 5 — An application of correction fluid really makes the numbers "pop" on both arms of the tool. [Dino Papas, KLØS, photo]

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

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

Paul Wade, W1GHZ, w1ghz@arrl.org

Microwavelengths

Understanding 10 GHz Propagation

Many microwave operators only operate portable, and even then it's fairly infrequent, such as during contest operations. On some days, long-distance contacts are easy, while on other days, every contact is a challenge. We have little idea what is "normal propagation," but we've consistently proven that it's far beyond line of sight. To better understand this, we try to monitor propagation. Microwave beacons can help with this, as they provide a continuous signal.

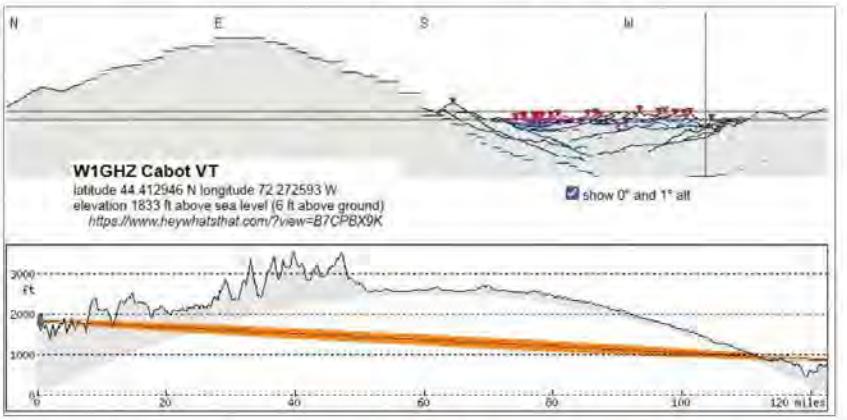


Figure 1 — A profile of the signal path from the VE2TWO/b beacon to Paul Wade, W1GHZ, with Earth curvature and mountains. The vertical scale is exaggerated.

New England Microwave Beacons

In New England, there are several 10 GHz beacons. From my location (FN34uj), I can receive two of them: N1JEZ/b on Mount Mansfield in Vermont (FN34om), 42 kilometers away, and K1FO/b on Mount Washington in New Hampshire (FN44ig), 81 kilometers away. The first one is so loud that it's only useful for verifying that my equipment is working. However, the path to Mount Washington to the east is blocked by a hill next to my house. I can only receive it weakly, with the signal bouncing off the Green Mountains to the west.

In the summer of 2018, a group of Canadian hams installed a new beacon, VE2TWO/b, west of Montreal (FN25uk), 196 kilometers away. I found that I could consistently receive it. That autumn, I set up my portable 10 GHz radio outside my walk-out basement door, which is slightly covered by a deck above. Each morning for more than 2 years now, I've noted signal levels from both VE2TWO/b and K1FO/b, to provide some indication of typical propagation, at least over this path.

The profile of VE2TWO/b's path in Figure 1 (made with **www.heywhatsthat.com)** shows serious obstructions over 3,000 feet high along the path, which also provides the reflection for the bounce path to K1FO/b. However, the obstructions are far enough away to only project about 1 degree above the horizon (according to the website), so it should be possible for some signal to get over them.

A Propagation Study

The 10 GHz receiver has a 2-foot dish, with perhaps 33 dB gain and 2 dB noise figure. To estimate signal strength, a FUNcube Dongle is tapped into the IF of a Yaesu FT-817, to provide signals to a panadapter using *HDSDR* (**www.hdsdr.de**) on a laptop. The panadapter shows the signal level above the noise directly. In Figure 2, the VE2TWO signal shown is barely detectable by ear. It's about 12 dB above the (average) noise in the 5.9 Hz bandwidth used by the panadapter, which would be 14 dB below the noise in the 2.4 kHz SSB bandwidth of the receiver. However, the human ear adapts to provide a narrower and more effective bandwidth. Contacts with a well-equipped station, with perhaps 20 dB more antenna gain than a beacon, would would be easy to copy on SSB.

A quick calculation from the October 2012 "Microwavelengths" column suggests that the signal in Figure 2 is roughly 90 dB weaker than the line-of-sight path loss — the curvature of the Earth, plus obstructions, result in about 90 dB additional path loss.

I record the peak signal level of VE2TWO/b and K1FO/b each morning, along with minimal weather information. I chose the peak level because the signal level varies, usually with slow fading over a few seconds (patience is important for microwave operation), but sometimes it fades so rapidly that it's difficult to copy a complete Morse character. I have yet to find any significant correlation to weather (except for rain- and snowscatter) or between the two beacon signals. Much of the prevailing weather travels up the Saint Lawrence

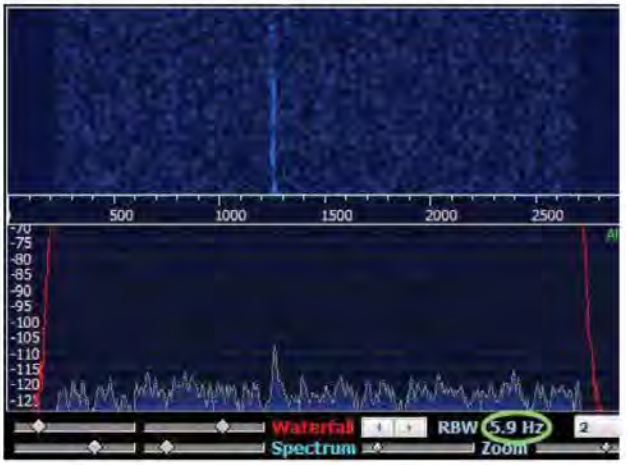


Figure 2 — A signal received from VE2TWO/b, just barely strong enough to copy CW.

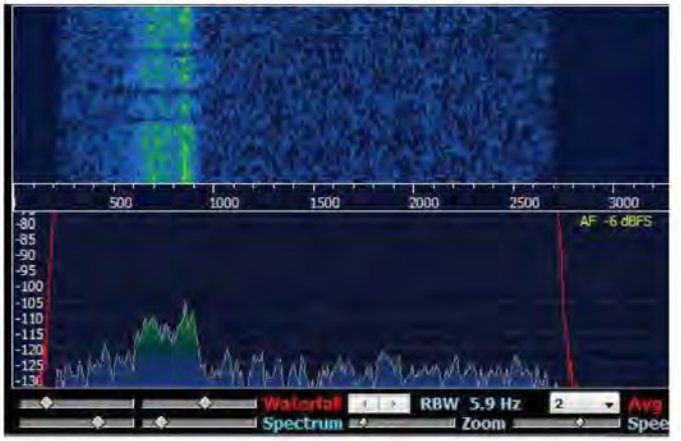


Figure 4 — A received signal broadened by rainscatter. Broad scattered signals sound louder and are easier to copy on CW.

River, from Lake Ontario past Montreal, directly across the signal path. I noted 65 days of rain- or snowscatter on the signal in 2019, and 61 days in 2020.

Data collection can't be automated. This is mostly because the VE2TWO/b frequency is temperature sensitive, varying at roughly –100 Hz/° C. Without the panadapter, it would be difficult to find the weak signal at times.

The signal level varies from day to day but doesn't show huge variations. The average signal level over 26 months was 18.3 dB above the noise, with a maximum of 42 dB. The graph in Figure 3, showing the number of days for each signal level, indicates that the signal was more than 10 dB above the panadapter noise level, enough for copying CW, on more than 80% of the days. This consistent level is far different than what I have observed at coastal locations during occasional contest operations, where signals over the ocean show tremendous variation and may have huge enhancement (low power stations pinning the needle from hundreds of kilometers). Stations in the Midwest also report more frequent tropospheric enhancement.

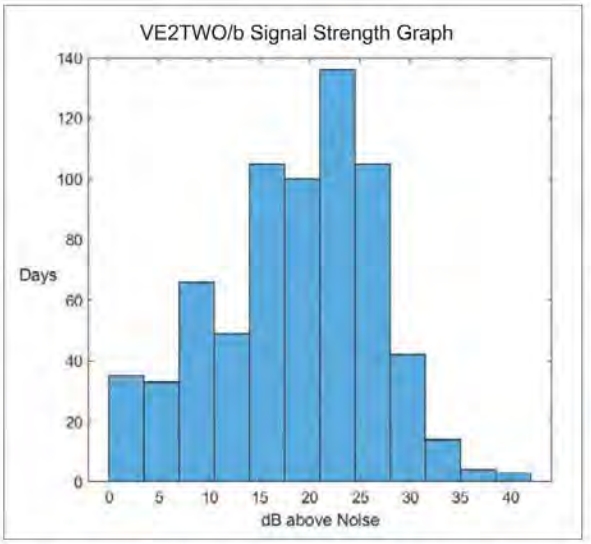


Figure 3 — A graph of received signal strength from VE2TWO/b, showing the number of days at each signal level over a period of 26 months.

Rain- and snowscatter provide the most frequent enhancement (see the October 2020 "Microwavelengths" column for more on this). Signals are broadened by the precipitation, so they sound much louder. The snowscatter signal in Figure 4 has a peak level of perhaps 19 dB above the noise, but sounds much louder because the signal is several hundred hertz wide and the average level is more consistent. One hypothesis is that much more audio power is provided to the ear. As a result, a CW rain- or snowscatter signal can be copied when it barely shows on the panadapter, with a very rough note. The enhancement is best when scattering by precipitation is along the path, whereas heavy rain at one end tends to absorb the signal, so less signals make it to the receiver.

Summary

This is not a thorough study of propagation, and studies over different paths would help with understanding. However, these results suggest that contacts over hundreds of kilometers are readily achievable on 10 GHz and lower microwave bands, even over difficult terrain. Microwaves are far from being limited to line of sight, and mountaintops are not essential. What is essential is getting on the air and making contacts to take advantage of the propagation potential.

Feedback

In the "Morse Code Sheep" item of the February 2020 "Up Front" column, Debra King's, N9GLG, call sign was accidentally omitted. *QST* regrets the error.

Steve Ford, WB8IMY, wb8imy@arrl.net

Eclectic Technology

Receiving Radiosondes with *MySondy GO*

Meteorological stations throughout the world regularly launch telemetry transmitters known as radiosondes *high into the atmosphere beneath helium-filled balloons to measure wind speeds, temperatures, and much more. In the US, about 90 National Weather Service offices launch radiosondes twice each day at 1200 and 2400 UTC. Most of these devices send their telemetry at about 400 MHz and the data is unencrypted for anyone to receive. While their RF output is less than 100 mW, radiosonde signals have surprisingly wide coverage.*

I've invited Anthony Le Cren, F4GOH/KF4GOH, to describe an interesting project that may make it even easier to track radiosondes with little more than a bit of hardware and your smartphone or tablet. — Steve Ford, WB8IMY

Using a TTGO ESP32 (433 MHz) transceiver module and a smartphone or tablet, it is now possible to receive radiosonde signals directly and track the positions of the probes. Everything is displayed on a smartphone or tablet thanks to a wireless Bluetooth connection with the module.

The main advantage of this system is that you don't need a laptop or desktop computer. In terms of software, all you need is the *MySondy GO* app for Android, available in the Google Play store. (At the time of this writing, the app has yet to be developed for iOS.) The author of the system is Mirko Dalmonte, IZ4PNN, and complete project details are available at **mysondy.altervista.org**.

The TTGO development board is equipped with an ESP32 microcontroller and an SX1276 or SX1278 modem. For the moment, the *MySondy GO* project does not use a Wi-Fi connection with the smartphone — only Bluetooth.

Assembly

You start by purchasing a TTGO transceiver module. They are available from several online vendors, such as AliExpress at **www.aliexpress.com**. On the website, do a search for the LILYGO TTGO ESP32-Paxcounter LoRa32. The cost is only about $21. If you order this module, take care to choose the 433 MHz version.

After receiving the module, download the firmware via the author's Dropbox links, along with the programming utilities. The downloadable instruction manual is available in both Italian and English.

Figure 1 — The programmed TTGO ESP 32 transceiver module. For better reception, you may want to attach a superior antenna, such as a UHF ground plane or small Yagi.

Figure 2 — The *MySondy GO* app for Android.

As soon as the TTGO module is connected to your PC with a microUSB cable, the drivers automatically install under Windows 10. For Windows 7, the drivers must be installed beforehand (use the CP210xVCPInstaller). For Linux, note that the name of the communication port should be **/dev/ttyUSB0**.

If the module is unresponsive when you attempt to program it using Windows, connect a wire between ground (GND) and pin GPIO0. This forces the programming mode in the module.

When *MySondy GO* app starts, the smartphone asks for permission to access the Bluetooth device and the phone or tablet GPS receiver for geolocation. Then the application searches for the TTGO module for pairing. Once it is paired, you are ready to start hunting radiosondes. — *Anthony Le Cren, F4GOH/KF4GOH*, **kb1goh@yahoo.com**

Welcome to CYCLE 25

A new solar cycle is under way and conditions on the HF bands are already improving.

Steve Ford, WB8IMY

The energy output of our nearest star rises and falls in cycles that span roughly 11 years. Scientists assign numbers to these cycles and speak of their peaks as solar maximums, and their troughs as solar minimums.

In 2018 and 2019, we reached the solar minimum of Solar Cycle 24. Solar activity was substantially reduced, with the solar flux index ranging between the upper 60s and the lower 70s. The sun was also bereft of sunspots (darkened regions of reduced temperature caused by magnetic fields rising from below the sun's surface) during much of this period. An active sun tends to spawn spots, but a quiet sun can be spotless for many weeks at a time.

When the sun goes quiet, the electron density of the ionosphere (the electrically charged region of our atmosphere responsible for refracting HF signals over great distances) diminishes. A lower electron density in the ionosphere means it's a less effective prism for signals, particularly at high frequencies. Therefore in the trough of Cycle 24, globe-spanning DX contacts became more challenging and less common. If you wanted the best conditions for long-distance communication, you had to go to the lower HF bands, such as 80 and 40 meters. Signals at those frequencies still offered DX opportunities because they were more easily refracted by the anemic ionosphere.

But in 2019, scientists noticed something out of the ordinary. A few sunspots appeared with magnetic fields whose polarities were reversed compared to the sunspots that came before. This trend continued, and by December 2019 these reversed-polarity sunspots became the norm.

Decades of solar research shows that when sunspots with reversed magnetic polarities become predominant, they herald the beginnings of new solar cycles. The scientific community reached the consensus that Cycle 24 had ended and Cycle 25 had begun!

Differing Predictions

At the end of 2020, the solar flux index shot upward and a cluster of powerful sunspots appeared. For the first time in years, the upper HF bands opened on a large scale. The boost eventually faded, but it may have provided a preview of what's in store.

The only problem with forecasting the solar future is that the sun can be a fickle creature. Scientists still don't know why solar activity runs in 11-year cycles, nor can they accurately predict what a new cycle may bring. Pessimistic forecasts predict Cycle 25 to be very much like Cycle 24 — mediocre, but with reasonably good DX conditions at the peak in 2025 and 2026 (see Figure 1). Optimistic forecasts call for a highly active cycle. They believe it will be like Cycle 23, which peaked in 2000 and again in 2001.

Many hams fondly recall the peak of Cycle 23, when 15 meters was open for DX daily and 10 meters frequently opened as well. Even on 6 meters, hams could achieve occasional transatlantic and transpacific DX contacts. If you enjoyed the HF bands, the Cycle 23 peak was a great time to be on the air.

Some veteran amateurs hold out hope that Cycle 25 could be spectacular, comparable to the legendary Cycle 19 of the late 1950s. Speak with them and you'll hear incredible stories of effortless worldwide communication any time of the day or night, even on 10 meters.

But the truth is, no one knows what Cycle 25 will bring. We know the new cycle has started, but how strong it will be is anyone's guess. At least the bleak predictions

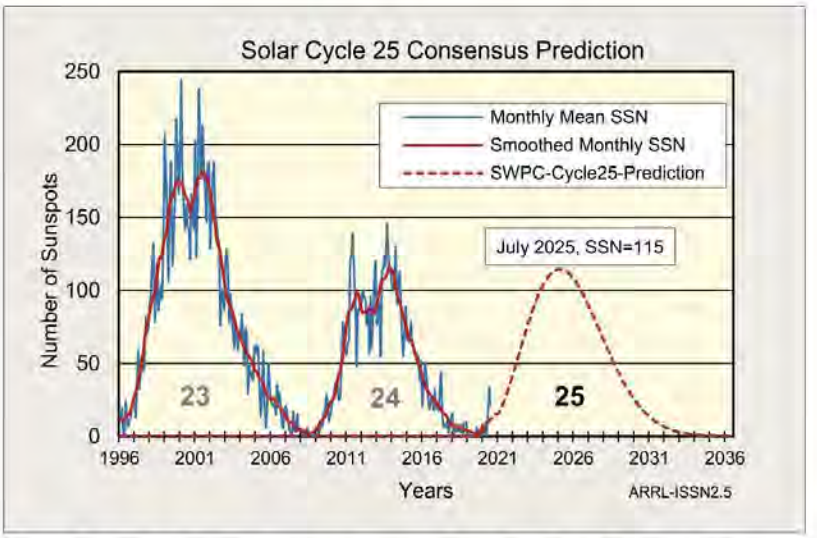


Figure 1 — The scientific consensus on what may lie ahead for Cycle 25 compared to previous solar cycles. However, predicting solar cycles is difficult.

2021 Propagation Forecast

Carl Luetzelschwab, K9LA

The major question is, "How big will Cycle 25 be?" I'm aware of 39 predictions for Cycle 25. There are so many because we don't fully understand the solar cycle process yet, and thus there are many different ways to make a prediction. Figure 2 shows the distribution of these 39 predictions.

The average of all 24 solar cycles is 179 (in terms of the V2.0 sunspot record). Thirty-three of the 39 predictions (85%) are for a below-average cycle, three are for an average cycle, and three are for a big cycle.

One of the predictions for a big cycle is by Scott W. McIntosh, Sandra Chapman, Robert J. Leamon, Ricky Egeland, and Nicholas W. Watkins (available at **www.arxiv.org/pdf/2006.15263.pdf**). This prediction has received much publicity in the scientific and amateur radio community. If it comes true, we'll have excellent propagation worldwide on 15, 10, and 6 meters, via the F2 region of the ionosphere.

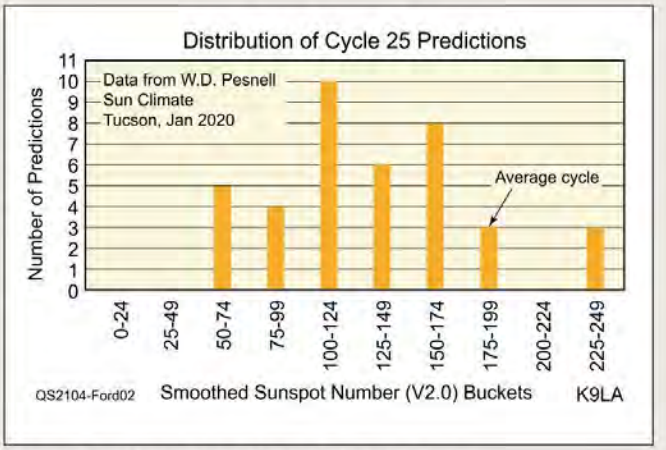


Figure 2 — Distribution of Cycle 25 predictions.

We'll know which of the predictions is the most accurate at Cycle 25's solar maximum, but that's 4 or so years from now. We may have an earlier clue by noting how fast Cycle 25 rises. This is because a big cycle rises faster than a small cycle. All we can do is wait and see what happens.

In regard to propagation in 2021, 17 meters will benefit first from the ascent of Cycle 25, with more consistent worldwide openings (more days in the month). Fifteen meters will follow in 2021 with more consistent worldwide openings, and 2022 should be even better. I don't expect consistent worldwide east-to-west openings on 10 meters until 2022. Of course, you should always check the higher bands due to the short-term events that happen in the ionosphere that are tough to predict.

(Originally published in the January/February 2021 issue of NCJ*)*

of an extended Cycle 24 solar minimum appear to be false, and that's good news.

Changes in Behavior

Let's take the middle path and anticipate that the behavior of Cycle 25 will fall somewhere between Cycles 23 and 24.

As we move into the early years of this decade, you'll notice that the 20-meter band will start remaining open well after sundown. This behavior on the "queen of the DX bands" will become pronounced by 2025, and you're likely to see episodes of 20 meters remaining open all night. Thirty meters will probably do the same.

Activity on 17 and 15 meters will begin to increase as these bands open for longer stretches of time during the day. As with 20 meters, 17 and 15 meters will likely remain open for a few hours after sunset.

Twelve and 10 meters will open almost every day. During the peak years in the fall and winter months, watch for 6 meters to occasionally become a DX band as well.

Lawrence Burt, KFØQ, operating on the HF bands. Expect a surge in DX and contest activity as these bands improve in the years to come. [Lawrence Burt, KFØQ, photo]

As the 6- or 10-meter bands become more active, a Moxon antenna may be all you need.

Increased solar activity is not a good thing for the lower bands. Hams who've enjoyed seeking out DX contacts on 160 through 40 meters will find their prospects reduced as the electron density of the ionosphere increases. More lower-frequency signal energy will be absorbed compared to quieter times, and less will be refracted. Noise levels at those frequencies will increase as well.

Low-Power Operating and Mobiles

As the ionosphere becomes more refractive, it becomes easier to make contacts with low power and compromise antennas. Some may recall that during the peak of Cycle 22 in the late 1980s and early 1990s, we saw a variety of inexpensive 10-meter transceivers flooding the market. These were lower powered radios that typically produced about 25 W output. Conditions were so good on 10 meters that you could work much of the world with these radios and a simple dipole antenna.

QRP operators — hams who use 5 W output or less — will benefit greatly from improved conditions to come. QRP operating has been popular for years because the radios are simpler (especially kit radios) and, at such low output levels, their signals are far less likely to cause interference. Even at the lowest solar minimum of Cycle 24, we saw the blossoming of activities such as Parks on the Air (POTA) and Summits on the Air (SOTA) with hams taking transceivers outdoors. As it becomes easier to make very low-power contacts, these activities will likely increase considerably.

HF mobile activity fell with the decline of Cycle 24 because the poor conditions made it difficult to enjoy operating from a vehicle. Even with 100 W transceivers, mobile antennas are suboptimal at best, and this handicap becomes more burdensome when the sun refuses to cooperate. But with the rise of Cycle 25, look for more HF mobile activity to accompany the improving conditions. By the time we approach the peak, mobile signals will become more common, especially on the upper HF bands, where their antennas are more efficient and effective.

Preparing for the Peak

There's little to be done at this moment in terms of your station equipment. However, you may want to consider plans for improving your capabilities on the upper HF bands.

As we approach the solar maximum, it will be helpful to have directional antennas for 17 through 10 meters. You'll find these antennas to be relatively inexpensive and easy to build. Also, as frequencies increase, antennas tend to become smaller and lighter. For example, Moxon antennas are not much more than wire or tubular rectangles, but the space-saving design can be remarkably effective.

Don't forget 6 meters. A directional antenna for 6 meters can be small (Moxons will also work on this band) and easy to build. If we start enjoying global openings on the "magic band," you'll be glad you were ready. These antennas can also provide excellent results during the shorter openings caused by sporadic-E propagation (mainly during the summer) and meteor scatter. These openings will take place regardless of the level of solar activity, so an investment in a directional 6-meter antenna will reap benefits for many years to come.

Better days are on the way — we just don't know by how much. All hams will benefit regardless of license class. Who knows? History may repeat itself and Cycle 25 could even rival Cycle 19.

Many thanks to Carl Luetzelschwab, K9LA, for his assistance during the preparation of this article.

Steve Ford, WB8IMY, is the retired Editor in Chief of *QST*.

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

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Homebrewed Baluns:
A Radio Club Project

Dave LeVasseur, NØDL, and Gary "Joe" Mayfield, KKØSD

After many years of ARRL Field Day setups and teardowns, our local radio club, the Lake Area Radio Klub (LARK) in Watertown, South Dakota, decided it was time to replace the center insulators of our 80- and 40-meter dipoles. The center insulators had been used for at least 40 years. Rather than use plain center insulators again, we decided to build 1:1 current baluns. We ended up turning this into a club project and building 30 baluns. Many of our members also wanted some for their own use.

The Lake Area Radio Club used this balun design to replace 40-year-old center insulators.

Our Balun Design

In our design, we wanted each balun to have 50 Ω: 50 Ω balun operation from 80 through 10 meters; legal-limit power capability; a well-researched core material for optimum performance; measurably good amplitude and phase balance, and durability for long-term, year-round use in South Dakota.

Additionally, we wanted this to be a hands-on project, in which club members from all license classes could participate. Because this project took place in 2019, we weren't affected by any COVID-19 limitations, but the project could be made pandemic-friendly by checking in via videoconference.

We surpassed our frequency range goal, as we found that our design works well from 160 through 10 meters. Using the rule of thumb that the common-mode impedance should be 10 times the feed-line impedance, we aimed for at least 500 Ω minimum common-mode impedance from 3.5 through 30 MHz and had room to spare.

Few network analyzers with balanced measurement ports such as this can limit their bandwidth. The test circuit shown in Figure 2 gets around the need to make a balanced measurement by creating a ground reference in the middle of the circuit. The chosen resistor values create a minimum loss network, allowing for singe-ended voltage measurements.

Figure 1 — LARK's balun design includes four turns of RG-8X coaxial cable through a 1.2-inch OD ferrite sleeve (about 2 inches long), made from Fair-Rite's #31 material.

LARK Balun Parts List

- (1) Ferrite sleeve, Fair-Rite P/N 2631103002, from Kreger Components
- (1) SO-239 connector, silver-plated, Amphenol 83-1R
- (1) 2 feet of RG-8X coaxial cable
- (1) 6 inches of Schedule 40 2-inch-diameter PVC pipe
- (1) 2-inch PVC test cap
- (1) 2-inch PVC end cap
- (2) ¼-inch × 20 × 1⅞-inch stainless steel eye hooks for antenna connection
- (1) ¼-inch × 20 × 1⅞-inch stainless steel eye hooks for support
- (8) ¼-inch × 20 stainless steel nuts for antenna eye hooks
- (2) ¼-inch × 20 stainless steel nuts for eye hook support
- (4) #12 ring terminal solder lugs for antenna
- (4) #4-40 machine screws to hold the SO-239
- (4) #4-40 lock washers for the SO-239 machine screws
- (4) #4-40 nuts to hold the SO-239
- (1) #20 ring terminal solder lug for SO-239 shield connection
- (1) Vinyl label

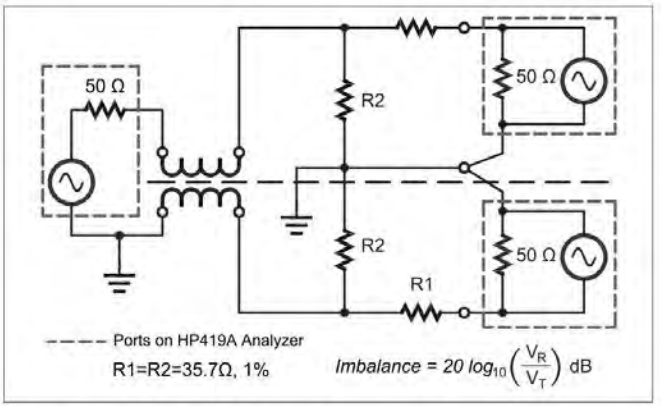

Figure 2 — LARK's test schematic.

The design for the balun itself was simple: four turns of RG-8X coaxial cable through a 1.2-inch outer diameter (OD) ferrite sleeve (about 2-inches long), made from Fair-Rite's #31 material (see Figure 1). Our research showed that #31 would provide a lot of inductance, hence common-mode impedance with just a few turns.

Rich Grant, KEØEPY, helped with the LARK balun assembly.

Figure 3 —The antenna connection on the outside of LARK's balun.

The use of coax instead of paired lead wire kept winding distributed capacitance low for use on 10 meters (our tests show that the balun even works well on 6 meters). A test jig (see Figure 2) was developed to test amplitude and phase balance over the applicable frequency range. Because most network analyzers are single-ended (unbalanced), the use of matched resistors in the test jig allowed us to test for both amplitude and phase balance.

It being pre-pandemic with no social distancing regulations, we were able to construct the baluns by way of forming an assembly line in Rich Grant's, KEØEPY, garage. As a retired owner of a plumbing and heating business, Rich's expertise was helpful in making everything come together (and stay together).

Tools and Supplies

Special tools weren't needed. We mounted an SO-239 connector in the center of a PVC test cap with stainless-steel machine screws and nuts forming the bottom of the balun, and used a standard cap for the top. We used ¼-inch × 20 stainless steel eye hooks. We connected the coax shield and center conductor to eye bolts inside the balun with electrical wire lugs held between a pair of nuts. The same arrangement for antenna connection can be seen on the outside of the balun in Figure 3. We also used Loctite sealant on the connections inside the balun, as it would be challenging to tighten them later.

We wrapped a thin layer of packing foam around the ferrite to slightly increase the bend radius of the coax, as we were concerned that too sharp of a bend might damage the coax. The foam also protects the brittle

ferrite sleeves from damage during assembly, installation, and ongoing use. Although this step is optional, it acts as insurance against breakage. Bubble wrap would probably work as well.

To reduce corrosion, we used stainless steel eye bolts and other hardware. LARK got 40 years out of the previous dipoles, so our goal was longevity. The assembled units were tested on an HP 4194A impedance/gain-phase analyzer and the performance variance from unit to unit was negligible.

Conclusion

Most of the assembly was carried out over a few Saturday afternoons. Club members of every license class participated, as well as purchased finished units. A special thank you to Rich Grant, KEØEPY; Todd Kuhlman, KEØRVH; Scott Schladweiler, KØSHD, and Chuck Olson, KBØVXD, for their help during assembly. It was a great opportunity for mentoring and fellowship between club members.

The LARK balun was relatively easy to construct. It performs well over a wide frequency range and costs less than $30 to build using readily available ferrite sleeves and hardware available at your local building supply store.

Dave LeVasseur, NØDL, earned his Novice-class license in 1974. He upgraded to Amateur Extra-class in 1977, and earned an FCC First Class Radiotelephone Operator license in 1978. Dave has taught ham radio classes, and participates as a Volunteer Examiner (VE). He earned a Bachelor of Science degree in electrical engineering and is a named inventor on two patents involving transformer and communication technology. Dave has been a designer of inductors and transformers since 1982, and currently works at Minntronix, Inc., a manufacturer of inductors, coils, and transformers. He can be reached at **n0dl@arrl.net**.

Gary "Joe" Mayfield, KKØSD, was first licensed in 1986. He enjoys contesting, ARRL Field Day, satellite operations, and experimenting with antennas on a small city lot. Gary also enjoys leading amateur radio licensing classes and participating as a Volunteer Examiner (VE) in exam sessions. He earned a Bachelor of Science degree in electrical engineering and currently works as an electrical engineer for Western Area Power Administration. Joe can be reached at **kk0sd@arrl.net**.

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

Congratulations

January 2021
QST Cover Plaque Award Winner

David A. Duncan
K7DUN

In his article, "CW-ELMER — An Advanced Morse Code Learning System," David describes a system and method for sharpening your Morse code timing and character keying skills. The method develops an ear for entire words and phrases at a time, much as one learns a new spoken language.

QST Cover Plaque Awards are given to the author or authors of the most popular article in each issue. *You* choose the winners by casting your vote online at

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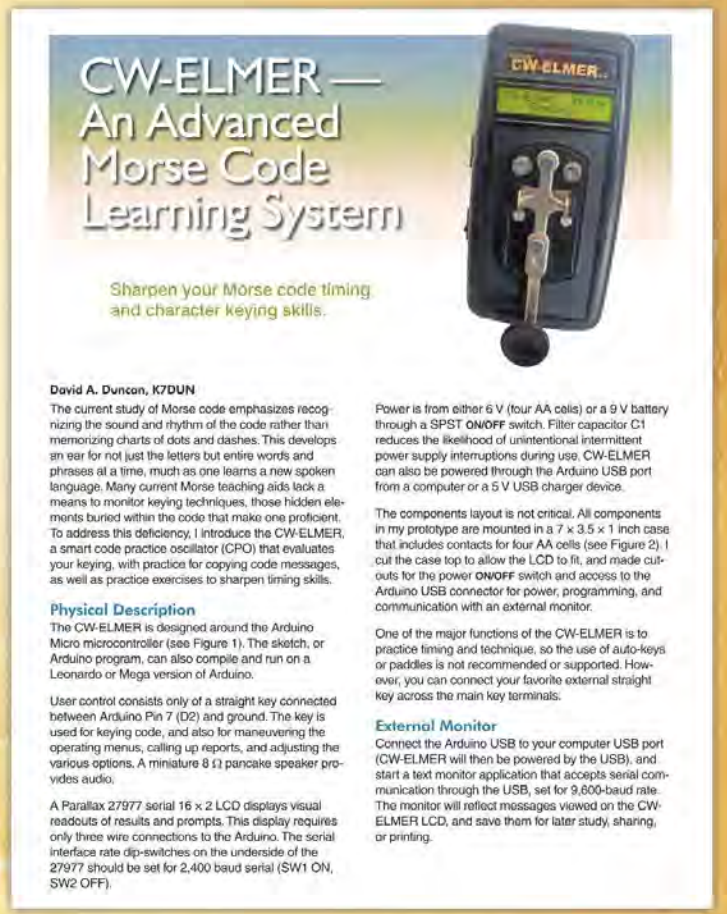
Log in now and choose your favorite article in this issue!


CW-ELMER — An Advanced Morse Code Learning System

Sharpen your Morse code timing and character keying skills.

David A. Duncan, K7DUN

The current study of Morse code emphasizes recognizing the sound and rhythm of the code rather than memorizing charts of dots and dashes. This develops an ear for not just the letters but entire words and phrases at a time, much as one learns a new spoken language. Many current Morse teaching aids lack a means to monitor keying techniques, those hidden elements buried within the code that make one proficient. To address this deficiency, I introduce the CW-ELMER, a smart code practice oscillator (CPO) that evaluates your keying, with practice for copying code messages, as well as practice exercises to sharpen timing skills.

Physical Description

The CW-ELMER is designed around the Arduino Micro microcontroller (see Figure 1). The sketch, or Arduino program, can also compile and run on a Leonardo or Mega version of Arduino.

User control consists only of a straight key connected between Arduino Pin 7 (D2) and ground. The key is used for keying code, and also for maneuvering the operating menus, calling up reports, and adjusting the various options. A miniature 8 Ω pancake speaker provides audio.

A Parallax 27977 serial 16 × 2 LCD displays visual readouts of results and prompts. This display requires only three wire connections to the Arduino. The serial interface rate dip-switches on the underside of the 27977 should be set for 2,400 baud serial (SW1 ON, SW2 OFF).

Power is from either 6 V (four AA cells) or a 9 V battery through a SPST **ON/OFF** switch. Filter capacitor C1 reduces the likelihood of unintentional intermittent power supply interruptions during use. CW-ELMER can also be powered through the Arduino USB port from a computer or a 5 V USB charger device.

The components layout is not critical. All components in my prototype are mounted in a 7 × 3.5 × 1 inch case that includes contacts for four AA cells (see Figure 2). I cut the case top to allow the LCD to fit, and made cutouts for the power **ON/OFF** switch and access to the Arduino USB connector for power, programming, and communication with an external monitor.

One of the major functions of the CW-ELMER is to practice timing and technique, so the use of auto-keys or paddles is not recommended or supported. However, you can connect your favorite external straight key across the main key terminals.

External Monitor

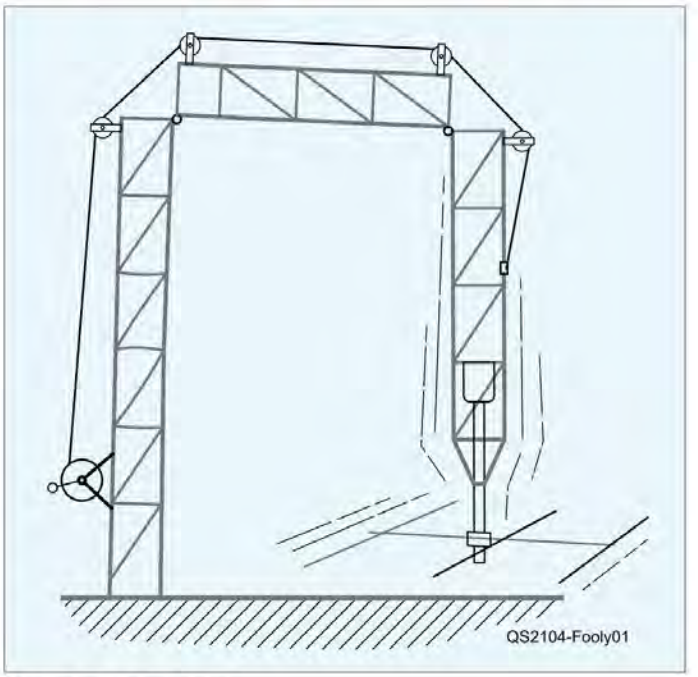
Connect the Arduino USB to your computer USB port (CW-ELMER will then be powered by the USB), and start a text monitor application that accepts serial communication through the USB, set for 9,600-baud rate. The monitor will reflect messages viewed on the CW-ELMER LCD, and save them for later study, sharing, or printing.

Down-to-Earth Crank-Up Tower

The perfect crank-up tower for the grounded ham — or fans of Tetris.

Wayne L. Hester, NK4T

I've finally designed the perfect crank-up tower! Looking at all the types of fold-over and crank-up towers, I found all these systems lacking in one important thing: They don't bring the top of the tower down low enough to install or repair beams from the ground without a ladder. At long last, I've found the solution. This down-to-Earth tower requires no ladders, cranks, or effort. While constructing your tower, simply zig it one way, zag it another, and *voila*! You've got the ideal, no-crank crank-up tower that meets you on the ground. It's perfect for me — although I admit I still need to work out a few minor kinks in the design.



Happy April Fool's Day!

New Products

PreppComm Releases DMX-40 Morse Code Decoder and Converter Transceiver

The DMX-40 is a self-contained QRP transceiver, with keyboard input for control and text, and a color GUI touchscreen for navigation, control, and display of transmitted and received text, including 28 function screens. The decoder uses analog and a digital filter to extract the signal out of minor to severe band noise. An external mode allows connection to an external transceiver.

Computer automation of call and answer functions, plus a rig programming language (RPL), allows customization of the automation as well as adding custom functions for net control or contests. The DMX-40 costs $349 and can be purchased at **www.PreppComm.com**.

ARRL Board Considers Plan to Cover New FCC Fee for Young Members

At its January 15 – 16 virtual Annual Meeting, the ARRL Board of Directors took action on several items to improve members' amateur radio experience.

The ARRL Board of Directors considered a motion at its January Meeting to offer a program for 2021 that would pay the new, but not-yet-implemented $35 FCC application fee, for a limited number of new sub-18-year-old license candidates who, at the time of testing, were members of an ARRL-affiliated 501(c)(3) charitable organization and who passed their tests through an ARRL VEC session. The movers of the motion stated that its purpose was to ameliorate the potential financial hardship posed by the pending $35 FCC license fee on certain young license candidates applying for their first license and to encourage new youth membership.

David Minster, NA2AA

Consideration of the motion, which was subject to much debate and concern, was deferred to an ad hoc committee composed of the members of the Administration & Finance Committee, two Members of the Programs & Services Committee, and CEO David Minster, NA2AA (or his designated representative), with the direction to review and more fully develop the motion and to submit a report to the Board by March 31, 2021 as to whether the program should be adopted and, if adopted, how it should be implemented.

The Board also agreed to take a second look into the use of electronic balloting systems "to augment paper balloting for ARRL elections." The Board instituted a hybrid paper and electronic balloting process in the fall of 2012, which was popular among those who took advantage of it, but overall voter participation declined significantly. In 2015, the Board's Ethics and Elections Committee decided to return to using solely paper ballots. The Ethics and Elections Panel said continuing changes in technology, the acceptance of remote meetings, and significant advancements in voting processes since then have made electronic balloting worth a second look.

"Electronic balloting is now in common use among professional organizations," the Board said. "Using electronic balloting would be of benefit to members who find paper ballots difficult to use. Providing electronic balloting as an alternative to paper balloting may result in a cost savings to the organization and decrease delays and potential conflicts over delays of paper ballots. It is likely, also, that the use of online balloting will be attractive to younger members who are more accustomed to online transactions."

The Board directed its Administration & Finance Committee to investigate the state, cost, and availability of commercial electronic balloting services as a member-selected alternative to paper ballots distributed and collected via the postal service and report back to the Board within a year.

Awards and Recognitions

The ARRL Board announced recipients of the ARRL Knight Distinguished Service Award and the 2020 ARRL Bill Leonard Professional Media Award. The Board also recognized several ARRL-affiliated clubs.

Skip Jackson, KSØJ

ARRL Minnesota Section Manager Richard "Skip" Jackson, KSØJ, is the recipient of the ARRL Knight Distinguished Service Award. During his 16-year tenure, Jackson "has actively promoted ARRL activities in his Section, including visiting hundreds of Field Day operations over the years, represented the League at numerous hamfests, and attended countless club meetings in his state, promoting the League," the Board's resolution read. The Board credited Jackson's leadership for developing "a strong working cadre of volunteers" in the Section, calling him "a model to ARRL Section Managers across the country as a strong supporter of ARRL and its activities."

The award's namesake is longtime veteran New Mexico Section Manager Joe T. Knight, W5PDY, (SK) who was the first recipient of the award in 2003. The award carries a $250 honorarium and a plaque.

The Board also approved, as recommended by the ARRL Public Relations Committee, Josh B. Nass, KI6NAZ, as the winner of the 2020 Bill Leonard Professional Media Award for Video Reporting. The Board cited Nass "for his outstanding YouTube channel, 'Ham Radio Crash Course,' which has garnered almost 170,000 subscribers." The Board resolution observed that Nass generated "productions of high levels of content and effective and entertaining instruction." The resolution also cited Nass for his use of "new modes of learning and information conveyance that enhance further education of amateur radio operators everywhere." The Leonard Award includes a $250 honorarium and a plaque.

Josh B. Nass, KI6NAZ, winner of the 2020 Bill Leonard Professional Media Award for Video Reporting.

The Board approved a change to the timing of the Philip J. McGan Memorial Silver Antenna Award and the Bill Leonard Professional Media Award. The nomination deadline for both awards has been changed to March 31 each year. This brings the cycle of the two media awards into alignment with five other prominent ARRL awards — the Hiram Percy Maxim Award; the ARRL Herb S. Brier Instructor of the Year Award; the ARRL Microwave Development Award; the ARRL Technical Service Award, and the ARRL Technical Innovation Award. Nominations for these awards will cover the previous calendar year. The change is effective with the March 31, 2022 nomination application, covering the period January 1 – December 31, 2021.

The Board also recognized:

- The 70th anniversary of the Garden State Amateur Radio Association, W2GSA. The Board resolution cited the club's "outstanding record of learning and education programs including youth programs."
- The 105th anniversary of the Amateur Radio Club of the University of Arkansas (ARCUA), W5YM, formed in 1916.
- The 50th anniversary of the Boeing Employees Amateur Radio Society-St. Louis, which became an ARRL affiliated club in 1971. The club "serves the public and the Boeing community in St. Louis by supporting various needs for radio communications; in times of emergency, requests for support of public service events, development and training in the field of radio communications technologies," the Board said.

Other Business

In other business, the Board:

- Directed the Administration and Finance (A&F) Committee to appoint an Investment Management Committee (IMC), composed of four voting members selected from Directors, Vice Directors, and officers to study and recommend to the Board "a plan for continuing management of its portfolio." Such a plan will be presented to the A&F Committee and the Board at its July meeting. The IMC will include ARRL Treasurer Rick Niswander, K7GM, as a voting member, and CEO David Minster, NA2AA, (or a delegate) as a nonvoting *ex officio* member.

- Authorized the ARRL staff to recruit and retain — either as an employee or a contractor — a professional, experienced, and/or trained individual to serve as the ARRL's Chief Development Officer (CDO). This individual will primarily develop, implement, and maintain an ongoing fundraising effort on behalf of ARRL.

- Modified the ARRL Foundation *Articles of Incorporation* to add a revised mission statement. The new mission statement will replace paragraph four of the *Articles*, beginning with the words "To operate exclusively for" and ending with "the purposes of the American Radio Relay League, Inc." The new mission statement will read, "To advance the art, science, and societal benefits of the Amateur Radio Service by awarding financial grants and scholarships to individuals and organizations in support of their charitable, educational, and scientific efforts."

- Authorized and directed ARRL to solicit and accept advertising of any form — including print, digital, and sponsorships — from non-amateur radio advertisers, "excluding pornography, criminal, and fraudulent enterprises."

- Recognized that ARRL management and staff "have made tremendous efforts to maintain the operations of Headquarters' functions" in spite of the difficulties imposed by the COVID-19 pandemic, and thanked and commended the Headquarters leadership and staff "for their diligence, professionalism, adaptability, and resiliency in continuing to serve the membership during this stressful time."

- Acting on behalf of ARRL as an IARU member-society, directed ARRL CEO/Secretary to vote "yes" on IARU proposals to admit the Amateur Radio Union of the Kyrgyz Republic (ARUKR) and the Bahrain Amateur Radio Society (BARS) as IARU member-societies. Candidate member-societies proposed for IARU membership are subject to a vote by current member-societies.

Committee Appointments

ARRL President Rick Roderick, K5UR, made a number of Board committee appointments. The appointments included Atlantic Division Director Tom Abernethy, W3TOM; Great Lakes Division Director Dale Williams, WA8EFK; Roanoke Division Director Bud Hippisley, W2RU; West Gulf Division Director John Robert Stratton, N5AUS, and Central Division Director Kermit Carlson, W9XA, to the Executive Committee.

Rick Roderick, K5UR

President Roderick, who chaired the session, welcomed newly elected Directors and Vice Directors: Dakota Division Director Bill Lippert, AC0W; Midwest Division Vice Director Dave Propper, K2DP, and Great Lakes Vice Director Scott Yonally, N8SY. He also acknowledged Pacific Division Director Kristen McIntyre, K6WX, and Midwest Division Director Art Zygielbaum, K0AIZ, who were attending as Directors for the first time, as well as recently appointed Vice Directors Dan Grady, N2SRK, of the Rocky Mountain Division, and Phil Temples, K9HI, of the New England Division.

Visitors

Visitors included IARU President Tim Ellam, VE6SH, and Radio Amateurs of Canada President Glenn MacDonell, VE3XRA. Ellam summarized the IARU's efforts over the past year, including challenges related to the pandemic, the evaluation of the IARU's core responsibilities and relationships, and its spectrum protection and planning efforts. He noted that the IARU was preparing a report regarding spectrum threats. He also touched on concerns related to Wireless Power Transfer (WPT), expressing the need for collaboration with ARRL to address those threats, specifically testing, ARRL Lab input, and communication with the FCC. In his report on behalf of the Electromagnetic Compatibility Committee, Central Division Director Kermit Carlson, W9XA, noted that his committee and the IARU have been in touch on issues regarding wireless power transfer. He also mentioned the committee's work with IEEE before reviewing the assorted interference matters it has been addressing.

Tim Ellam, VE6SH

Glenn MacDonell, VE3XRA

MacDonell stated that the pandemic has presented many challenges as well as opportunities, pointing out that interest in amateur radio had increased over the last year. He also noted the challenges to amateur frequency allocations.

Rick Lindquist, WW1ME, ww1me@arrl.org

Happenings

ARRL to FCC: Additional Volunteer Examiner Coordinators Not Needed

ARRL has told the FCC that no additional Volunteer Examiner Coordinators (VEC) are needed to oversee the administration of amateur radio exams by Volunteer Examiners (VEs). Examination opportunities have continued to be widely available throughout the US — except for a couple of months during the onset of the COVID-19 pandemic — and adding VECs to the 14 now in place would "have no effect" on the number of available exams, ARRL said. ARRL's comments were in response to a January 5 FCC *Public Notice* seeking input on possible expansion of the VEC pool.

"ARRL reviewed the amateur examination numbers for the past 5 years, including the COVID-19 pandemic period," ARRL commented. "We found that even though 10 of the 12 months for calendar year 2020 were times of severe disruption throughout the nation, including for FCC and ARRL Headquarters staff, amateur examination opportunities and numbers were strong." New FCC licenses issued in January 2021 numbered 2,838, compared with 2,058 for a year earlier. Upgrades were also up significantly — 920 in January 2021 to 554 for the same month last year.

"Instead of increasing the number of VECs, we would encourage volunteers to become accredited as VEs and to volunteer to help the current VECs wherever possible." ARRL pointed out that VEs, not VECs, are responsible for administering amateur radio exams.

The ARRL VEC — the nation's largest — has 30,000 accredited VEs, with 11,000 of them regularly participating in exam activities on a weekly or monthly basis.

"Increasing the number of individual VECs would expand the complexity of VEC coordination and management and demand on FCC resources to interface with additional organizations, and raise the potential for abuse and fraud," ARRL said.

Jessica Rosenworcel Appointed as Acting FCC Chair

In January, President Joseph Biden designated FCC Commissioner Jessica Rosenworcel as acting chair of the FCC. She succeeds, at least temporarily, former FCC chair Ajit Pai, who resigned effective on January 20.

"I am honored to be designated as the Acting Chairwoman of the Federal Communications Commission by President Biden," Rosenworcel said in a statement. "I thank the President for the opportunity to lead an agency with such a vital mission and talented staff. It is a privilege to serve the American people and work on their behalf to expand the reach of communications opportunity in the digital age."

Prior to joining the FCC, she served as Senior Communications Counsel for the US Senate Committee on Commerce, Science, and Transportation.

The FCC's newest commissioner, Nathan Simington, a Republican appointee, said Rosenworcel "brings deep knowledge and experience and highly informed judgment to her new position." He expressed appreciation that the Biden Administration acted promptly to establish FCC leadership by "selecting such a distinguished public servant for this vital role."

Acting FCC Chairwoman Jessica Rosenworcel

Fellow Democrat Geoffrey Starks said Rosenworcel "has been a passionate advocate for bringing the benefits of broadband to all Americans — particularly our children." He said her designation as acting chair "comes at a critical juncture for the Commission, as COVID-19 has made bold action to end internet inequality more vital than ever."

The Commission's other Democratic appointee, Brendan Carr, called Rosenworcel "a talented and dedicated public servant, as evidenced by her 8 years of distinguished service on the FCC."

FT8 and the Other *WSJT-X* Digital Modes are "Tools," K1JT Says

WSJT-X software co-developer Joe Taylor, K1JT, says the very popular FT8 and the other digital modes in the software suite "are tools, freely available to hams who want to use them. They are very good at some things, not so good at others." Nonetheless, FT8 — and, by extension, its contest-mode variation, FT4 — have become game-changers on the HF bands, although, as Taylor explained, FT8 "was explicitly designed" for making contacts during weak, multi-hop, sporadic-E openings on 6 meters.

"It's extremely good at that," he added, noting that transcontinental and intercontinental DX on 6 meters has greatly benefited from the use of FT8. Developed in 2017, FT8 is named after its developers — Taylor, and Steven Franke, K9AN. The numeral designates the mode's eight-frequency shift-keying format.

Taylor said that while the development team did not foresee that FT8 would have the sort of impact it's had on HF operating, FT8 watering holes are sometimes the only places to find signals on HF bands that otherwise might be considered dead.

Joe Taylor, K1JT

Taylor agreed that FT8 is "a mature mode" and said details of message structure, in particular, will not change in a way that is not backward compatible.

Although some FT8 fans may feel the mode is running out of room on some bands, Taylor said that as far as he and his fellow *WSJT-X* developers are concerned, the 3 kHz slices of spectrum suggested for FT8 use are just that — suggestions.

"There is no reason why additional slices should not be used when over-occupancy requires it," he told ARRL. "We don't attempt to dictate such usage patterns; band planning is best done by committees created for that purpose."

In February, the *WSJT* Development Group announced the general availability release of *WSJT-X* Version 2.3.0. It includes a new Q65 mode but does not involve any changes to the FT8 protocol.

ARRL to Extend Field Day Rule Waivers from 2020, Add Class D and E Power Limit

The COVID-19 pandemic-modified ARRL Field Day rules from 2020 will continue this June, with a power limit imposed on Class D (Home Stations) and Class E (Home Stations-Emergency Power) participants. The news from the ARRL Board's Programs and Services Committee comes as many clubs and groups are starting preparations for Field Day in earnest. Field Day 2021 will take place June 26 – 27.

"This early decision should alleviate any hesitancy that radio clubs and individual Field Day participants may have with their planning for the event," said ARRL Contest Program Manager Paul Bourque, N1SFE.

For Field Day 2021, Class D stations may work *all other* Field Day stations, including other Class D stations, for points. This year, however, Class D and Class E stations will be limited to 150 W PEP output.

For Field Day 2021, an aggregate club score will be published — just as it was done last year. The aggregate score will be a sum of all individual entries who attributed their score to that of a specific club.

ARRL Field Day is one of the biggest events on the amateur radio calendar. Last summer, a record 10,213 entries were received.

"With the greater flexibility afforded by the rules waivers, individuals and groups will still be able to participate in Field Day, while still staying within any public health recommendations and/or requirements," Bourque said.

The preferred method of submitting entries after Field Day is via the web applet. The ARRL Field Day rules include instructions on how to submit entries, which must be submitted or postmarked by Tuesday, July 27, 2021.

The ARRL Field Day web page (**www.arrl.org/field-day**) contains complete rules and entry forms, as well as any updated information as it becomes available. You can also join the ARRL Field Day Facebook page, at **www.facebook.com/groups/arrlfd**.

ARISS and Partners Investigating Ham Radio Anomaly Following Spacewalk

Amateur Radio on the International Space Station (ARISS) and its partners began troubleshooting what was keeping the amateur station in the ISS *Columbus* module off the air in January.

ARISS-International Chair Frank Bauer, KA3HDO, explained that during a January 27 spacewalk to install exterior cabling on the ISS *Columbus* module, the coax feed line installed 11 years ago was replaced with another built by the European Space Agency (ESA) and Airbus. It included two additional RF connectors to support the Bartolomeo payload-hosting platform installed last spring on *Columbus*.

"On January 26, prior to the EVA [extravehicular activity], our *Columbus* next-generation radio system was shut off and the ISS-internal coaxial cable to the antenna was disconnected from the ARISS radio as a safety precaution for the EVA," Bauer said. During the spacewalk, an external four-connector coax feed line replaced one with two RF connections.

"This change was made to allow ESA to connect ARISS and three additional customers to Bartolomeo, as compared to ARISS and one additional RF customer," Bauer explained.

With the spacewalk completed, the ISS crew restarted the ISS ham radio station on January 28, but no voice repeater or automatic packet repeater system (APRS) downlink reports were heard, and no downlink signal was heard during an attempted scheduled school contact either.

Bauer said that because the exterior cable is not an ARISS cable, ARISS is working with ESA and NASA on a way forward. "NASA has opened a Payload Anomaly Report on this issue," Bauer said.

Section Manager Nomination Notice

To all ARRL members in Colorado, Eastern Washington, Georgia, Los Angeles, Sacramento Valley, San Francisco, South Texas, West Virginia, and Western Washington: 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. It is acceptable to submit signatures that have been sent via email or mail under the following guidelines: The petition copies must be made from the original form supplied by ARRL or downloaded from the ARRL website. The form must be exactly the same on both sides (i.e., autobiographical information should appear exactly the same on all copies). All forms/copies must be submitted together.

Candidates may use any of the available electronic signature platforms such as Docusign, Hellosign, and Signed PDF. Candidates who use an electronic signature platform to be nominated, as described above, do not have to send in original paper copies of the nominating documents. The packet that is sent to ARRL Headquarters must be complete. Multiple files or emails for a single petition will not be accepted.

We suggest the following format:

(Place and Date)

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

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

(Signature _____ Call Sign ____ City ___ ZIP ____)

Any candidate for the office of Section Manager must be a resident of the Section, an amateur radio licensee of Technician class or higher, and a full member of the League for a continuous term of at least 2 years immediately preceding receipt of a nominating petition. Petitions must be received at Headquarters by 4 PM Eastern Time on June 4, 2021. If more than one member is nominated in a single Section, ballots will be mailed from Headquarters no later than July 1, 2021, to full members of record as of June 4, 2021 which is the closing date for nominations. Returns will be counted August 24, 2021. Section Managers elected as a result of the above procedure will take office October 1, 2021.

If only one valid petition is received from a Section, that nominee shall be declared elected without opposition for a 2-year term beginning October 1, 2021. If no petitions are received from a Section by the specified closing date, such Section will be resolicited in the October *QST*. A Section Manager elected through the resolicitation will serve a term of 18 months. A Section Manager vacancy occurring between elections is filled through appointment by the Field Services Manager. — *Bart Jahnke, W9JJ, Field Services & Radiosport Department Manager*

SM Nomination Petition Resolicitation

Because no nomination petitions were received for the Orange Section Manager election by the nomination deadline of December 4, 2020, nominations are hereby resolicited. See the above for details.

Rick Lindquist, WW1ME, ww1me@arrl.org

Amateur Radio World

International Amateur Radio Union Preparing for WRC-23

Preparations are under way by the International Amateur Radio Union (IARU) to represent the interests of the Amateur and Amateur-Satellite Services at World Radiocommunication Conference 2023 (WRC-23). The International Telecommunication Union (ITU) sponsors WRCs, typically every 4 years, to consider revisions to the international *Radio Regulations* that define frequency allocations for various radio services.

"As an incumbent radio service with allocations at intervals throughout the radio spectrum, the amateur service faces challenges at every WRC," IARU Secretary David Sumner, K1ZZ, said. "Successfully defending our existing access to the spectrum is a significant accomplishment at any WRC, but sometimes it is possible also to improve our existing allocations."

Sumner noted that WRC-19 resulted in major improvements in 50 MHz allocations in Region 1. "Without any doubt, this could not have happened without the concerted efforts of dozens of IARU volunteers over the course of several years," he said.

IARU volunteers have been participating in virtual meetings of ITU working parties and preparatory committees of regional telecommunications organizations (RTOs) as they address WRC-23 agenda items of particular concern to amateur radio. Potentially affected bands are 50 – 54 MHz (a new service has been proposed in an adjacent band); 1240 – 1300 MHz; 3300 – 3400 MHz; 10.0 – 10.5 GHz, and 241 – 250 GHz. In addition, studies are being conducted to identify protection requirements for space weather sensors that operate in frequency bands stretching from 13 kHz to at least 15 GHz.

Barry Lewis, G4SJH, Chair of IARU Region 1 Spectrum Affairs, announced in early February that the IARU Administrative Council has agreed on preliminary positions for WRC-23, covering the six most important agenda items for the Amateur and Amateur-Satellite Services.

"The IARU Spectrum and Regulatory Liaison Committee asks that the regional representatives and member-societies take careful note of these positions and follow them when discussing WRC-related matters with their national regulators," Lewis said.

Sumner said participation of IARU member-societies in preparations at the national level is an important contribution to amateur radio's eventual success at a World Radiocommunication Conference.

The IARU Administrative Council has chosen "Amateur Radio: Home but Never Alone" as the theme for World Amateur Radio Day on Sunday, April 18, 2021. With the pandemic driving adoption of physical isolation to reduce the spread of the virus, the worldwide amateur radio community has responded positively to overcome the resulting social isolation.

"This theme offers the opportunity for our member-societies to tailor meaningful messages to the general public about the values of the global amateur radio community," Sumner said.

IARU Has Been Gifted the hamradio.org Domain

The IARU has announced that Andrew J. Wolfram, KI7RYC, has donated the **hamradio.org** domain to the IARU for non-profit educational use to promote the Amateur and Amateur-Satellite Services. In accepting this gift, IARU President Tim Ellam, VE6SH, said, "The **hamradio.org** domain offers a unique opportunity, for which we are deeply grateful to Andrew. It is our intention to develop a website that can serve as a focal point for anyone, anywhere, who may be seeking information on amateur radio."

Rick Palm, K1CE, k1ce@arrl.net

Be Part of the HF Public Service Net Renaissance

Solar Cycle 25 began with the sunspot nadir of 2019; the zenith of sunspots is predicted for 2025. Experts from NASA and the National Oceanic and Atmospheric Administration (NOAA) have discussed their analysis and predictions about the new solar cycle, and how the upswing will impact our lives. This month, we'll discuss how the new solar cycle may affect us as emergency and public service communicators, particularly with respect to HF propagation and Earth's surface weather.

HF Propagation 101

High-frequency signals entering the ionosphere at a low angle can be reflected back toward the Earth by an ionized layer, if the ionization is strong enough for the selected frequency. In general, the more ionization (caused by increasing sunspot numbers and solar activity), the more frequencies can be used for HF communications with better conditions. This varies depending on the time of day, season, and year, as well as the 11-year solar cycle. The maximum usable frequency (MUF) can be derived from the varying conditions. The bottom line is, more sunspots mean better HF communication conditions, and the numbers should keep rising until around 2025. That bodes well for HF voice public service nets that have been challenged by sunspot lows for years.

HF Voice Net Challenges

We've suffered through the sunspot lows of Solar Cycle 24 and the poor HF propagation and conditions that came with them. When I asked Hurricane Watch Net (HWN) Manager Bobby Graves, KB5HAV, about how the low sunspot numbers affected his net's operations in recent years, he said the solar minimum "has really hurt our HWN operations [on 20 meters]… Forty meters (the net's secondary band) over the past 3 years has also not been good." He added that the forecast of improved band conditions should help.

How Sunspots Create a Need for SKYWARN® Spotters

While there's debate among scientists about the degree to which sunspot activity affects climate, the National Weather Service (NWS) says that when examining Earth on a global scale (and over long periods of time), it's certain that the solar energy output does affect the Earth's climate (**www.weather.gov/fsd/sunspots**). The phenomenon could mean more surface-severe weather. Thus, more ambitious recruitment efforts would seem to be indicated for the SKYWARN program. Prime targets for recruitment efforts include ARES organizations and general amateur radio clubs.

NWS encourages public service-minded individuals to join the SKYWARN program. Radio amateurs comprise a large segment of SKYWARN storm spotters. To find a class in your area, visit **www.weather.gov/skywarn/wfo_links**. Training is free and lasts about 2 hours. You'll learn about thunderstorm development, fundamentals of storm structure, identifying severe weather features, information to report, how to report information, and basic severe weather safety.

Check into HF SKYWARN Nets! These nets are all across the country. All you have to do is search ARRL's online Net Directory at **www.arrl.org/arrl-net-directory-search**.

Julio Ripoll, WD4R, veteran Assistant Coordinator of the National Hurricane Center (NHC) amateur station WX4NHC, agreed with Graves. He said, "HF propagation has been very poor for at least 20 years, in comparison to the propagation we experienced during the 1990s and early 2000s." This means hurricane observation reporting on 20 and 40 meters can be difficult at times.

Poor conditions on the low bands — 75 and 40 meters — have made it difficult to copy stations on the voice nets, such as Amateur Radio Emergency Service (ARES®) medium- and long-haul message handling for county and state emergency operation centers, SKYWARN, and Red Cross shelters. Consequently, these operations may have waned. Filling the void to the credit of ham ingenuity, however, has been the development of new data modes and networks with weak signal capability, increasing speeds, reliability, and long-distance capability. The Winlink development team, for example, has advanced its system with weak signal, accepting virtual terminal node controllers (TNCs) like VARA HF. They've served ARES and our partner agencies well. Also seeing a rise in popularity during the time of solar minimum has been the *WSJT* suite of weak signal modes. The challenge is how those interested in public service will make use of the *WSJT* modes.

However, with the new solar cycle increasing sunspots and allowing for better HF propagation, it's time to revisit, renew, and support HF voice public service nets again.

Get On an HF Voice Net

There are many HF voice nets that serve ARES, Radio Amateur Civil Emergency Service (RACES), Auxiliary Communication Services (ACS), and other organizations with related message-handling training, drills, and real-world emergency and disaster response communications. Along with local, county, Section, and statewide nets, there are international and maritime service nets. Information about public service net activity in your area may be obtained through your ARRL Field Organization leaders, such as Net Managers, Emergency Coordinators, and others. ARRL Section Managers are listed on page 12 in every issue of *QST*. Check ARRL's social media page for local groups, and make sure to sign up for email updates.

You can also sweep the HF bands to find public service nets you may not have heard before or haven't heard in many years. With improving HF conditions, now is the time to get back on those voice nets!

Great Time for Technician Upgrades

With the forecasted improvement in HF conditions, now is the perfect time to upgrade your Technician-class license to a General. As Technicians, you're likely already active on VHF repeater ARES, RACES, and ACS nets. Upgrading to your General-class license allows you to extend your public service interests to the HF voice bands, which will see a rise in activity during the next few years. Upgrading to a General-class license — which conveys extensive HF privileges — only requires passing a written exam. Once you do, the entire range of operating modes and the majority of the amateur spectrum below 30 MHz become available to you.

Be a part of the HF public service net renaissance. Pull out your microphone, plug it in, and push-to-talk!

Field Organization Reports

January 2021

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**.

495
N9VC

483
W7PAT

435
WA3EZN

365
KE8BYC

364
WA7PTM

330
ND8W

310
KE8KOC

274
WØPZD

271
WA2CCN

260
KW9EMG

240
KT2D

200
KD2NMG

197
K8RDN

175
W3GWM

170
KM8V

165
KB8RCR

160
W2PH
K8AMH

156
W9RY

155
AI9F
KI5GRH

152
AD8CM

150
W4DNA
AC8NP

149
W8IM
WM2C

148
WD8USA

146
WA2BSS

145
N8SY

142
KD2LPM

140
ACØKQ
K4IWW
WB9QPM
KØRCJ
WO2H
KD8ZCM

138
KDØHHN

135
W7GRG
N5MXY
W3YVQ

133
KD2GRS

130
WB9WKO
W7EES
WK4WC
W8DJG
AD3J
KI7TIG
KW1U

128
KC8T

125
AG9G
KF5OMH

120
WA4VGZ
WC4FSU
W4CMH
K9LGU
KC9FXE
K2TV
KA9QWC
N1LL
AB8M

KC8WH
K3JL
WØLAW
W4NWT
KY2D
NA7G
N7IE

117
AB3WG

115
N1TF

114
N2DW

110
W1KX
WA3QLW
KA9MZJ
KA5AZK
KF5IOU
WB8YLO
W8MAL
N3SW
AF4NC
N1IQI
W1RVY
KB2QO
WF2Y
WB8TQZ
K8BKM
K1XFC
K3IN
K6HTN

108
KG5NNA

107
KC8YVF

105
W2PAX
N2WGF

101
AD4DO

100
WB4RJW
K9GDF
KN9P
NX9K
KØFBS
KE5YTA
AC8RV
WB8SIQ
K3RC
WB6UZX
KB3YRU
KD2JKV
N1LAH
W3CJD

AA3SB
KB2YAA

99
NI2W

97
N8CJS
W3ZR
W8DW

96
WA1URS

95
W9EEU
KC1HHO
KC1KVY
WS4P
K1HEJ

94
W7PHX
WV5Q

93
KU1U

92
K8MDA

91
KD2IWN

90
KM4WHO
N4CNX
N4ZM
AB9ZA
N2LC
K8KRA
KB8HJJ
KA1G
KL7RF
N3KRX
N2TSO
AA7BM
K7OED
K3MIY
WA1LPM
KA2HZP
W2AH
K8ED
K2EAG
W2JPS

88
WX2DX

86
N6IET

85
K6JT
WB8YYS
K3AUX

83
W9BGJ
K1STM

82
N3RB

81
KF7GC

80
KB9GO
N8MRS
W8GSR
KG7QWR
KJ7BHO
KE1ML
WB8R
KB1NAL

79
AJ7B
WB4ZDU
KB3MXK
N3JET

77
W4TTO
W5XX

76
KBØDTI

75
NØUMP
KAØDBK

74
K4FHR
KD2GXL

73
WB2VUF
KB8PGW

72
W4INK
NV1N
KC1MSN

71
KA2JFU

70
K6RAU
KD8UOT

The following station qualified for PSHR in Nov. 2020, but was not reported in the Feb. *QST* column: N2TSO 90.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AR, AZ, CO, CT, DE, EB, EMA, IL, IN, KS, KY, LA, LAX, MDC, MI, MN, MO, MS, MT, NC, ND, NE, NFL, NM, NNJ, NTX, NV, OH, OR, SC, SD, SFL, SJV, TN, UT, WCF, WI, WMA, WNY, WPA, WTX, WV, WWA, WY.

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: CT, DE, EB, ENY, IA, KY, MI, MO, MS, ND, NLI, NM, NNJ, NV, OH, OR, PAC, SCV, SD, SFL, SJV, SNJ, STX, UT, VA, VI, WCF, WI, WPA, WY.

Brass Pounders League

The BPL is open to all amateurs in the US, Canada, and US possessions who report to their SMs a total of 500 or more points or a sum of 100 or more origination and delivery points for any calendar month. Messages must be handled on amateur radio frequencies within 48 hours of receipt in standard ARRL radiogram format. Call signs of qualifiers and their monthly BPL total points follow.

KY2D 1,555, NX9K 1,532, K6HTN 1,005, N9CK 969, WB9WKO 717, KW1U 707, N1IQI 658.

W1AW Schedule

PAC	MTN	CENT	EAST	UTC	MON	TUE	WED	THU	FRI
6 AM	7 AM	8 AM	9 AM	1300		FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
7 AM-1 PM	8 AM-2 PM	9 AM-3 PM	10 AM-4 PM	1400-1600 1700-1945	VISITING OPERATOR TIME (12 PM-1 PM CLOSED FOR LUNCH)				
1 PM	2 PM	3 PM	4 PM	2000	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
2 PM	3 PM	4 PM	5 PM	2100	CODE BULLETIN				
3 PM	4 PM	5 PM	6 PM	2200	DIGITAL BULLETIN				
4 PM	5 PM	6 PM	7 PM	2300	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
5 PM	6 PM	7 PM	8 PM	0000	CODE BULLETIN				
6 PM	7 PM	8 PM	9 PM	0100	DIGITAL BULLETIN				
6^{45} PM	7^{45} PM	8^{45} PM	9^{45} PM	0145	VOICE BULLETIN				
7 PM	8 PM	9 PM	10 PM	0200	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
8 PM	9 PM	10 PM	11 PM	0300	CODE BULLETIN				

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.

♦ 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.

For more information, visit us at
www.arrl.org/w1aw

♦ 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.

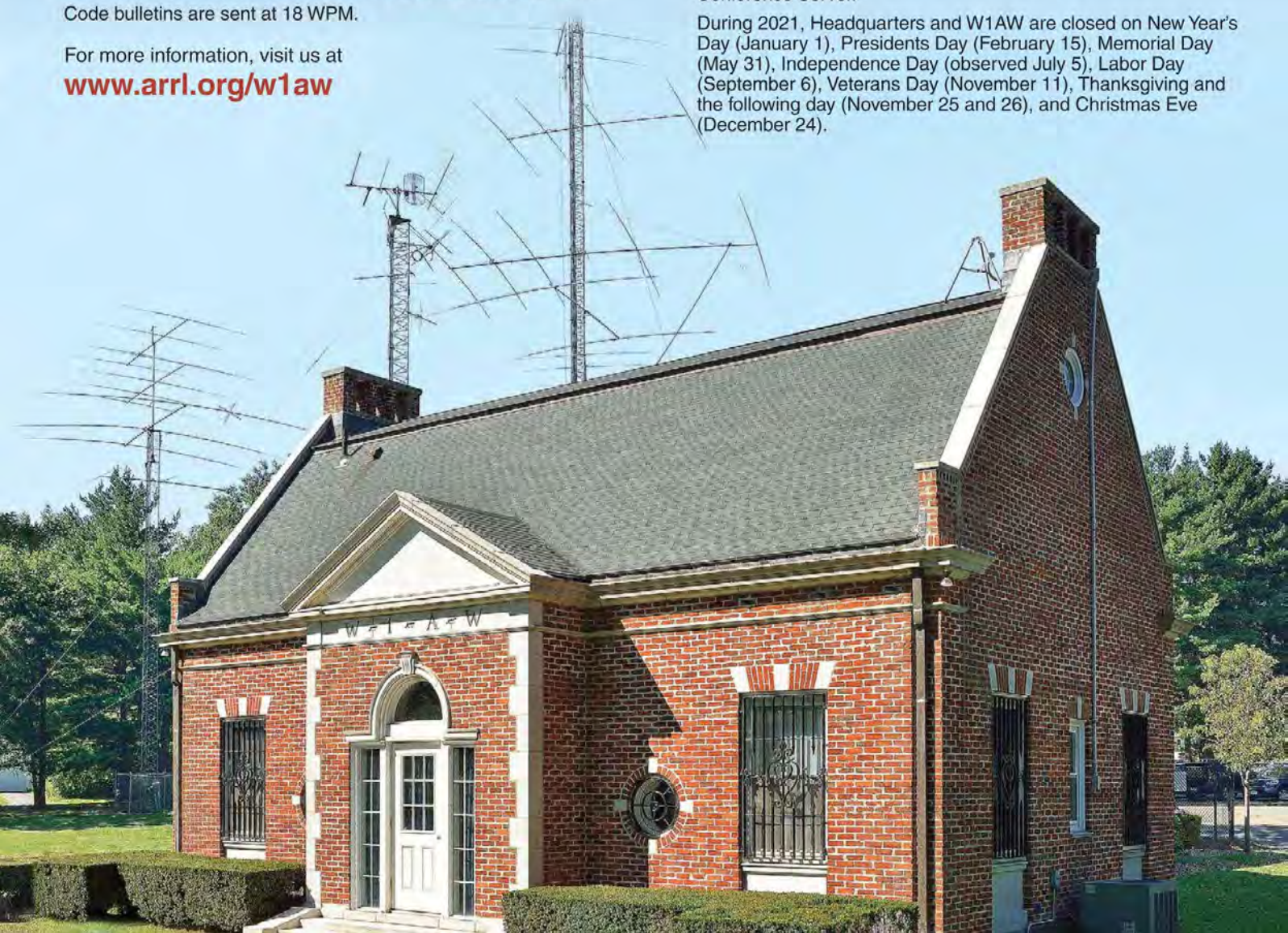
Keplerian elements for many amateur satellites will be sent on the regular digital frequencies on Tuesdays and Fridays at 6:30 PM Eastern time using Baudot and PSK31.

♦ 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 a reference copy of your current FCC amateur license. 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 2021, Headquarters and W1AW are closed on New Year's Day (January 1), Presidents Day (February 15), Memorial Day (May 31), Independence Day (observed July 5), Labor Day (September 6), Veterans Day (November 11), Thanksgiving and the following day (November 25 and 26), and Christmas Eve (December 24).



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

Contest Corral

April 2021

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

Start - Finish				Bands	Contest Name	Mode	Exchange	Sponsor's Website
Date	Time	Date	Time					
1	1700	1	2000	3.5	SARL 80-Meter QSO Party	Ph	RS, serial, grid locator	www.sarl.org.za
1	1800	1	2200	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	nrrlcontest.no
1	1900	1	2100	1.8-50	SKCC Sprint Europe	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
2	2000	2	2100	1.8-14	K1USN Slow Speed Test	CW	20 WPM max. Name, SPC	k1usn.com/sst.html
3	1000	4	0400	14	PODXS 070 Club PSK 31 Flavors Test	Dig	SPC, mbr or name	www.podxs070.com
3	1400	4	0200	1.8-144	Louisiana QSO Party	CW Dig Ph	RS(T), LA Parish or SPC	laqp.louisianacontestclub.org
3	1400	4	0200	1.8-144	Mississippi QSO Party	CW Ph Dig	RS(T), MS county or SPC	www.arrlmiss.org
3	1400	4	2200	3.5-28	Florida State Parks on the Air	CW Ph Dig	Park ID or SPC	flspota.org/rules
3	1500	4	1500	1.8-28	SP DX Contest	CW Ph	RS(T), SPC province or serial	spdxcontest.pzk.org.pl
3	1600	4	1600	3.5-28	EA RTTY Contest	Dig	RSQ, EA province or serial	concursos.ure.es/en
4	0000	4	0400	3.5-14	North American SSB Sprint Contest	Ph	Other's call, your call, serial, name, SPC	ssbsprint.com/rules
4	1500	4	1730	3.5,7	DARC Easter Contest	CW Ph	RS(T), DOK or serial	www.darc.de
5	1900	5	2300	144	144 MHz Spring Sprint	CW Ph Dig	4-char grid square	sites.google.com/site/springvhfupsprints
6	0100	6	0159	1.8-50	Worldwide Sideband Activity Test	Ph	RS, age group (OM, YL, or Youth)	wwsac.com/rules.html
6	0100	6	0300	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqrp.blogspot.com
6	1700	6	1900	3.5-14	RTTYops Weeksprint	Dig	Other's call, your call, serial, name	rttyops.wordpress.com
7	1300	7	1400	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
7	1700	7	2000	144	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
7	1900	7	2000	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
7	1900	7	2030	3.5	RSGB FT4 Contest Series	Dig	4-char grid square	www.rsgbcc.org/hf
7	2000	7	2100	3.5	UKEICC 80-Meter Contest	Ph	6-char grid square	ukeicc.com/80m-rules.php
8	0300	8	0400	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
10	0000	10	0600	1.8-28	QRP ARCI Spring QSO Party	CW	RS, SPC, mbr or power	qrparci.org/contest
10	0700	11	1300	1.8-28	JIDX CW Contest	CW	RST, JA prefecture or CQ zone	jidx.org/jidxrule-e.html
10	1200	11	1200	1.8-28	OK/OM DX Contest, SSB	Ph	RS, county code or serial	okomdx.crk.cz
10	1200	11	1200	3.5-28	FTn DX Contest	Dig	RST, state or province or serial	europeanft8club.wordpress.com
10	1200	11	1800	3.5-28	IG-RY World Wide RTTY Contest	Dig	RST, 4-digit year first licensed	igry.webs.com/ig-ry-ww-contest
10	1200	11	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
10	1300	11	2200	1.8-UHF	Nebraska QSO Party	CW Ph	County or SPC (or grid for FT8)	www.nebraskaqsoparty.org
10	1400	11	0200	1.8-144	New Mexico QSO Party	CW Ph Dig	Name, NM county or SPC	newmexicoqsoparty.org
10	1600	11	0400	1.8-28	Georgia QSO Party	CW Ph	RST, GA county or SPC	gaqsoparty.com
10	1800	11	1800	1.8-144	North Dakota QSO Party	CW Ph	RS(T), ND county or SPC	ndarrlsec.com
10	2100	11	2100	1.8-28	Yuri Gagarin International DX Contest	CW	RST, ITU zone	gc.qst.ru/en/section/32
11	1000	11	2100	3.5-14	WAB 3.5/7/14 MHz Data Modes	Dig	RS, serial, WAB square or country	wab.intermip.net
11	1200	12	1100	3.5-28	DIG QSO Party, CW	CW	RST, mbr or "none"	diplom-interessen-gruppe.info
11	1500	11	1600	3.5	Hungarian Straight Key Contest	CW	RST, serial, power	hskc.ha8kux.com
11	1900	11	2030	3.5	RSGB RoLo SSB	Ph	RS, 6-char grid of previous QSO	www.rsgbcc.org/hf
12	0000	12	0200	1.8-28	4 States QRP Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqrp.com
12	1900	12	2030	3.5	RSGB 80-Meter Club Championship, CW	CW	RST, serial	www.rsgbcc.org/hf
14	0030	14	0230	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
14	1700	14	2000	432	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
16	2100	17	2100	1.8-28	Holyland DX Contest	CW Ph Dig	RS(T), 4X area or serial	iarc.org/iarc/#HolylandContest
17	0500	17	0859	3.5,7	ES Open HF Championship	CW Ph	RS(T), serial	www.erau.ee/en
17	0600	18	0559	3.5-28	Worked All Provinces of China	CW Ph	RS(T), province or serial	www.mulandxc.com
17	0700	18	0659	3.5-28	YU DX Contest	CW Ph	RS(T), YU county or serial	yudx.yu1srs.org.rs
17	0900	18	2359	3.5-28	CQMM DX Contest	CW	RST, continent	www.cqmmdx.com
17	1400	18	2000	All	Texas State Parks on the Air	CW Ph Dig	RS(T), TX park or SPC	www.tspota.org
17	1600	18	0400	3.5-28	Michigan QSO Party	CW Ph	Serial, MI county or SPC	miqp.org/Rules.htm
17	1700	18	1200	3.5-28	EA-QRP CW Contest	CW	RST, category code	www.eaqrp.com
17	1800	17	2159	1.8-50	Feld Hell Sprint	Dig	RST, mbr, SPC, grid	sites.google.com/site/feldhellclub
17	1800	18	1800	1.8-144	Ontario QSO Party	CW Ph	RS(T), ON county or SPC	www.va3cco.com
18	1800	18	2359	3.5-28	ARRL Rookie Roundup, SSB	Ph	Name, 2-digit year licensed, SPC	www.arrl.org/rookie-roundup
18	2300	19	0100	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
21	1900	21	2030	3.5	RSGB 80-Meter Club Championship, SSB	Ph	RS, serial	www.rsgbcc.org/hf
24	0001	25	2359	28	10-10 International Spring Contest, Digital	Dig	Name, mbr or "0," SPC	www.ten-ten.org
24	0800	24	1800	3.5-21	QRP to the Field	CW Ph	RST, SPC, name or SOTA ID	www.zianet.com/qrp
24	1300	25	1259	1.8-28	Helvetia Contest	CW Ph Dig	RS(T), HB canton or serial	www.uska.ch/contest
24	1600	25	2159	7-28	Florida QSO Party	CW Ph	RS(T), FL county or SPC	floridaqsoparty.org/rules
25	1200	25	1800	3.5,7	International Vintage Contest HF	CW Ph	RS(T), 6-char grid square	contestvintage.beepworld.it
25	1700	25	2059	3.5-28	BARTG Sprint 75	Dig	Serial	bartg.org.uk/wp
28	0000	28	0200	1.8-50	SKCC Sprint	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
28	2000	28	2100	3.5	UKEICC 80-Meter Contest	CW	6-char grid square	ukeicc.com/80m-rules.php
29	1900	29	2030	3.5	RSGB 80-Meter Club Championship, Data	Dig	RST, serial	www.rsgbcc.org/hf

There are a number of weekly contests not included in the table above. For more info, visit: **www.qrpfoxhunt.org**, **www.ncccsprint.com**, and **www.cwops.org**. 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.*

2020 September VHF Contest Results

Check out the results of the event, held September 12 – 14, 2020.

Ralph "Gator" Bowen, N5RZ, wb5aar@gmail.com

During the 2020 ARRL September VHF Contest, Oleh Kernytskyy, KD7WPJ, operated from DM27, a rare grid square in Nevada. Oleh chose a campsite on Upper Pahranagat Lake in the Pahranagat National Wildlife Refuge, to avoid areas affected by California's wildfires. [Oleh Kernytskyy, KD7WPJ, photo]

Top Ten

Classic Rover

K8GP/R	198,488
N7GP/R	79,918
VE3OIL/R	70,551
VE3SMA/R	40,502
KJ7JC/R	33,456
AG4V/R	31,668
W3ICC/R	30,355
N7OW/R	28,557
W5VY/R	20,097
W2EV/R	15,084

Limited Rover

NF2RS/R	56,499
KJ2G/R	17,524
N6RH/R	14,042
N6GP/R	14,022
AE5P/R	12,710
K5ND/R	7,110
W5TN/R	6,808
KX6A/R	6,275
WB8LYJ/R	6,072
AF1R/R	5,600

Unlimited Rover

N2SLN/R	32,718
N0LD/R	28,329
K6VHF/R	12,441
KD5IKG/R	8,550
K9JK/R	8,494
W9YOY/R	2,898
KJ1K/R	1,426
KG6CIH/R	1,185
VE7AFZ/R	1,037
KD6RMS/R	420

Single Operator, High Power

K1TEO	397,488
K1RZ	259,700
W3IP	133,037
W5ZN	123,714
WZ1V	86,028
K1KG	69,402
N3RG	64,320
N1AV	60,600
K1GX	55,564
KE8FD	50,490

Single Operator, Low Power

WB1GQR (W1SJ, op)	126,195
AF1T	124,509
K2DRH	80,908
N2WK	66,679
KG6IYN	46,986
VE3DS	33,614
WA3EOQ	30,805
WA2VNV	30,450
W3EKT	25,800
WB2JAY	24,050

Single Operator, Portable

WB2AMU	2,835
WD5AGO	1,120
NA1KW (N1SPX, op)	437
WK9U	378
VA3TO	360
AG1A	357
K2CZH	351
W9SZ	242
KR6TOM	155
VE3IPS	120

Single Operator, Three-Band

N3AAA	28,356
KO9A	26,132
K1HC	11,872
NU6S	8,925
K3TEF	8,900
W3FAY	8,010
KT9L	7,735
WA4LDU	7,598
KA2BPP	7,579
WB9TFH	7,524

Single Operator, FM Only

K6LMN	3,366
W6HIP	980
N6UTC	882
KC9PCP	720
KW6RON	517
KC1MXI	304
K6QCB	288
WG4I	198
KA6KEN	182
N9HRT	162

Limited Multioperator

N2NT	142,800
AA4ZZ	100,555
N8GA	73,179
K5QE	47,142
WD9EXD	39,634
W9VW	27,018
W1QK	23,430
WA3EKL	14,580
VE3MIS	6,400
WB4WXE	4,640

Unlimited Multioperator

W2SZ	213,624
W2EA	136,136
W4IY	65,919
N4SVC	42,723
KV1J	30,800
KD2LGX	30,345
W4ZST	24,255
KE1LI	12,354
N2BJ	11,524
W3KWH	5,253

Full Results Online

You can read the full results of the contest online at **http://contests.arrl.org**. 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.

Division Winners

Classic Rover

Atlantic	W3ICC/R	30,355
Central	K9TMS/R	7,672
Dakota	KC0P/R	5,053
Delta	AG4V/R	31,668
Great Lakes	WB8TGY/R	48
Hudson	NJ1F/R	1,558
Midwest	WA0CNS/R	1,330
New England	WB2VVQ/R	1,896
Pacific	W2TAR/R	686
Roanoke	K8GP/R	198,488
Southwestern	N7GP/R	79,918
West Gulf	K2EZ/R	13,494
Canada	VE3OIL/R	70,551

Limited Rover

Atlantic	NF2RS/R	56,499
Central	N9REP/R	3,840
Delta	AE5P/R	12,710
Hudson	WB2SIH/R	3,549
New England	KJ2G/R	17,524
Northwestern	KA7RRA/R	5,044
Pacific	KG6BXW/R	3,007
Roanoke	W4YN/R	1,150
Rocky Mountain	AB0YM/R	1,078
Southeastern	WB8LYJ/R	6,072
Southwestern	N6GP/R	14,022
West Gulf	N6RH/R	14,042
Canada	VE3RKS/R	1,464

Unlimited Rover

Atlantic	N2SLN/R	32,718
Central	K9JK/R	8,494
New England	KJ1K/R	1,426
Southwestern	K6VHF/R	12,441
West Gulf	N0LD/R	28,329
Canada	VE7AFZ/R	1,037

Single Operator, High Power

Atlantic	K1RZ	259,700
Central	W0UC	41,750
Dakota	W0GHZ	7,172
Delta	W5ZN	123,714
Great Lakes	KE8FD	50,490
Hudson	W2KV	31,248
Midwest	K0TPP	4,756
New England	K1TEO	397,488
Northwestern	KE7SW	13,566
Pacific	K6KLY	10,535
Roanoke	W3IP	133,037
Rocky Mountain	W9RM	3,780
Southeastern	WA4GPM	10,480
Southwestern	N1AV	60,600
West Gulf	K5TR	30,780
Canada	VE3ZV	17,794

Single Operator, Low Power

Atlantic	N2WK	66,679
Central	K2DRH	80,908
Dakota	KA0PQW	3,570
Delta	KG5CCI	5,980
Great Lakes	KF8QL	7,497
Hudson	WA2VNV	30,450
Midwest	AB0RX	7,772
New England	WB1GQR (W1SJ, op)	126,195
Northwestern	WZ8T	8,534
Pacific	K6MI	8,900
Roanoke	N4RA	2,706
Rocky Mountain	NJ7A	299
Southeastern	W4EUH	6,149
Southwestern	KG6IYN	46,986
West Gulf	N5CXX (K3NT, op)	3,069
Canada	VE3DS	33,614

Single Operator, Portable

Atlantic	W3MEO	25
Central	WK9U	378
Hudson	WB2AMU	2,835
Midwest	NA1KW (N1SPX, op)	437
New England	AG1A	357
Pacific	KR6TOM	155
Roanoke	KO4ELL	84
Southwestern	KK4BZ	36
West Gulf	WD5AGO	1,120
Canada	VA3TO	360

Single Operator, Three-Band

Atlantic	N3AAA	28,356
Central	KO9A	26,132
Dakota	N0UR	3,960
Delta	K5OLV	1,073
Great Lakes	N9AGC	740
Hudson	KA2BPP	7,579
Midwest	K0PHP	324
New England	K1HC	11,872
Northwestern	N7QOZ	2,728
Pacific	NU6S	8,925
Roanoke	WA4LDU	7,598
Rocky Mountain	WB0NRV	429
Southeastern	K4MY	4,753
Southwestern	N7IR	6,840
West Gulf	N5KS	399
Canada	VE3PJ	3,420

Single Operator, FM Only

Atlantic	WB2AIV	1
Central	KC9PCP	720
Delta	K4NRT	15
New England	KC1MXI	304
Northwestern	K7IMA	56
Pacific	N9VM (N1VM, op)	135
Roanoke	N4QX	18
Rocky Mountain	KG7AZY	44
Southeastern	WG4I	198
Southwestern	K6LMN	3,366
West Gulf	KJ5T	2

Limited Multioperator

Atlantic	WA3EKL	14,580
Central	WD9EXD	39,634
Great Lakes	N8GA	73,179
Hudson	N2NT	142,800
Midwest	WQ0P	3,710
New England	W1QK	23,430
Roanoke	AA4ZZ	100,555
Rocky Mountain	K5LRW	783
Southeastern	WB4WXE	4,640
Southwestern	WO1S	1,121
West Gulf	K5QE	47,142
Canada	VE3MIS	6,400

Unlimited Multioperator

Atlantic	W2EA	136,136
Central	N2BJ	11,524
Hudson	W2SZ	213,624
New England	KV1J	30,800
Roanoke	W4IY	65,919
Southeastern	N4SVC	42,723
West Gulf	KC5MVZ	1,300

Regional Leaders

Boxes list call sign, score, and class: LM = Limited Multioperator; R = Classic Rover; RL = Limited Rover; RU = Unlimited Rover; SO3B = Single Operator, Three-Band; SOFM = Single Operator, FM Only; SOHP = Single Operator, High Power; SOLP = Single Operator, Low Power; SOP = Single Operator, Portable, and UM = Unlimited Multioperator.

West Coast Region
(Pacific, Northwestern, and Southwestern Divisions; Alberta, British Columbia, and NT Sections)

N7GP/R	79,918	R
KJ7JC/R	33,456	R
N7OW/R	28,557	R
N7DSX/R	11,388	R
N6ZE/R	4,370	R
N6GP/R	14,022	RL
KX6A/R	6,275	RL
KA7RRA/R	5,044	RL
KG6BXW/R	3,007	RL
WB6HUM/R	2,304	RL
K6VHF/R	12,441	RU
VE7AFZ/R	1,037	RU
KD6RMS/R	420	RU
N1AV	60,600	SOHP
W7MRF	24,024	SOHP
KE7SW	13,566	SOHP
N7VD	11,505	SOHP
N7EPD	11,400	SOHP
KG6IYN	46,986	SOLP
K6MI	8,900	SOLP
WZ8T	8,534	SOLP
K2GMY	8,330	SOLP
N7RK	5,070	SOLP
KR6TOM	155	SOP
KK4BZ	36	SOP
KN6BXC	2	SOP
KF7KTC	2	SOP
NU6S	8,925	SO3B
N7IR	6,840	SO3B
N7QOZ	2,728	SO3B
WB6HYH	2,124	SO3B
W6NCB	1,960	SO3B
K6LMN	3,366	SOFM
W6HIP	980	SOFM
N6UTC	882	SOFM
KW6RON	517	SOFM
K6QCB	288	SOFM
WO1S	1,121	LM
W6FM	231	LM

Midwest Region
(Dakota, Midwest, Rocky Mountain, and West Gulf Divisions; Manitoba and Saskatchewan Sections)

K2EZ/R	13,494	R
KT5TE/R	12,030	R
KB0YHT/R	6,231	R
KC0P/R	5,053	R
N0HZO/R	4,960	R
N6RH/R	14,042	RL
K5ND/R	7,110	RL
W5TN/R	6,808	RL
KI5FIQ/R	5,520	RL
KA5D/R	3,250	RL
N0LD/R	28,329	RU
KD5IKG/R	8,550	RU
K5TR	30,780	SOHP
K5LLL	17,871	SOHP
WQ5S	7,178	SOHP
W0GHZ	7,172	SOHP
K0AWU	5,856	SOHP
AB0RX	7,772	SOLP
N0LL	4,332	SOLP
KA0PQW	3,570	SOLP
N5CXX (K3NT, op)	3,069	SOLP
AA5AM	1,440	SOLP
WD5AGO	1,120	SOP
NA1KW (N1SPX, op)	437	SOP
N0JK	42	SOP
N0UR	3,960	SO3B
K0VG	1,221	SO3B
WB0NRV	429	SO3B
K5TA	425	SO3B
N5KS	399	SO3B
KG7AZY	44	SOFM
KJ5T	2	SOFM
K5QE	47,142	LM
WQ0P	3,710	LM
K5LRW	783	LM
KC5MVZ	1,300	UM

Central Region
(Central and Great Lakes Divisions; Ontario East, Ontario North, Ontario South, and Greater Toronto Area Sections)

VE3OIL/R	70,551	R
VE3SMA/R	40,502	R
VE3WJ/R	11,656	R
K9TMS/R	7,672	R
VA3ELE/R	2,100	R
N9REP/R	3,840	RL
VE3RKS/R	1,464	RL
K9JK/R	8,494	RU
W9YOY/R	2,898	RU
KE8FD	50,490	SOHP
W0UC	41,750	SOHP
KB8U	27,600	SOHP
N8LRG	22,325	SOHP
VE3ZV	17,794	SOHP
K2DRH	80,908	SOLP
VE3DS	33,614	SOLP
K9MU	20,020	SOLP
W9GA	15,604	SOLP
KF8QL	7,497	SOLP
WK9U	378	SOP
VA3TO	360	SOP
W9SZ	242	SOP
VE3IPS	120	SOP
W9CY	42	SOP
KO9A	26,132	SO3B
KT9L	7,735	SO3B
WB9TFH	7,524	SO3B
N9TF	7,260	SO3B
WB8BZK	5,856	SO3B
KC9PCP	720	SOFM
N9HRT	162	SOFM
KD9OIN	2	SOFM
N8GA	73,179	LM
WD9EXD	39,634	LM
W9VW	27,018	LM
VE3MIS	6,400	LM
K9KLD	4,134	LM
N2BJ	11,524	UM

Southeast Region
(Delta, Roanoke, and Southeastern Divisions)

K8GP/R	198,488	R
AG4V/R	31,668	R
W5VY/R	20,097	R
AE5P/R	12,710	RL
WB8LYJ/R	6,072	RL
W4YN/R	1,150	RL
WD5HJF/R	352	RL
K3XY/R	195	RL
W3IP	133,037	SOHP
W5ZN	123,714	SOHP
N4QWZ	37,530	SOHP
K1HTV	31,680	SOHP
W4NF	11,088	SOHP
W4EUH	6,149	SOLP
KG5CCI	5,980	SOLP
KC7RW	3,115	SOLP
N4RA	2,706	SOLP
AA4DD	2,691	SOLP
KO4ELL	84	SOP
WA4LDU	7,598	SO3B
K4MY	4,753	SO3B
KV4ZY	3,444	SO3B
K4FJW	3,320	SO3B
W4WWQ	2,910	SO3B
WG4I	198	SOFM
N4QX	18	SOFM
K4NRT	15	SOFM
K3TW	8	SOFM
KG5FHU	6	SOFM
WB2FKO	6	SOFM
AA4ZZ	100,555	LM
WB4WXE	4,640	LM
W4IY	65,919	UM
N4SVC	42,723	UM
W4ZST	24,255	UM

Northeast Region
(New England, Hudson, and Atlantic Divisions; Maritime and Quebec Sections)

W3ICC/R	30,355	R
W2EV/R	15,084	R
KV2X/R	5,376	R
AE2DM/R	4,480	R
WB2VVQ/R	1,896	R
NF2RS/R	56,499	RL
KJ2G/R	17,524	RL
AF1R/R	5,600	RL
WB2SIH/R	3,549	RL
N1QDQ/R	2,325	RL
N2SLN/R	32,718	RU
KJ1K/R	1,426	RU
KG6CIH/R	1,185	RU
K1TEO	397,488	SOHP
K1RZ	259,700	SOHP
WZ1V	86,028	SOHP
K1KG	69,402	SOHP
N3RG	64,320	SOHP
WB1GQR (W1SJ, op)	126,195	SOLP
AF1T	124,509	SOLP
N2WK	66,679	SOLP
WA3EOQ	30,805	SOLP
WA2VNV	30,450	SOLP
WB2AMU	2,835	SOP
AG1A	357	SOP
K2CZH	351	SOP
W3MEO	25	SOP
K2PHD	24	SOP
N3AAA	28,356	SO3B
K1HC	11,872	SO3B
K3TEF	8,900	SO3B
W3FAY	8,010	SO3B
KA2BPP	7,579	SO3B
KC1MXI	304	SOFM
WB2AIV	1	SOFM
N2NT	142,800	LM
W1QK	23,430	LM
WA3EKL	14,580	LM
W1FM	2,133	LM
N1NW	1,392	LM
W2SZ	213,624	UM
W2EA	136,136	UM
KV1J	30,800	UM
KD2LGX	30,345	UM
KE1LI	12,354	UM

In the ARRL 2020 September VHF Contest, Alex Nersesian, K6VHF; Vlad Tryasorukov, WY6DX, and Vlad Boyko, W6BVB, took first place in the Unlimited Rover category in the Southwestern Division, and third place overall for W/VE. The K6VHF team's rover vehicle is pictured at their location in grid square DM44, near Gila County, Arizona. [Alex Nersesian, K6VHF, photo]

The next September VHF Contest will be held September 11 – 13, 2021.

2021 Straight Key Night Results

Many hams chose to ring in the new year by participating in ARRL's classic event.

Paul Bourque, N1SFE
ARRL Contest Program Manager

Amateurs from around the world look forward to Straight Key Night (SKN) with much anticipation, whether they participate every year or for the first time. As we said farewell to 2020, 214 participants logged over 1,600 contacts during the event.

Activating W1AW

For some lucky participants, SKN 2021 was extra special, as several ARRL staff activated W1AW for the event. ARRL CEO David Minster, NA2AA, operated on 40 meters, while ARRL Lab Manager Ed Hare, W1RFI, operated the 20-meter station. Additionally, ARRL Product Development Manager Bob Inderbitzen, NQ1R, operated on 80 meters using the W1AW call from the ARRL Headquarters club station, W1HQ.

Joe Carcia, NJ1Q, W1AW Station Manager, said the Headquarters staff used some special keys during the event. Minster used Hiram Percy Maxim's straight key from Hiram's rotary spark-gap transmitter "Old Betsy," Inderbitzen used the Begali key replica of one of Hiram's straight keys, and Hare used W1AW's J-38 key. In all, W1AW completed 173 contacts on the three bands. Carcia added that due to the pandemic, access to the facilities were limited and no more than one operator was present at any given time.

Soapbox Comments

The number of submitted entries was slightly higher than last year, and many participants reported that there was plenty of activity on the bands. Jack Schuster, W1WEF, noted that "It was the most activity I ever saw and the highest number of contacts I ever made in SKN."

While many participants operated strictly on the HF bands, some chose to operate on the higher frequency bands. Chris Bisaillion, VE3CBK, along with a group of other operators in Ontario, Canada, made several contacts on 2 meters.

Some operators dusted off their keys for the first time in years, and others used the event as an opportunity to mentor new and prospective hams. Eric Bartholomew, W8QT, stated that he hadn't made a CW contact in over 25 years, and enjoyed the challenge of working CW again. Aaron Ray, N4ARY, said that being joined by his daughter was "the highlight of this year's SKN."

For SKN 2021, Ralph Irons, N4RLI, uncovered his vintage station, consisting of a Heathkit DX-20 transmitter paired with an Allied Radio Knight-Kit V44 VFO, and a Heathkit HR-10 receiver. [Ralph Irons, N4RLI, photo]

Best Fist and Most Interesting QSO

Each year, we ask SKN participants to cast their votes for "Best Fist" and "Most Interesting QSO." This year's vote for "Best Fist" is a six-way tie between Tom Billings, AA4TB; Nenad Tufekcic, AC6YY; Paul Raiche, N1XI; Jim Zimmerman, N6KZ; Bob Buecker, N9HAL, and Michael Hall, WB8ICN. For the "Most Interesting QSO," there was a four-way tie between Jack Hill, KKØI; William Diman, W2WLD; Randall Myers, WB4SPB, and Dennis Mudge, WB6PGJ.

The next ARRL Straight Key Night will be held on January 1, 2022. Let's see if we can continue the increase in activity for the event next year, as we move farther into Solar Cycle 25.

Participating Stations

AA4AI, AA4TB, AA5AD, AA7FV, AA7IR, AA8KY, AA8UU, AAØQZ, AB8FJ, AB9BZ, AC6YY, AD8Y, ADØKH, AE3A, AE6Y, AE7CG, AE8EA, AF8A, AG4W, AI6SL, K1EEE, K2AL, K3AFS, K3BVQ, K3MD, K3SWZ, K3TW, K4EQ, K4FOY, K4HGX, K4RCW, K5JM, K5LDA, K5MBA, K5SOH, K5TSK, K6CTW, K6DF, K6GAS, K6KQV, K6PBQ, K6SK, K6SQL, K6TY, K7JRB, K7NSW, K7UA, K8LF, K8NB, K8TM, K9MMS, K9PFA, K9PMV, K9UQN, K9VKY, K9WWT, K9YA, KØARY, KØJW, KØKP, KØMIS, KØWOI, KA4WJB, KA6JLT, KA7T, KAØLDG, KAØMLX, KB2MN, KB2PVC, KB6NU, KB8TXZ, KB9W, KBØLMB, KC2LM, KC4HW, KCØINP, KD2BD, KD5QHV, KD5TXX, KD8CGH, KE1R, KE8AQW, KEØTT, KEØZ, KF8KS, KG4KGY, KG7BF, KI4TG, KJ9X, KN5L, KN8RHM, KO4GBD, KO8S, KQ9J, KR4U, KT3A, KW6G, KZ1X, N1ADX, N2BE, N2KDZ, N2KZ, N3EQF, N3HCN, N3YUG, N4ARY, N4CF, N4NTO, N4QR, N4RLI, N4TOL, N5DTF, N5EEI, N6KZ, N6TCZ, N7GOA, N8KC, N8QE, N8SS, N8XMS, N8XMW, N9BOR, N9BT, N9CKZ, N9EP, NØIMJ, NØKJI, NOØV, NWØM, NF8M, NIØR, NJ3K, NN7A, W1AW, W1PDI, W1PID, W1TPB, W1TS, W1WEF, W2GIW, W2LID, W2NTN, W2QJH, W2VTV, W3CB, W4FLL, W4RK, W4SGP, W4UR, W4YE, W5CUB, W5NZ, W5ZA, W6JHQ, W6KOW, W6PAP, W7GK, W7IY, W7QH, W8DO, W8DPK, W8DXU, W8SHF, W8UA, W8VE, W8WTS, W8WZ, W9ABD, WØAAA, WØESE, WØFUN, WØKIZ, WØKU, WA1CFX, WA2CHV, WA2ELW, WA2TBQ, WA7AXT, WA7OET, WA7YAZ, WA8UMT, WA8ZNC, WA9STI, WAØCFQ, WAØVQY, WB2AWQ, WB3CEG, WB3JKQ, WB4OFT, WB6AAJ, WB7AEA, WB7EHX, WB8CFO, WB8RFB, WB9HFK, WBØB, WBØCJB, WD5ABC, WD6EGW, WD8RIF, WDØK, WI9P, WN9U, and WR4RW.

DX and VE stations included HP1IBF, HP1RIS, VA3RKM, VE3CBK, VE3DQN, VE3WMB, VE6KC, VE7NI, VO1NA, VY1KX.

April 2021 Frequency Measuring Test

The format for the April Frequency Measuring Test (FMT) will include two transmit stations — K5CM in Oklahoma and W8RKO in Ohio. Transmissions will be made on three bands: 30, 40, and 80 meters. For those interested in checking WWV and using it as a guide to the current Doppler shift, the 30-meter run is only 100 kHz higher.

The FMT will start with a "call up" at 0130 UTC on April 9 (Thursday evening in North America). Measure the transmitted frequency and report your results at **fmt.arrl.org**. Results must be submitted by 0200 UTC on April 12, at which time the results will be published on the website. Stations submitting measurements within +/– 1 Hz for all six transmissions will be listed in the "Green Box" of the results.

The call-up frequency may not be the same exact frequency as during the key-down period (it may shift as much as +/– 10 Hz).

Although the call up is scheduled to start at a specific time, K5CM will try to start earlier. Every effort will be made to start key down at the published time. The key-down period will be 1 minute.

K5CM
30-meter schedule near 10103 kHz
01:30 Call up
01:33 Key down
01:34 End 30-meter run

W8RKO
30-meter schedule near 10103 kHz
01:45 Call up
01:48 Key down
01:49 End 30-meter run

K5CM
40-meter schedule near 7064 kHz
02:00 Call up
02:03 Key down
02:04 End 40-meter run

W8RKO
40-meter schedule near 7064 kHz
02:15 Call up
02:18 Key down
02:19 End 40-meter run

K5CM
80-meter schedule near 3598 kHz
02:30 Call up
02:33 Key down
02:34 End 80-meter run

W8RKO
80-meter schedule near 3598 kHz
02:45 Call up
02:48 Key down
02:49 End 80-meter run

Strays

Free Online Class for New Hams on April 24

The Nashua Area Radio Society will offer its popular Ham Bootcamp program via Zoom on Saturday, April 24, from 10 AM to 6 PM. The program, which was featured in Fred Kemmerer's, AB1OC, October 2020 *QST* article, "Ham Bootcamp: Getting Hams on the Air," includes demonstrations and tutorials designed to help new hams of all license classes get on the air. Bootcamp is also a great opportunity for prospective hams to learn what the hobby has to offer. Bootcamp additions include "Learning Morse Code." The Bootcamp is free. You can learn more and register to attend at **https://n1fd.org/bootcamp**.

Ham Bootcamps were held in person prior to the COVID-19 pandemic. Nashua Area Radio Society, who sponsors the Bootcamp, has since adapted the program to a videoconference format.

Certificate of Code Proficiency

Recipients

Sponsored by
VIBROPLEX
www.vibroplex.com

This month, ARRL recognizes merit and progress in Morse code proficiency on the part of the following individuals, who have achieved proficiency at the following rates, in words per minute.

November 2020

Matthew J. Blauser, KT5WB	10
Christopher A. Doutre, KC9AD	10
Gregory S. Glenn, WB6MPH	10
Stephen F. Hersey, K7OFG	10
David D. Herzberg, K7MTD	10
Nyles McKeithan, KS4S	10
Bernd Peters, KB7AK	10
Glenn E. Sigler, N8IJY	10
George R. Anderson, W4GRA	15
Riley P. Grieb, KC9OP	15
Bernd Peters, KB7AK,	15
Robert J. Ramborger, K7JNV	15
David M. Tenenbaum, AB1KT	15
James E. Toler, N2ZUT	15
Thomas F. Miller, W1PDI	20
Joseph M. Rinella, KG0HG	20
Robert W. Wilson, N4XU	35

December 2020

Robert C. Dupuis, K7CJN	10
Bobby P. Hargrave, KN4UCN	10
Robert T. Marston, AA6XE	10
Jason G. Warren, WE8L	10
Steve M. Kuzyszyn, KB2WQ	15
Nyles McKeithan, KS4S	15
David J. Warwick, K4DJW	15
David Loveridge, AC9TA	20
Nelson F. Mikeska, Jr., KI5JF	20

January 2021

Rene M. Beland, KE8NPD	10
Victor Denisov, N6DVS	10
Dale L. Martin, KG5U	10
Michael M. Piehl, K7LNT	10
David J. Redanz, N9HX	10
Frances R. Rogers, AC3GH	10
Burton D. Wizeman, K4SRQ	10
Norman R. Cox, KE0ZT	15
Clifford P. Culpepper, W4VN	15
Justin C. Jackson, Jr., WB4ABY	15
Kenneth A. Knox, KD2KEH	15
Dale L. Martin, KG5U	15
Frances R. Rogers, AC3GH	15
Glenn E. Sigler, N8IJY	15
Galen L. Babcock, Sr., AG5LS	20
Edward G. Corbett, AA1ZX	20
Leonard G. Crispino, WB2MJH	20
Nyles McKeithan, KS4S	20
Dennis G. Martin. WA2USA	25
Robert S. Zarges, Jr., K2MZ	25
Robert S. Zarges, Jr., K2MZ	30
Frank P. Arciuolo, W1ZAH	35
Lahra "Flip" Svare, KT9X	35

Congratulations to all the recipients.

April 2021 W1AW Qualifying Runs

W1AW, the Hiram Percy Maxim Memorial Station at ARRL Headquarters in Newington, Connecticut, transmits Morse code Qualifying Runs to assist ham radio operators in increasing and perfecting their proficiency in Morse code. Amateur radio operators can earn a Certificate of Code Proficiency or endorsements by listening to W1AW Qualifying Runs.

April Qualifying Runs will be transmitted by W1AW in Newington, Connecticut at the times shown 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 are tentatively scheduled to be transmitted by KH6TU on Wednesday, April 28 at 6 PM HST (0400 UTC on April 29) on 7047.5 and 14047.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 40 WPM.

Amateur radio operators who participate in Qualifying Runs may submit proof of 1 minute of the highest speed they have copied in the hope of qualifying for the Certificate of Code Proficiency, or an endorsement to their existing certificate.

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.

Members of the North Fulton (Georgia) Amateur Radio League (**https://nfarl.org/**) are offering to subsidize the total cost of a Code Proficiency certificate or endorsement submission for any individual age 21 years and younger, and who reside in either the US or Canada. Participants who wish to make use of this offer should indicate on their qualifying run submissions they are age 21 or younger, and certify as such via their signature. Eligible participants are not required to send any fee with their Code Proficiency submissions.

For more information about Qualifying Runs, please visit **www.arrl.org/qualifying-run-schedule**.

For information about how to qualify for the Certificate of Code Proficiency, please visit **www.arrl.org/code-proficiency-certificate**.

W1AW Code Proficiency Schedule — April 2021
(All times are in Eastern Daylight Time)

Monday	Tuesday	Wednesday	Thursday	Friday
4/5 4 PM – 2000Z 10 – 35 WPM	**4/6** 7 PM – 2300Z 35 – 10 WPM		**4/8** 10 PM – 0200Z **(4/9 – UTC)** 10 – 40 WPM	**4/9** 9 AM – 1300Z 35 – 10 WPM
	4/13 4 PM – 2000Z 10 – 35 WPM	**4/14** 7 PM – 2300Z 10 – 40 WPM	**4/15** 9 AM – 1300Z 35 – 10 WPM	**4/16** 10 PM – 0200Z **(4/17 – UTC)** 10 – 35 WPM
	4/20 9 AM – 1300Z 10 – 35 WPM	**4/21** 10 PM – 0200Z **(4/22 – UTC)** 35 – 10 WPM	**4/22** 7 PM – 2300Z 10 – 35 WPM	**4/23** 4 PM – 2000Z 10 – 40 WPM
4/26 10 PM – 0200Z **(4/27 – UTC)** 10 – 40 WPM		**4/28** 9 AM – 1300Z 35 – 10 WPM	**4/29** 4 PM – 2000Z 35 – 10 WPM	

Bernie McClenny, W3UR, w3ur@arrl.org

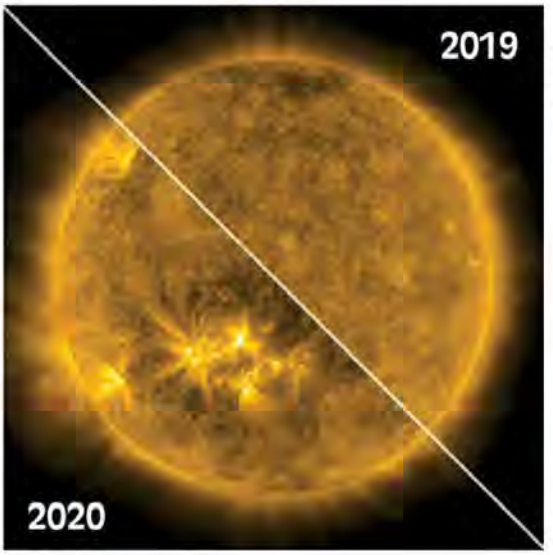
How's DX?

DXing and Solar Cycle 25

With the beginning of Solar Cycle 25, many DXers, contesters, and other operators will be focusing their efforts on the higher HF bands. This month Carl Luetzelschwab, K9LA, steps in to give us some insight on the new Solar Cycle.

Carl Luetzelschwab, K9LA

We've just begun our ascent out of a second, deep solar minimum — the first was the last solar minimum between Solar Cycles 23 and 24. These two solar minimum periods have been the longest in our lifetimes. Prior to these two, solar minimums have only been around 2 years in duration (defined by me as when the smoothed sunspot number was below 20), whereas the durations between Cycles 23 and 24 and between Cycles 24 and 25 were on the order of 5 years (see Figure 1).



A comparison between the sun's activity during solar maximum in November 2019 (left) and during solar minimum at the beginning of Solar Cycle 25 in early 2020 (right). [Photo courtesy of NASA and Solar Dynamics Observatory]

Cycle 25 and 15, 12, and 10 meters

Let's take a very broad look at how Solar Cycle 25 will affect propagation for DXers on our higher HF bands and on top band.

As Steve Ford, WB8IMY, mentions in his article, "Welcome to Cycle 25," elsewhere in this issue, forecasts vary for the magnitude of Cycle 25 (see Figure 2).

Many operators are wondering when the higher HF bands will offer worldwide propagation, and the answer has several factors that should be considered. For example, for consistent daily, monthly, and yearly worldwide propagation on 10 meters, the smoothed 10.7-centimeter solar flux needs to be above 100 (that's a smoothed sunspot number of 70). That's not likely to happen for a couple years.

Something else to consider is that the sun sometimes hiccups enough to open the higher HF bands — even at solar minimum. For example, at the end of 2020, the 10.7-centimeter solar flux spiked up to over 100 (see Figure 3). That opened the higher HF bands for the CQ World Wide DX Contest (phone) in October 2020, the CQ World Wide DX Contest (CW) in November 2020, and the ARRL 10-Meter Contest in December 2020. The sun was spotless during 14 days in January 2021, indicating the sun has at least briefly settled back down to solar minimum levels. I suggest monitoring the daily 10.7-centimeter solar flux, and head to the higher HF bands if it does spike up.

Location and station capability determine how much DX you can work.

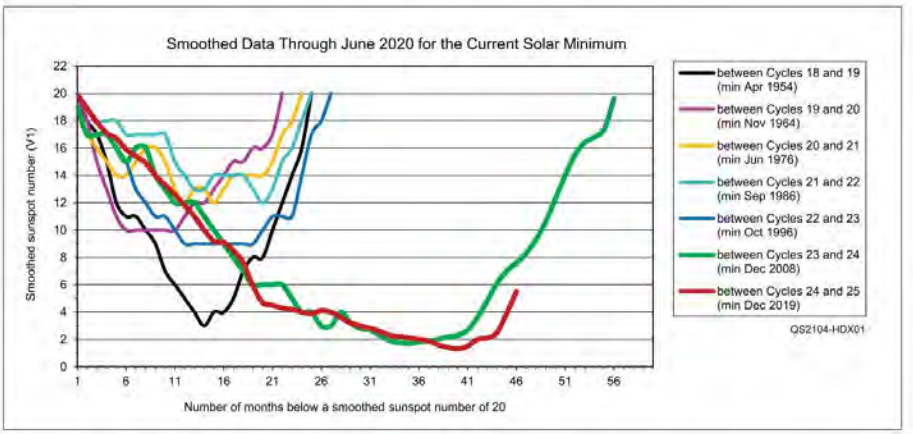


Figure 1 — The last seven solar minimum periods.

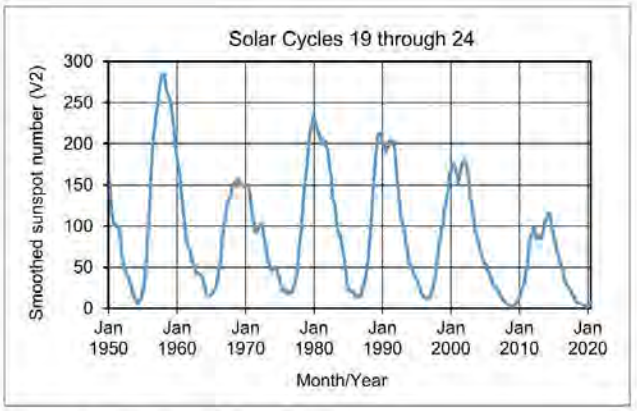


Figure 2 — Cycles 19 through 24.

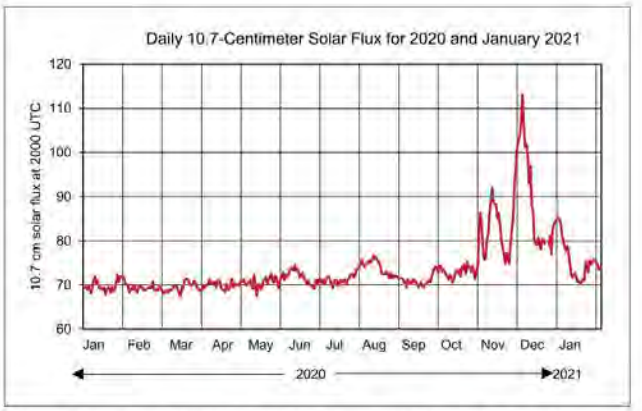


Figure 3 — The big spike in 10.7-centimeter solar flux at the end of 2020.

A big West Coast station will have an advantage to Asia. A big East Coast station will have an advantage to Europe. If you have a modest station, don't give up.

Additionally, the digital modes have a signal-to-noise ratio advantage over SSB and CW. When the higher HF bands (and even 6 meters) are marginal or nonexistent for SSB and CW, try a digital mode. And don't forget sporadic E, as it is relatively independent of solar cycle activity. You can work DX on 10 meters and 6 meters using this mode, especially during the summer months. As for 6 meters, a small cycle like Cycle 24 may only give us DX opportunities via the "normal" F2-region around solar maximum. But trans-equatorial propagation (TEP) via the F2-region to the south will still be available due to the robust equatorial ionosphere.

At the DX Engineering Propagation Summit on January 23, 2021, Frank Donovan, W3LPL, gave a presentation about what to expect as Cycle 25 rises. He reviewed what 10.7-centimeter solar fluxes are needed for the higher HF bands, what to expect with respect to disturbances to propagation as Cycle 25 rises, and much more. I highly recommend viewing his presentation, along with the three others, that are on the Contest University website at **www.contestuniversity.com**.

Solar Cycle 25 and 160 meters

DXing on 160 meters during Cycle 23 and Cycle 24 solar minimums hasn't matched that of the solar minimum between Cycles 22 and 23 (roughly 1995, 1996, and 1997) in terms of the number of openings and the signal strength. There are others expressing this same view.

Until the long solar minimum periods between Cycles 23 and 24 and between Cycles 24 and 25, I considered all solar minimum periods to be equal. Now, I suspect there are differences, just like there are differences between solar maximums.

The difference may be due to galactic cosmic rays. These are mostly very energetic protons coming into our atmosphere day and night, with solar minimum allowing the greatest amount of them into our atmosphere due to the sun's magnetic field being weakest at solar minimum. Visit **https://spaceweather.com** for more information on galactic cosmic rays.

Galactic cosmic rays can cause an increase in electrons at D- and lower-E-region altitudes via collisional ionization. Electron production rates in the technical literature for galactic cosmic rays suggest that the electron density in the lower ionosphere could be doubled, which means an increase in ionospheric absorption on a band that often does not have much signal margin to begin with.

But as Cycle 25 rises, the sun's magnetic field will become stronger. This will start keeping out galactic cosmic rays, which may result in reduced ionospheric absorption, so we can do more DXing on 160 meters in the short term. Consider monitoring 160 meters as Cycle 25 rises. We may see an improvement before Cycle 25 minimums rise too high and normal absorption, solar flares, and coronal mass ejections become prevalent.

For more information, check out my blog page at **http://k9la.us**, where I post a monthly propagation feature.

Wrap-Up

That's all for this month, with thanks to K9LA and W3LPL for helping to make this month's column possible. Feel free to send 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, NØJK, n0jk@arrl.org

The World Above 50 MHz

New Year South Pacific Fireworks on 6 Meters

Figure 1 — PSK Reporter spots E51WL on 6-meter FT8 on January 6, 2021 around 0110Z. [**pskreporter.info/pskmap**]

On January 1, 2021, a major 6-meter opening took place in the afternoon for North America to Australia and New Zealand. Stations in Arkansas and Oklahoma made contacts into New Zealand. K5CM (EM25) worked ZL3AS, W5EME (EM32) worked ZL1A, and Steve, W5KI (EM36), logged Cliff, ZL4AS (RE43), at 2314Z.

Cliff told Steve that he is "the most southerly ZL station you are likely to encounter on 6 meters. ZL4LV lives 52 kilometers east of me, and lives on a high hill with a very good look to North America. I am using a three-element SteppIR Yagi."

Larry, W5LDA (EM15), made his first contact with New Zealand, working ZL4LV (RE54) at 2332Z. From Arizona, Larry, WO7R; Ned, AA7A, and Bud, N7CW, worked New Zealand and North Cook Islands on FT8. Larry noted FT8 contacts with E51WL (RF82) at –11 dB, and seven different New Zealand stations.

The next day, Texas worked Australia. K5VVV sent me an FT8 screenshot showing 50 MHz contacts between N5DG (EM20), VK2EMA, and VK5ZK.

Lightning struck again on 6 meters on January 4. Chip, K7JA (DM03), went into his shack at 2255Z and found E51WL calling CQ on FT8. Chip quickly selected him, and he came right back. He found a rare new country at 2324Z with ZL7DX. Chip observed, "For over 2 hours, the 6-meter band stayed open to the VK/ZL area, with a total of 15 Pacific DX contacts." He said he had never heard a VK5 station before that, and he ended up working five of them. One station gave his 150 W signal a +00 report, and one station was his first US contact. His contact with ZL1AKW was the last station heard at 0054 UTC. Chip added, "It was the longest VK/ZL opening I've ever experienced. Typically, these winter openings go to the Gulf Coast, or into W4 land," leaving those by the Pacific Ocean out. But Chip said this opening made up for it.

In Arizona, WO7R, found 19 VK/ZL stations, as well as E51WL and KH6HI on Oahu. His longest-distance contact was with VK5BC/P (PF85) at 8,487 kilometers away.

The DX kept rolling on January 5 – 6 UTC. E51WL made contacts with stations in North America on 50.313 MHz (see Figure 1). He reached California then went east to Kansas, Missouri, and Arkansas. Larry, NØLL (EM09), heard KRØP (EN10) calling E51WL. KFØM (EM17) decoded E51WL. Arne, N7KA (DM65), worked E51WL. From Utah, Mike, K7ULS (DN41), missed the South Pacific DX but found XE1R, XE1AO, and several XE2 stations (see Figure 2). For him, the sporadic-E cloud supported the path from E51WL to other parts of North America. Lee, KY7M (DM51), at NA7TB, worked E51WL. Lee also worked NH6Y, KH6TU, and KH6CJJ on Maui.

These remarkable 6-meter openings occur yearly in a window from the last week of December through the first week of January. This is the peak of the North American winter sporadic-E

Figure 2 — Mike's, K7ULS, 6-meter portable set up in the Utah snow. [Mike White, K7ULS, photo]

season and the peak of the summer sporadic-E season in the Southern Hemisphere. Sporadic E obviously plays an important role, along with some help from trans-equatorial propagation (TEP). The propagation mode is thought to be single- or double-hop sporadic E on both ends of the path with afternoon TEP getting the signals over the Pacific Ocean. Despite a solar flux of only 78, it works. No sunspots are needed. The most common contacts are from New Zealand to North America. In December 2020 and January 2021, E51WL North Cook Islands, ZL7DX Chatham Island, and Australia were also in several times. Hawaii was worked on 2 days. This is unusual, as Hawaii is north of the geomagnetic equator. Propagation from North America to Hawaii may have been multi-hop sporadic E.

Figure 3 — Contacts between HC and W5 on 6 meters on January 15, 2021. [**dxmaps.com**]

On the Bands

50 MHz. On January 3, K3FR (FM18) worked 17 different stations on E_S, including K1LO (FN42) and N4UPX (EM50).

There was rare trans-Atlantic propagation from North America to Europe. On January 14, multi-hop sporadic E took place from New England to Europe. From Quebec, VE2XK (FN07) copied EA2XR (IN83) and F4ARU (JN03) on 50.313 MHz FT8. EI3KD copied K9RX (EM84) at 1843Z.

On January 14, sporadic E from W5LDA (EM15), AA5AM (EM13), and others logged stations in Ecuador. In Ecuador, HC1BI and HC2FG were active (see Figure 3). On January 16, there was an extensive E_S opening across eastern North America. Sporadic-E clouds were located over western New York and Kentucky. I, NØJK (EM28), worked AC4BV (FM17) at 0034Z on FT8. On January 17 in the ARRL VHF Contest, WA2HMM (FN30) worked WG8S (EM64), as well as stations in the Chicago area on FT8. I was portable from EM28 and found W4ZST (EM84) and W5PR (EL29) on E_S. Stations along the east coast had strong sporadic-E openings during the contest. On January 24 and 25, K3FR worked stations in Florida and Texas on FT8.

It is summer in the Southern Hemisphere during our winter. Pipe, CE3SX, sent in a report of what he worked during their summer E_S season. He made contacts from Chile to Australia and New Zealand on many days from December 8, 2020, to January 23, 2021, when he worked ZL1AKW. He made a total of 77 contacts, with 47 from ZL, 26 from VK, and 4 from ZL7. Broken down by mode, there were 64 on JT65, 9 on FT8, and 3 on FT4. JT65 is popular among VK and ZL 6-meter operators. Pipe's best DX was with VK4BLK at 12,380 kilometers.

144 MHz. John, KFØM (EM17), made 17 contacts in 12 grids on 2 meters during the contest. His best DX contacts were with K5QE (EM31), WE7L (DM79), and K2DRH (EN41). He said they were only possible because of FT8. He said FT8 activity on 2 meters has reached "critical mass" in the Midwest states.

Q65. The *WSJT-X* team is introducing a new mode called "Q65" in the "release candidate beta" *WSJT-X* 2.4.0-rc1. The team said, "Q65 is designed for making two-way QSOs over especially difficult propagation paths." Full details about Q65 are in the *Quick-Start Guide* to Q65, available here: **https://physics.princeton.edu/pulsar/k1jt/Q65_Quick_Start.pdf**.

Here and There

John Tudenham, WØJRP, joined the Silent Keys on January 28. He was active on the VHF and UHF bands for many years from Joplin, Missouri. On September 13, 1992, John worked W2SZ/1 (FN32) on 222 MHz tropo after a call from K5SW. During Solar Cycle 22, I was driving while monitoring the Pittsburg, Kansas, 2-meter FM repeater. Tudenham's excited voice broke the squelch to announce that South Africa and Reunion Island were in on 6-meter F2. I pulled off to the side of the road and worked several with 10 W on SSB. Tudenham helped and encouraged many on the VHF bands.

Maty Weinberg, KB1EIB, events@arrl.org; www.arrl.org/special-event-stations

Special Event Stations

Working special event stations is an enjoyable way to help commemorate history. Many provide a special QSL card or certificate!

Mar. 11 – Mar. 14, 0000Z – 0000Z, W5T, Cleburne, TX. Club KC5NX. **Battleship *Texas* Birthday**. 14.255 14.045 7.240 7.235. QSL. Club KC5NX, 9200 Summit Ct. W., Cleburne, TX 76033-8212. **jay.n.violet@gmail.com, www.qrz.com/db/kc5nx**, *or check here to find us*: **https://www.dxwatch.com/dxsd1/dxsd1.php?f=0&c=w5t&t=dx**

Apr. 1 – Dec. 31, 0000Z – 2359Z, all calls, all areas. VE2GT and VE2NCG. **Quebec Parks on the Air (QCPOTA)**. Certificate. *This is an operating event. See website for details.* **qcpota.ca**

Apr. 10, 1600Z – 2300Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum Ship. **Doolittle Raid**. 7.250 14.320 14.070 (PSK31) DSTAR via PapaSystem repeaters. QSL. USS *Midway* CV-41 COMEDTRA NI6IW, 910 N. Harbor Dr., San Diego, CA 92101. **www.qrz.com/db/ni6iw**

Apr. 10, 1700Z – 2100Z, W4D, Kodak, TN. Sevier County Emergency Radio Service. **Spring has Sprung**. 14.280 7.200; PSK31 14.070 7.070; CW only 7.060. QSL. Thomas P. Baxter, W9TPB, 2054 James Rd., Sevierville, TN 37876. **www.eventqsl.webs.com**

Apr. 10 – Apr. 11, 0001Z – 2359Z, KNØWCW, Leonardo, NJ. FISTS North America. **The Annual Nancy Kott Memorial KNØWCW Event**. 10.058 7.058 10.118 3.558. Certificate. Cody Codianni, 413 Martin Ct., Leonardo, NJ 07737. **fistsna.org/operating.html**

Apr. 10 – Apr. 11, 1200Z – 2359Z, W4E, Auburn University, AL. Auburn University. **155th Anniversary of Auburn University**. 7.060, 7.074; 7.047.5, 14.074; 14.080, 7.070. QSL. Stew Schneller, 1869 Hillton Ct., Auburn, AL 36830-2693. **www.qrz.com/db/k4jop**

Apr. 14 – Apr. 22, 1200Z – 2200Z, various calls, various areas, Germany. Maritime Radio Day Group. **Maritime Radio Day 2021**. CW only. Certificate & QSL. Rolf Marschner, Narzissenweg 10, 53359 Rheinbach, Germany. *This is an operating event. See website for details.* **mrd.sfk-bremen.com**

Apr. 17 – Apr. 19, 1400Z – 0200Z daily, K5LRK, The Colony, TX. Lake Area Amateur Radio Club. **Texas State Parks On the Air (TSPOTA)**. CW Phone VHF. QSL. Ken Mitchell, KD2KW, 931 Amber Ln., Little Elm, TX 75068-2283. The Colony, TX 75056. *K5LRK will be on as a special event station. Operating event to activate as many Texas parks as possible, see website for details.* **www.k5lrk.com** *or* **www.tspota.org**

Apr. 17 – Apr. 24, 0000Z – 2359Z, W5L, West Monroe, LA. NorthEast Louisiana Amateur Radio Club. **Celebrating the Louisiana Purchase**. 14.250 21.250 7.250 3.850. QSL. Jim Ragsdale, W5LA, 111 Eagle Lake Dr., West Monroe, LA 71291. **www.qrz.com/db/W5L**

Apr. 24 – Apr. 25, 1400Z – 2359Z, K5T, Nacogdoches, TX. Nacogdoches Amateur Radio Club. **San Jacinto Day Special Event**. 7.216 14.260 21.350 28.350. QSL. Army Curtis, 167 CR 2093, Nacogdoches, TX 75965. *All contacts will be confirmed via LOTW.* **https://w5nac.com**

Apr. 24, 1500Z – 2100Z, W5S, West Memphis, AR. AG5QY. **156th Anniversary of Sultana Disaster**. 14.240. QSL. Marc Gwin, 1402 Stratford Dr., West Memphis, AR 72301. **https://ag5qy9.wixsite.com/ag5qy**

Apr. 24, 1600Z – 2200Z, W7VW, Klamath Falls, OR. Klamath Basin Amateur Radio Society. **OC&E Woods Line Last Train 31st Anniversary**. 14.074. Certificate & QSL. Jim English, 2602 Wiard St., Klamath Falls, OR 97603. **wo7v@arrl.net** *or* **www.facebook.com/kfalls.radio**

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 (three units of postage) 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. Off-line 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 **July** *QST* would have to be received by **May 1**. In addition to being listed in *QST*, your event will be listed on the ARRL Web Special Events page. Note: All received events are acknowledged. If you do not receive an acknowledgement within a few days, please contact us. ARRL reserves the right to exclude events of a commercial or political nature.

You can view all received Special Events at **www.arrl.org/special-event-stations**.

Strays

2019 Cass Award Winners Announced

Janusz Wegrzyn, SP9FIH, is the winner of the 2019 Single-Operator Cass Award, and the 5KØK DXpedition team are the winners of the 2019 Unlimited Cass Award. Sponsored by Club Log, DXLab, and the Northern California DX Club, the Cass Awards encourage DXpeditions to maximize the number of DXers worked with a plaque for the Single-Operator DXpedition that works the most unique call signs during a 2-week interval and a plaque for the "unlimited" DXpedition that works the most unique call signs. This is Wegrzyn's third win in a row, this time for his DXpedition to Palestine, where he worked 7,518 stations. The 5KØK team worked 20,744 unique stations during their October 2019 DXpedition to San Andres Island.

Steve Ewald, WV1X, sewald@arrl.org; www.arrl.org/hamfests-and-conventions-calendar

Convention and Hamfest Calendar

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

Abbreviations

Spr = Sponsor
Tl = Talk-in frequency
Adm = Admission

VIRTUAL OZARKCON

April 10, Online
8 AM – 4 PM Central. *Spr:* Four State QRP Group.
www.ozarkcon.com

VIRTUAL COMM ACADEMY 2021

April 10 – 11, Online
S
9 AM – 5 PM Pacific. *Spr:* Western Washington Medical Services Communications Team. *Adm:* none.
www.commacademy.org

VIRTUAL MICROHAMS DIGITAL CONFERENCE

April 24, Online
8 AM – 5 PM Pacific. *Spr:* MicroHams ARC.
www.microhams.com/mhdc/mhdc2021

Alabama (Fort Payne) — Mar. 27 D H R T

7 AM – Noon. *Spr:* DeKalb County ARC. DeKalb County VFW, 151 18th St. NE. *Tl:* 147.270 + (100 Hz). *Adm:* $5.
www.w4gbr.org

Georgia (Savannah) — Apr. 24 F R T

8 AM – 1 PM. *Spr:* Coastal ARS. Savannah Hilton Head Regional Airport Recreation Building, Crossroads Pkwy. *Tl:* 442.70, no tone. *Adm:* Free. **www.coastalamateurradiosociety.net/wpW4LHSblog/?page_id=1001**

Illinois (Sandwich) — May 2 D F H R T V

7 AM – 1 PM. *Spr:* Kishwaukee ARC. Sandwich Fairgrounds, 1401 Suydam Rd. *Tl:* 146.730 – (100 Hz), 146.52 simplex. *Adm:* Advance $8, door $10. **www.karc-club.org**

New Jersey (Fair Lawn) — Apr. 24 F H R T

8 AM. *Spr:* Fairlawn ARC. Fair Lawn Recycling Center, 19-25 Saddle River Rd. *Tl:* 145.470 – 600 (167.9 Hz). *Adm:* $5.
www.fairlawnarc.org

Ohio (Athens) — Apr. 25 D F H R T V

8 AM – 1 PM. *Spr:* Athens County ARA. Athens Community Center, 701 East State St. *Tl:* 145.15 – no tone. *Adm:* Advance $8, door $10. **www.ac-ara.org**

Pennsylvania (McKeesport) — Apr. 18 D F H Q R V

8 AM – 2 PM. *Spr:* Two Rivers ARC. The McKeesport Palisades, 100 Fifth Ave. *Tl:* 146.73 – (100.0 Hz). *Adm:* $5.
www.trarc.net

Tennessee (Tullahoma), Outdoor Tailgate — Mar. 13 D F H Q R S T V

8 AM – 2 PM. *Spr:* Middle Tennessee ARS. Waggoner Memorial Park, 1300 E. Carroll St. *Tl:* 146.700 – (114.8 Hz). *Adm:* $5. **www.mtars-ham.org**

Tennessee (Sevierville) — Mar. 27 D F H R S T V

8 AM – 4 PM. *Spr:* Sevier County ARS. Sevier County Fairgrounds & Exhibit Hall, 754 Old Knoxville Hwy. *Tl:* 146.94 – no tone. *Adm:* $5. **www.seviercountyars.com**

Tennessee (Memphis) — Apr. 10 D F H Q R S T V

9 AM – 3 PM. *Spr:* Mid-South ARA, Bartlett Station Municipal Center Auditorium 5868 Stage Rd. *Tl:* 147.03 + (107.2 Hz). *Adm:* Free. **www.maraonline.org/freefest**

Tennessee (Greeneville) — Apr. 17 F T

7:30 AM – 2 PM. *Spr:* Andrew Johnson ARC. Greene County Fairgrounds, 123 Fairgrounds Cir. *Tl:* 145.39 – (88.5 Hz), 443.20 – (100 Hz). *Adm:* $5. **www.greenevillehamfest.com**

ARRL VIRGINIA VIRTUAL SECTION CONVENTION

April 24, Vienna, VA
D F H Q R S T V
9 AM – 2 PM. *Spr:* Vienna Wireless Society, online event. *Adm:* Free. **www.viennawireless.net/wp/events/winterfest**

Wisconsin (Superior) — May 1 D F H Q R V

9 AM – 1 PM. *Spr:* Arrowhead Radio Amateurs Club. Head of the Lakes Fairgrounds, 4700 S. Tower Ave. *Tl:* 146.94 – (103.5 Hz). *Adm:* $7. **www.thearac.org**

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 **May 1** to be listed in the **July** 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**.

A Look Back

QST
June 1971
75 Cents
devoted entirely to
amateur radio
OFFICIAL JOURNAL OF THE ARRL
ARRL

A 42-foot crank-up fold-over tower.

•Gimmicks and Gadgets

A 42-Foot Crank-Up

BY GORDON H. WEILER,* W9ZQK

IF YOU TOLD a friend you were going to build a crank-up tower, you would probably get the same comments I did – "Oh yeah?" After buying some new gear recently, the thought of having to purchase a tower didn't settle too well with my budget. An article in an earlier *QST* showed a good basic design.[1] After discussing the project with my brother-in-law, we decided to undertake the construction job. He was able to borrow a welding machine and knew how to operate it.

Top-Section Construction

The plan of building the inside section first, as mentioned in the earlier article, was followed. Each leg was constructed from a 21-foot piece of 1 1/4-inch standard black pipe. Six wooden forms, made of 1/2-inch-thick plywood approximately 24 inches square, were used as spacers for the three legs. Each form had three holes, mutually spaced 13 inches apart, center to center.

Steel cross braces were made from 1/4 x 1-inch bar stock cut to a length of 13 inches and placed at 16-inch intervals along the legs. The welds and cross pieces were kept on the inside of the legs to assure that the outer section, when completed, would slide freely over the inner section during the crank-up operation. Angle stock was used to check the position of each weld by sliding a short piece of it over the outside of the leg at the weld point. The angle stock must not touch the cross brace or weld. Three guides, made from 3/4-inch angle iron, were welded to the bottom as shown in Fig. 1. The wooden forms were removed when all of the welding was completed.

Fig. 1 — The guides for the inside section are mounted about 15 inches from the bottom. The winch mounted on the side of the tower is used for crank-up. The other one is used to lower the tower to the ground.

Construction of the Outer Section

Before placing the outer-section legs in position, a guide, similar to the ones mentioned above, was welded to one end of each of the remaining 21-foot pipes. Then the pipes were fastened with rope to the already completed tower section. We assured sliding clearance for the inside section by placing 1/16-inch spacers between each guide and its associated leg. The cross section braces were carefully welded in place so that the distance between the inside and outside legs remained constant. When the welding work was finished, the spacers were removed. The final product seemed remarkably straight. Since the completed tower was a bit heavy to handle,

* 4843 N. 90th Street, Milwaukee, WI 53218.

1 Filion, "A 65-Foot Crank-Up," *QST*, August, 1968.

QST for

Fold-Over Tower

even for two men, we disassembled the sections. An identification mark was placed on adjoining legs so that the sections could be reassembled with the same sides facing each other.

The Base Plate

A hinge on the base plate was needed to tilt the cranked-down tower to ground level. A 3-inch steel plate was welded across one side of the tower and 3 pairs of 1 1/4-inch OD (7/8-inch ID) mechanical tubing, 1 1/4 inches long, were attached to it. Similar pieces of tubing were welded at three places on the base plate. Then, a 1/2-inch pipe was inserted through the tubing to form the hinge. A photograph of this assembly is shown in Fig. 2. A second set of tubing was used to lock the tower when in the upright position.

Winches

Two winches, each rated at 1000 pounds, were purchased from Sears, Roebuck and Company at a cost of $9 apiece. A 3-inch-diameter pulley, sandwiched between two pieces of 1 1/4-inch bar stock, was welded to the top of the outside tower section and a similar assembly was welded to the bottom of the inside section. Fig. 3 shows the arrangement. The crank-up winch was mounted 4 feet from the bottom of the tower. The cable from this winch was strung through the top pulley, down between the sections, and through the bottom pulley. It was then fastened to the top of the outside tower. This arrangement provides a mechanical advantage factor of 2. The second winch, mounted on a small support near the base of the tower, has its cable fed through a pulley attached to the house, and connects to the top of the first section.

Final Thoughts

The tower was spray painted, first with a coat of zinc-oxide undercoat, and then with enamel. The lower section is supported by the house, so guy wires were not necessary. But if the builder were to place the tower away from any supporting structure, at least one set of guys should be used at the top of the first section.

I installed bicycle padlocks over the winch handles. This procedure keeps the neighborhood gang from "experimenting." I wish to thank my brother-in-law, Arnold Gross, for his help in accomplishing this project. QST

Fig. 3 — A pulley is sandwiched between two pieces of bar stock and welded to the top of the outside section.

June 1971

The house serves as both an anchor point for the fold-over pulley and a supporting structure for the lower half of the tower.

Fig. 2 — Hinge detail.

Celebrating Our Legacy

Remembering Ham Radio Camp

Although I started experimenting with electronics in 1963, I wasn't familiar with amateur radio. At summer camp that year, the junior counselor in my bunk had a Hallicrafters S-120 shortwave receiver he listened to nearly every night. After camp, I found out that my father had been a licensed ham in the 1930s, but let his license lapse. He encouraged me to become active in the hobby and at 13 years old, I earned my Novice-class license.

My father, who was in his 50s at the time, was having difficulties learning Morse code. We decided to go to Camp Albert Butler in Alleghany County, North Carolina, which had been advertised in *QST*, so he could reinstate his license. The camp held one 2-week session every summer. We learned technical essentials and increased our Morse code speed with daily practice sessions. At the end of camp, we were able to take our license tests right on the campground. It was an amazing experience.

I've been active in amateur radio ever since. I currently spend nights on 75 and 40 meters talking to friends around the country. I also operate all low bands except 160 meters. I was an early 2-meter FM amateur and helped to establish one of the first repeaters in south Florida in the late 1960s, before I graduated high school. I worked part-time for Motorola and learned all about commercial gear, which we then converted for 2-meter FM. I now operate FM and digital on 2 and 440 meters.

My father eventually earned his license again and my son has earned his license as well. We're a three-generation ham radio family, who have been enjoying the hobby since the 1930s!

Wayne Schonfeld, WA4YDJ
Hollywood, Florida

Building My First Radio

Growing up in Belgium, I discovered ham radio at 13 years old in 1948, while reading one of my father's books on how to design your own radio and the wonders of shortwave listening. My dad gave me the pieces of a crystal set he built many years earlier, so I could rebuild it. With knowledge from his book about how to build an antenna, I connected the crystal set to outdoor telephone wires via a homebrewed capacitor using cellophane and aluminum foil. Shortly after, the telephone company asked us to remove it. After this, I built a one-tube regenerative receiver from a schematic published in *Popular Mechanics*, and it worked great. I discovered that the more I increased the feedback, the more the receiver became selective and I could disturb broadcast radio reception in the entire neighborhood. I still have it in working condition.

By the time I was a sophomore in high school, I had discovered *QST* and other radio-related American, English, and French magazines, as well as *The ARRL Handbook*. I used my parents' radio with its one shortwave band to listen to ham radio and international broadcast stations, but reading about communications radios excited me and I wanted to design my own. I combined parts from various projects in *The ARRL Handbook* and magazines. However, because I didn't feel confident enough to design the necessary inductors myself, I bought a ready-made frequency conversion section from the Italian manufacturer Geloso, which consisted of an RF amplifier, frequency conversion amplifier, and local oscillator with all the necessary inductors and capacitors that allowed for shortwave listening on six bands. I decided to use three IF amplifiers, a high-gain tube used in radar, and TV IF amplifiers, even though I read that three amplifiers would oscillate.

I added a noise suppressor circuit that used a parallel IF amplifier and, to reduce unwanted sounds, I added a bass and treble control circuit copied from a Heathkit high-fidelity preamplifier design. I built it all on three radio chassis, which worked well, except the bass and treble control potentiometers didn't influence the sound. I spent hours looking for a wiring mistake, but never found one. Many years later, I realized that the frequency range of the small speaker was so limited, it was outside the adjustment range of the Heathkit circuit.

After earning my electrical engineering degree and emigrating to the US from Belgium, I eventually earned my Amateur Extra-class license and operated as NY7O.

Guy Olbrechts, NY7O
Scottsdale, Arizona
Life Member

Wayne Schonfeld, WA4YDJ, and his father with fellow campers at Camp Albert Butler in the 1930s.

Send reminiscences of your early days in radio to "Celebrating Our Legacy," ARRL, 225 Main St., Newington, CT 06111 or **celebrate@arrl.org**. Submissions selected for publication will be edited for space and clarity. Material published in "Celebrating Our Legacy" may also appear in other ARRL media. The publishers of *QST* assume no responsibility for statements made in this column.

George Benson, N8RU, n8ru@arrl.net

Classic Radio

The Heathkit HW-16 Novice Transmitter/Receiver

The Heathkit HW-16's front panel. [George Benson, N8RU, photo]

In the 1950s to early '70s, many Novices had a hard time graduating to General class. One factor was that the equipment they used was limiting, and it discouraged them from getting on the air. Very often, the receiver a Novice could afford lacked the selectivity needed to hear anything through the noise and interference on the crowded Novice bands. Compounding this, station management issues were difficult for beginners. Potentially dangerous problems arose while getting a transmitter and receiver to work together on the same antenna.

No doubt the engineers at Heathkit had all of this in mind when they developed the HW-16. Brought to market in 1968, it was designed specifically for the Novice-class operators as an affordable, self-contained station, housing transmitter and receiver in a single cabinet.

Priced just above $100 when introduced, the HW-16 provided a capable platform for CW communication on the 80-, 40-, and 15-meter Novice bands. It became the radio that opened amateur radio to many aspiring hams.

A Novice Transceiver

At the HW-16's heart is a surprisingly good CW-only receiver with selectivity and narrow filtering emulating the performance of more expensive equipment of the time. The HW-16 also employs internal antenna-switching and muting circuits, allowing seamless transition between transmit and receive on a single antenna. In effect, this made it a rudimentary transceiver. However, the HW-16 only mimics the functions of a true transceiver, because the transmitter and receiver are tuned independently of each other. Until the end of 1972, the FCC required Novice transmitters to be crystal controlled, fixing the HW-16's output to the frequency of the crystal used. Set up this way, the operator tuned the transmitter to the crystal's frequency first and then adjusted the receiver to zero-beat on it. This had to be repeated, of course, each time transmit frequency was changed with a different crystal.

Transmitter, Receiver, and T/R Switching

The HW-16's transmitter consists of three tubes: a 6CL6 for the crystal oscillator, another 6CL6 as a driver, and a 6GE5 final amplifier. Grid-block keying is employed. When not transmitting, a negative bias voltage is applied to the grids of all three tubes, preventing any output. When the key is closed, the bias is removed from the oscillator and driver and reduced at the amplifier, allowing transmission.

The transmitter's pi output circuit requires a 50 Ω antenna load. This simplifies tuning. First setting the **TUNE** control to a maximum meter reading, followed by adjusting the input **POWER LEVEL** over a range of 50 to 90 W.

The receiver is a six-tube, CW-only, double-conversion design, tuning the first 250 kHz of 80, 40, and 15 meters. Signals are broadly tuned at the RF stage and passed on to a heterodyne oscillator/mixer employing a crystal band-pass circuit, converting them to an intermediate frequency (IF) range of 5296 to 5546 kHz. The VFO in the following stage tuned a range from 1900 to 2150 kHz, and when mixed with the signal from the first oscillator/mixer, it produces an IF of 3396 kHz. The signal then passes through a narrow 500 Hz crystal filter, then to the BFO, detector, and audio output.

The chassis layout. The receiver's PC assembly is on the left, the transmitter in the upper right, and the power supply in the lower right. [George Benson, N8RU, photo]

Receiver controls are minimal: **RF GAIN** and **AF GAIN**, as well as some RF-stage preselection by the **TUNE** adjustment shared with the transmitter's pi output circuit. There is no AGC in the receiver and strong signals are attenuated by manual adjustment of the **RF GAIN**.

The pi network output circuit of the HW-16's transmitter does double duty as the receiver's RF input. A diode functions as a transmit/receive switch. When forward biased on transmit, the diode prevents output current from entering the receiver's RF circuit. On key up, it allows incoming signals to pass to the receiver. The result is full-break-in keying (QSK), with switching back to receive in the intervals between dots and dashes.

Design Compromises and Modifications

With so much of the radio's cost concentrated in the receiver, there are some design tradeoffs. These include the lack of an automatic gain control (AGC) circuit, an adjustable filter width in the receiver, and a volume control for the side-tone oscillator. There is also no option to allow semi-break-in keying as an alternative to full QSK.

The HW-16 also has two design flaws worth noting. The first involves the 15-meter loading coil, which is overvalued, not allowing full resonance of the pi output circuit. In this condition, the transmitter can't reach full power output. And with the pi network doubling as the receiver's RF-stage input, it results in less than optimal reception on this band. A less-than-perfect fix is to reduce the coil's inductance by pushing the turns as far apart as possible without shorting them on the adjacent chassis.

The second design flaw is the HW-16's tendency to chirp on key down. This was a common problem of its era, caused by temporary voltage instability in the oscillator when keyed at the same time as the driver and final stages.

There are several possible fixes. Sometimes, it is as simple as switching out crystals. If that's not sufficient, a 100 pF to 220 pF mica capacitor can be placed between the oscillator's screen and ground. A more aggressive cure is to insert a voltage regulator tube between the oscillator's screen and the power supply, or to disconnect the oscillator's screen grid from the voltage it shares with the driver and amplifier, supplying it instead through the receiver's B+.

WB4OMM's HW-16

Steve Szabo, WB4OMM, has fond memories of going with his father to the Heathkit store in New York City in December 1969, returning with an HW-16 as his Christmas present. He had yet to prepare for the Novice-class license and had no experience on a project of this size. But with the promise to get it all done, his father made the investment for him.

Constructing the radio took about 2 months, in short sessions carved out between schoolwork and his part-time job at the neighborhood grocery store. "When I finally switched it on for the first time — my folks looking over my shoulder — there was a flash and loud bang, instantly transforming the HW-16 into a smoking basket case." Having been so patient and methodical putting it together, Steve was crestfallen, and the radio was sent out for repair. The HW-16 came back in perfect condition, and there was a note attached from Heathkit indicating the short was caused by a component failure. It was no fault of his own.

Steve received his Novice license early in 1971, starting out running a 40-meter dipole mounted on the roof of his apartment building. With his Novice license, he was able to work all states and continents before upgrading to General.

Steve said: "The HW-16 had a terrific receiver. While it may not have filtered out all interference, it gave a real edge on the Novice bands. But operating was still a challenge. When calling CQ, you were pretty sure a Novice coming back to you was using a crystal that didn't match your frequency. So, you had to dial the receiver and listen, searching for another station maybe a kilohertz away, somewhere in a bunch of other signals. That's what built my skill as a CW operator."

Steve pulled the HW-16 out about 5 years ago, restored with new PS caps, and is now a regular in the Novice Rig Roundup every March. Steve said each contact brings back the original thrill of a hard-won contact, "like being a 16-year-old again — thanks, Dad."

100, 50, and 25 Years Ago

April 1921

- The cover art shows a ham conducting spring repairs to his antenna system.
- The editorial, "Help the Cops," shares that police departments of several large cities were making nightly broadcasts of information on stolen cars, asking hams in nearby towns to copy and deliver that information to their local police chief.
- "The Spark Station Contest" reports that the editor was pleased with the response to the call for articles about spark transmission, and notes the article competition winners: first prize, 9ZN; second prize, 6CS, and third prize, 1AE.
- Gilbert Mears tells readers of "A Midnight Visit to T.O.M.'s," with cartoon illustrations by 8UX.
- "Some Simple C.W. Sets" reports on the transmitter of the Brown University Radio Club, 1XX; 7AD's small transmitter built in a cigar box, and the A.C.-powered transmitter of Roy Copp from Dayton, Ohio.
- J. F. Scholtes, 9AR, discusses the perennial problem of "QRM and the Relay Game."

April 1971

- The cover photo shows Dave Porter, K2BPP, standing at the South Pole.
- The editorial, "Larger Voice Bands?", discusses the pros and cons of expanding HF voice bands, following the issuance of the FCC's *Notice of Proposed Rule-making, Docket 19162.*
- Douglas Blakeslee, W1KLK, describes his project, "A Transmatch for Field Day."
- Gerald Hall, K1PLP, examines "The Digital Message Generator with RTTY."
- L. V. Gibbs, ZL2AVF, tutors readers on "Digital Filters."
- R. H. Turrin, W2IMU, describes "The Five-Finger Keyer" that he developed, aiming for easier and more accurate Morse sending.
- Lewis McCoy, W1ICP, explains "Simplified Antenna Switching."
- VHF/UHF expert Paul M. Wilson, W4HHK, shares information on "A 2.3-GHz Crystal-Controlled Converter" that he designed.
- "Around the World in Five Steps" reports that the US Navy awarded a commemorative plaque to Dave Porter, K2BPP, for his work in providing 50,000 phone patches over a 16-year period for personnel at the South Pole during Operation Deep Freeze.

April 1996

- The cover photo shows the recently licensed family of KC7HCA (dad), KC7EUU (son), and KC7HBZ (daughter) as they tune the bands.
- The editorial reminds hams to be helpful to our new amateur radio operators.
- A photo in "Up Front in *QST*" shows Z2/G3VIE operating "elephant mobile" while visiting the Imire Rhino and Wildlife Conservation in Zimbabwe.
- Berry P. Fletcher, ZS1FJ, shares the plans, problems, thrills, and successes of his DXpedition, in "Kermadec, ZL8 — Now or Never!"
- Mike Lamb, N7ML, relays the story of a successful short-term Technician license class, in "Zero to Technician in Two One-Day Sessions."
- "Solar Power for Your Ham Station — It's Easier than You Think," explains David Casler, KE0OG.
- Dwayne Kincaid, WD8OYG, shares how to build and use "A Microprocessor-Controller Repeater Voting System: The RVS-8."
- World-traveler George Pataki, WB2AQC, reports on "Amateur Radio in Morocco," with photos of 14 CN8 hams and their stations.
- George Badger, W6TC, expresses the importance of World War II-era tube, "The 811A: Grandfather of the Zero-Bias Revolution."
- Interference guru Ed Hare, KA1CV, shares the strange story of "Electric Fence Interference — A Case History."

Silent Keys

It is with deep regret that we record the passing of these radio amateurs:

K1AOI **Olney**, Richard C., Oxford, MA
KC1BC **Clark**, Ellis J., Lyman, ME
K1BHA **Gratkowski**, Theodore F., Easthampton, MA
WB1CCG **Pitts**, Donna D., Portland, ME
♦• K1CTK **Rohrer**, Bradley D., Annapolis, MD
• N1CZS **Weber**, John J., Jr., Dalton, MA
♦N1EHI **Marotta**, Louis J., Watertown, MA
KA1EIX **Meeker**, Alan D., Cortland, NY
N1IUE **Collins**, William E. "Bill," Hingham, MA
K1JFK **Keena**, John F., Jr., Westminster, MA
WM1KE **Staines**, Mike K., Richmondville, NY
K1MYL **Moniz**, Leonard A. "Lenny," Westport, MA
K1NON **Burnham**, Robert L. "Bob," Charlton, MA
KC1NQW **Vedral**, John, Buxton, ME
AA1O **Churchill**, William P., Jr., Carlisle, MA
K1QLG **Ravens**, Fred J., Jr., Falmouth, MA
N1VS **Santis**, Vincent A., Winsted, CT
W2ACR **Armstrong**, Steve D., Shortsville, NY
N2BI **Leahy**, Thomas F., Norwich, NY
• W2DUC **Cupp**, Frederick B. "Fred," Williamsport, PA
KH2G **Manns**, Richard M., Phoenix, AZ
K2IGW **Hardy**, Robert J., Las Cruces, NM
♦NP2L **Preston**, Malcolm M., Ashburn, VA
W2LLB **Kronenberg**, Allan A., Albany, NY
NP2NI **Morris**, Lee N., Saint John, VI
W2OU **Moore**, E. Drew, Piscataway, NJ
♦K2PLF **Green**, Martin J., Jr., Street, MD
K2QBV **Kornreich**, Joel H., Pomona, NY
NX2R **Palumbo**, Salvatore J., Cheyenne, WY
♦WA2TWS **Brown**, Roy C., Flemington, NJ
WB2UCR **Thayer**, George A., Ellicottville, NY
KE2UH **Rose**, Richard, Brewster, NY
WB2VMV **Tyndall**, Marvin W. "Marv," Absecon, NJ
W3DE **Greenhalgh**, William H., Wilmington, DE
N3DEI **Seitelman**, Michael L., Wilmington, DE
N3FYD **Jeffers**, Gregory E., Emporium, PA
WA3IVV **Tanner**, Richard G., Beaver Falls, PA
N3KKU **Arnold**, Randolph A., Hatfield, PA
KB3LES **Jewell**, Donald E., Falls Creek, PA
KB3LY **Sperling**, Elliott M., Seaside, CA
N3MLG **Ginter**, Martin L., Harrisburg, PA
W3NUS **Podroskey**, Frank J., Jr., Clairton, PA
• N3RSX **Pier**, John L., Wellsboro, PA
W3TPN **Sharp**, Kenneth L., Gilbertsville, PA
• N3UMJ **Kowalski**, William J., Erie, PA
KJ3V **Simons**, Marvin L., Jr., Birmingham, AL
• KA3WRQ **Sneff**, Vera M., State College, PA
WU3X **Hale**, Thomas B., Halifax, PA
WN4A **Brothers**, Floyd G., Sr., Washington, NC
WA4AGS **Camp**, Luther J., Raeford, NC
K4BKD **Riker**, Peter J., Marietta, GA
KK4EH **Stiltner**, Arthur, Grundy, VA
KC4ET **O'Kain**, Jim G., Powell, TN
N4EWR **Boehlein**, Louis C., Gainesville, FL
W4HAM **Moye**, Hugh A. "Anson," Archer, FL
N4HVA **Morrison**, Cameron E., Saint Petersburg, FL
KG4JSV **Shell**, Thomas B., Centerville, GA
WD4KXJ **Penven**, Donald S., Raleigh, NC
♦WD4LGP **Corbacho**, Fernando R., Tampa, FL
• N4RLS **Sorensen**, Raymond L., Hayden, AL
• N4NAB **Henderson**, John A., Cape Carteret, NC
KF4NI **Byrd**, Ruby C., Thomasville, NC
♦N4NO **Cross**, Jerome L., Huntsville, AL
K4OQB **Anthony**, Ted A., Lake Alfred, FL
WA4PBA **Midkiff**, Edward A., Mount Airy, NC
NC4R **Shaver**, Hallie F., Enka, NC
♦WB4RSU **Moore**, Michael W., Starr, SC
K4SSU **Johnson**, David J., Winder, GA
• K4TMO **Arteaga**, Joaquin B. "Art," Merritt Island, FL
W4TPS **Simpson**, Thomas P., Rocky Point, NC
KJ4TYV **Conner**, James W., Gloucester, VA
W4VOK **Howard**, Kenneth W., Birmingham, AL
N4XMR **Clark**, Roger D., Sumter, SC
♦WB4ZIQ **London**, Henry A. "Hal," II, Johns Island, SC
W5AL **Parsons**, Leonard G., Amarillo, TX
K5AMM **Williams**, Lloyd W., Fort Worth, TX
KD5CBK **Duke**, Phillip W., Enterprise, MS
KA5DAN **Dye**, Randle K., Corinth, MS
KB5DCV **Vandagriff**, Georgia F., Ardmore, OK
KD5DVI **Davidson**, Donald C., Sherman, TX
WF5E **Bannon**, Leslie A. "Les," Lewisville, TX
KG5FVM **Kemp**, James W., McKinney, TX
♦K5JB **Butler**, Joseph A., Ocean Springs, MS
W5JWW **Whitten**, John W., III, Sumner, MS
KW5K **Stinson**, Walter H., DeRidder, LA
W5KK **Stroupe**, George K. "Bubba," Senatobia, MS
KN5LRM **McLean**, Lillian R., Sealy, TX
N5LW **Wood**, James L., Beggs, OK
N5MAV **Vann**, Matthew, Midland, TX
KE5MXH **Gregory**, Donald, Bristow, OK
♦K5NRM **Kunesh**, Robert J. "Bob," Georgetown, TX
KJ5OA **Norris**, Robert Tab, Eastland, TX
N5OCA **Anderson**, Orville C., Millsap, TX
WA5PRH **Worley**, William W., Waco, TX
K5QXY **Cohen**, Melvin D., Dallas, TX
KC5RDU **Harris**, Shirley A., Pea Ridge, AR
♦K5TE **Blair**, Charley A., Mineral Wells, TX
WA5VAF **Sippel**, John P. "JP," Cibolo, TX
WJ5Y **Bird**, Thomas J., Alexandria, LA
KB5YTT **Casey**, James L., Taylor, TX
W6DHN **Sharit**, Frank M., Georgetown, CA
♦W6EMD **Meacham**, David D., Redwood City, CA
KD6IQB **Hugo**, Alan J., Roseville, CA
K6ITM **Pielage**, Henry W., Santa Cruz, CA
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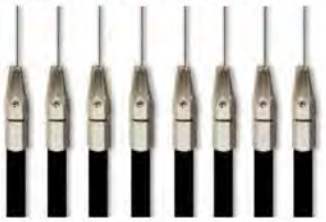

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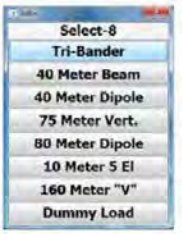

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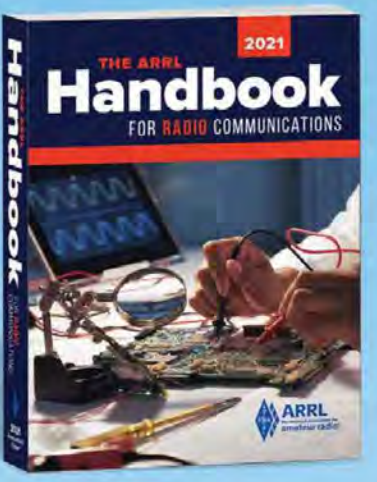

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Has 5-second brake delay, Test/Calibrate functions. Low temp grease, tough alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, weatherproof AMP connectors plus 8-pin plug at control box, triple bearing race with 138 ball bearings for large load bearing, electric locking steel wedge brake, North/South center of rotation scale meter, low voltage control, $2^{1}/_{16}$" max mast. **MSHD, $139.95**. Above tower heavy duty mast support. T2X, HAM-IV, HAM-V, HAM-VI. Accepts $1^{7}/_{8}$-$2^{5}/_{8}$" OD.

T-2XD2 – $979.95 with DCU-2

T-2XD3 – $1039.95 with DCU-3

TAILTWISTER Rotator Specifications	
Wind Load Capacity (inside tower)	20 square feet
Wind Load (w/mast adapter)	**10 square feet**
Turning Power	1000 in.-lbs.
Brake Power	**9000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**Triple race/138 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	31 lbs.
Effective Moment (in tower)	**3400 ft.-lbs**

CD-45II – $499.95

For antenna arrays up to 8.5 sq. feet mounted inside tower or 5 sq. ft. with mast adapter.

Low temperature grease good to -30 F degrees. New Test/Calibrate function. Bell rotator design gives total weather protection, dual 58 ball bearing race gives proven support. Die-cast ring gear, stamped steel gear drive, heavy duty, trouble free gear train, North center scale, lighted directional indicator, 8-pin plug/socket on control unit, snap-action control switches, low voltage control, safe operation, takes maximum mast size to $2^{1}/_{16}$ inches. MSLD light duty lower mast support included.

CD-45D2 – $599.95 with DCU-2

CD-45D3 – $659.95 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**
Shipping Weight	22 lbs.
Effective Moment (in tower)	**1200 ft.-lbs**

New!

Hy-Gain Programmable DCU-3 Digital Rotator Controller

DCU-3 – $499.95

Hy-gain DCU-3 Digital Controller lets you program 6 beam headings! Gives you full automatic or manual control of your hy-gain HAM or Tailtwister Rotators.

Press a memory button or dial in your beam heading or let *Ham Radio Deluxe* (or other) take control. Your antenna auto rotates precisely and safely to your DX.

DCU-3 automatically jogs your antenna free and safely unlocks it before rotating begins (*great for older rotators with "sticky" brakes*) then turns off your motor before reaching its final heading. Your antenna gently coasts to a stop before the brake re-locks -- greatly reducing damaging overshoots and extending rotator life.

Simply press *Left* and *Right* buttons for full manual control and fine tuning.

Bright blue LCD shows current, dialed in and computer controlled beam headings in one degree increments and your call.

Calibrate lets you accurately match your display to your true beam heading. Has USB/RS-232 ports for computer control. Adjustable LCD sleep time. Field upgradeable firmware. 8.5Wx4.3H x9D".

110 VAC. Order DCU-3X for 220 VAC.

DCU-2 Digital Rotator Controller – $459.95
Like DCU-3, but less programmable memories. 110 VAC. Order **DCU-2X**, for 220 VAC.

AR-40 – $399.95

For compact antenna arrays and large FM/TV up to 3.0 square feet wind load area.

Dual 12 ball bearing race. Automatic position sensor never needs resetting. Fully automatic control – just dial and touch for any desired location. Solid state, low voltage control, safe and silent operation. $2^{1}/_{16}$ inch maximum mast size. MSLD light duty lower mast support included.

AR-40 Rotator Specifications	
Wind Load Capacity (inside tower)	3.0 square feet
Wind Load (w/mast adapter)	**1.5 square feet**
Turning Power	350 in.-lbs.
Brake Power	**450 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/12 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**5**
Shipping Weight	14 lbs.
Effective Moment (in tower)	**300 ft.-lbs**

Replace your Yaesu Rotator Controller

YRC-1 – $369.95

Hy-gain YRC-1 -- more features, more robust, far less prone to lightning damage. Costs less than repairing!

Easy-to-use -- dial in your beam heading and tap GOTO button. Exclusive 180 degree *AutoReversal*™ for fast longpath operation. All DCU-2 features. Bright blue LCD shows current, dialed-in, computer controlled beam headings, call. USB port for computer control. Extra heavy-duty AC power supply. Fast variable DC motor minimizes overshoot. Intuitive menu. Field upgradeable. For Yaesu G-800/1000/2800/G450/650. AC or DC motors.

YRC-3, $449.95. Like YRC-1 and adds 6 memories.

AR-500 Rotator/Controller – $169.95

UHF/VHF/6-Meter, MFJ-1886 Rotator/Controller and Remote. For use of small VHF/UHF, 6M, TV, FM, the MFJ-1886 wide band receiving loop and other light-weight ham antennas. Rotator is built in a weather-proof one piece cast aluminum housing with precision all metal gears, steel thrust bearings and automatic braking. Includes rotator, controller, remote, clamps, and all hardware.AR-500 remembers up to 12 directions even after a power outage! Use remote control or direct console. Displays location and relative position.

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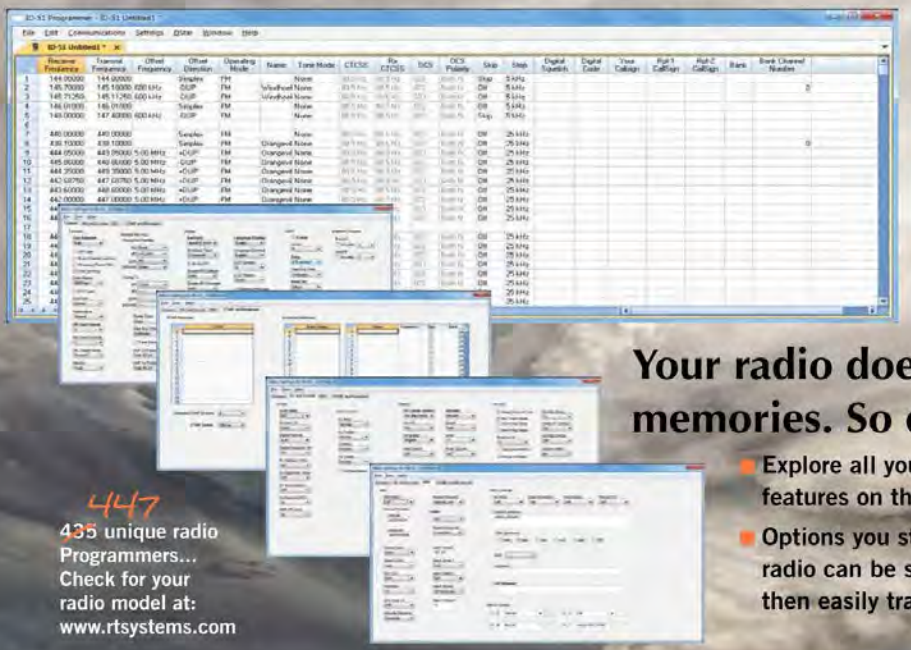

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Use as an adjustable phasing network. Combine two antennas to give you a powerful receive station and have a variety of directional patterns.

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RF-sense T/R switch auto bypasses your rig when you transmit. Adjustable T/R delay time. Use 12 VDC or 110 VAC with **MFJ-1312D, $19.95.** 6½X1½X6¼ inches.

MFJ-1025, $209.95. Like MFJ-1026, less the built-in active antenna. Use external antenna connection.

MFJ *Ultrasonic* Receiver with parabolic reflector *pinpoints* power line noise

HF and VHF operation can be affected by noise, makes it hard to hear weak stations, adds to fatigue. Often, noise comes from power lines. Power companies are willing to help with issues, but don't have equipment or trained personnel to locate it. MFJ aids in finding noise generated by corona discharge and arcing components. Acoustic receiver is tuned to 40 KHz. 18" diameter plastic dish gives a narrow beamwidth to pinpoint noise sources less than 12" at 50 feet. Also listen to nature: bats, birds, and insects!

MFJ-5008 **$199.95**

MFJ Power Line Noise Finder

MFJ-852 **$139.95**

Walk or drive around with these *handheld* power line noise meters to search out leaky insulators, loose hardware and corroded ground lines quickly. Track noise right down to the pole,transformer or insulator, or other source. Operates in 135 MHz region where activity is minimum and radiation from corona/arcing is more localized. 0.3 uV sensitivity and wide-range AGC for noise level meter -- *over 70 dB!*

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MFJ-856, $179.95. Combination of MFJ-852 noise finder and MFJ-1767 three-element beam antenna.

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Clearly hear signals 50 KHz to 30 MHz you never knew existed. Power line noise and static disappears. Rotating the MFJ-1886 eliminates interfering signals or greatly peaks desired signals. Excellent antenna and preamplifier balance gives deep null. Gives excellent strong and weak signal performance without overload. Fully protected state-of-the-art push-pull Gali MMICs preamplifier gives high dynamic range, low IMD and 25 dB of low noise gain. Use inside or outside.

Reduce Harmonics, Avoid TVI with MFJ Low Pass Filters

Suppress TVI, RFI, telephone, other interference by reducing unwanted harmonics to your antenna. Your HF signal still passes through with low loss so you snag that rare DX! *Keep the wife and neighbors happy!*

MFJ-702B, $44.95. 200W. SWR below 1.5 to 30 MHz.

MFJ-704, $109.95. 1500W. SWR below 1.3 to 30 MHz.

MFJ-705, $159.95. 2500W. SWR below 1.3 to 30 MHz.

MFJ Clamp-on RF Ammeters

MFJ-854 **$139.95**

Clamp-On RF Ammeters quickly snap over wires and cables to measure RF currents flowing in antenna elements, radials, ground wires and on outside of coax. Tune counterpoises, radials, ground systems. Study/optimize antennas for peak performance. Find peaks/nulls. MFJ-854 has five calibrated ranges to 3 Amperes, including sensitive 30 mA range.

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MFJ-853H, $79.95. 3/10/30 A ranges.

MFJ-805, $119.95. Check RFI on cables up to 1/4" dia. VLF to VHF.

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Filters and reduces AC power line RFI, hash, noise, transients, surges generated by computers, motors, RF transmitters, static/lightning by 30 db and up to 60-80 dB with ground. Fast, *nano-second* overvoltage protection. Provides inductive isolation, capacitive decoupling, RFI rejection, overvoltage protection of common mode, differential signals. Rejects/shunts undesired signals to ground. 12Wx3½Hx2D".

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MFJ Wire Antennas

G5RV -- *Most popular antenna in the world!*

Operate 80-10 or 40-10M with tuner. 14 gauge, 7-strand copper antenna wire. 1.5kW. 32.5' ladder line matching section with SO-239 for coax.
MFJ-1778, $69.95. 80-10M. 102 feet long.
MFJ-1778M, $59.95. 40-10M. 52 feet long.

End Fed Half Waves

Operate 80-10 or 40-10M with one support/no tuner.
80-10 Meters, 132 feet:
MFJ-1982HP, $109.95. 800 Watts.
MFJ-1982MP, $79.95. 300 Watts.
MFJ-1982LP, $59.95. 30 Watts.
40-10 Meters, 66 feet:
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MFJ-1984MP, $69.95. 300 Watts.
MFJ-1984LP, $49.95. 30 Watts.

Off Center Fed Dipoles

Lightweight, virtually invisible. Gives you directivity and gain (*see MFJ website*).
MFJ-2012, $89.95, 40/20/10/6 Meters, 1500 Watts. 67 ft.
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MFJ-1777, $79.95.102 foot, 160-6 Meters with tuner/balun. *Extremely low feedline loss.* Super strong fiberglass center insulator provides stress relief for included 100 feet ladder line. *Ceramic* end insulators. 1500 Watts SSB/CW/Digital.

MFJ 1.5 kW Dipoles

7-strand, 14-ga. copper wire.*Ceramic* insulators. Center insulator with SO-239
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MFJ-1779B, $59.95. 80-40M,135 feet.
MFJ-1779A, $79.95. 160M, 265 feet.

20M Extended Double Zepp

MFJ-1742, $99.95. See web for gain. 90 ft. long, 100 ft. ladder line. 7-strand, 14-ga. wire. 80-10M with tuner/balun. 1500 Watts SSB/CW/Digital.

80M End-Fed Zepp

MFJ-1748, $99.95. 125 feet long, 100 foot ladder line included. 7-strand, 14-ga. wire. Use tuner/balun. 1500 Watts SSB/CW/Digital.

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MFJ Vertical Mounted Antennas

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MFJ-1836H, $299.95. Six-bands: 20/17/15/12/10/6 Meters, 1.5 kW. *Perfect for restricted space.* Nearly invisible. 9x9x'/2 feet, 8 lbs. Outstand-ing performance! Horizontally polarized gives less noise, more gain over verticals. Omni-directional. No radials needed! Works great at low heights. Low SWR.
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MFJ *4-Band* Dipole Octopus Antenna

Octopus *antenna hub turns hamsticks into four balanced* HF/VHF/UHF *dipoles!* Rotate for maximum signal, minimum QRM/noise. Mount low for local NVIS, high for DX. Perfect for portable, limited space, HOAs, camping, ARES. Balun. No tuner needed.
MFJ-2104, $289.95. Includes 8 hamsticks for 75/40/20/15 M.
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MFJ Multi-Band Verticals, no radials needed!

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Built-to-last. Solid fiberglass rod, aircraft aluminum tubing.
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MFJ-1797LP, $339.95. Like MFJ-1797, but only 9 feet tall. Narrower bandwidth on 40 Meters.
MFJ-1799, $449.95.10 bands: 80/40/30/20/17/15/12/10/6/2M. 20 ft.
MFJ-1799X, $399.95. Like MFJ-1799, but less 80M.

MFJ 43-foot Vertical, 160-6 Meter

MFJ-2990,$399.95. High performance 43 foot vertical operates 160-6 Meters, 1500 Watts SSB/CW/Digital. 2 square feet wind load. Self-supporting, no guy wires needed. 6063 aircraft aluminum tubing, bottom section 2" OD, .120" wall thickness. 20 lbs. Requires antenna tuner, ground/counterpoise.

BigStick ™ Vertical

MFJ-2286, $119.95. 7-55 MHz, *full 1/4 wave* 20-6M, 40M coil. 17 ft. extended, 28" collapsed. 2 lbs. 1 KW. Mount, radial kit included.

BigEAR ™ Dipole

MFJ-2289, $209.95. 7-55 MHz. *Full-size* 20-6 Meter dipole, 40M air loading coil. Two 17 ft. telescopic whips, 28" collapsed.

Lightning surge protectors

MFJ-270, $24.95. 400W.
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MFJ-1982MP, $79.95

• **Get on the air** 80-10 Meters with a single wire *EFHW* and one center or end support. Fast, easy set-up/take-down for portable use.

• **End-Fed Half-Waves** (EFHW) resonate on halfwave fundamental frequency and even harmonics. 80-10 Meters -- no traps, stubs, resonators. Broad-band matching transformer gives you low SWR! No tuner usually needed.

• **No long counterpoise**, radials or feedline required

• **Nearly invisible,** no-tangle black *Teflon* insulated radiator wire.

• **Weather** and U/V resistant. Easy storage and transport.

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MFJ-1984MP, $69.95. *300 Watts* Restricted space, 40-10M. 66 feet.

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MFJ-1984HP, $89.95. *800 Watts*, high power, 40-10 Meters. 66 feet.

MFJ-1982LP, $59.95. *30 Watts* QRP, 80-10 Meters. 132 feet.
MFJ-1984LP, $49.95. *30 Watts* QRP, 40-10 Meters. 66 feet.

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MFJ-1979, $69.95. Premium stainless steel, 17 feet ext., 27" collapsed. Adjust length for full 1/4 wave antenna on 20-2M. Use MFJ-67 loading coil for 30/40/60/80M. For 3/8-24 standard mounts.

33' Telescopic *Portable* Mast

MFJ-1910, $99.95. Fiberglass. 3¾ ft collapse, 3.3 lbs.

BigEAR™ Dipole

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BigStick™ Vertical

MFJ-2286, $119.95. 7-55 MHz 17' ext., 28" collapsed, mount, counterpoise, 30/40M coil, 1kW.

BigEar™ Combo

MFJ-2289PKG, $339.95. BigEAR, tripod/mast. Canvas carry bag, padding, pockets, handle.

Single-band Rotatable mini Dipoles

MFJ-22XX, $69.95. Lightweight *true balanced* mini-dipoles for portable and space limited use. Choose: 75/60/40/30/20/17/15/12/10/6 Meters. Includes two HF sticks of your choice and dipole mount.

MFJ-347, $24.95. *True isolated balanced* dipole mount only. 1.25" mast size.

MFJ *Walk-About* 80-6M Antenna

MFJ-1899T, $99.95. Operate 80-6 Meters/WARC bands. BNC attaches directly to your Yaesu FT-817, Elecraft KX1/2/3, Icom IC-705, Xiegu G-90, X5105. 12" loading coil with wander lead. 10-section telescopic whip, 52" ext., 7" collapsed. Whip unscrews for easy carry and storage. 25 Watts.

MFJ-7703, $8.95. BNC/PL-259 right angle adapter.

10-band 80-2M *Mobile/Portable*

MFJ-1699T/S, $79.95 HF: 80-10 Meters, VHF: 6 and 2 Meters. Low SWR, 200 Watts. Wander lead changes bands. Maximum height is 49.5 inches. 3/8-24 or PL-259. Whip unscrews at base for quick storage.

Hamsticks! Choose: 75/40/30/20/17/15/12/10/6 Meters. **$19.95-$29.95 each.**

4-Band *Octopus* Antenna *Hub*

MFJ-2100, $109.95. *Turns pairs of hamsticks into four fully balanced dipole antennas in minutes!* Any bands: 80-2M, 440 MHz. Balun, single coax feed, no antenna tuner needed. Perfect for fiberglass pole on tripod at any height. Eight 3/8-24 connectors for antennas.

MFJ *QuickStik™* Mount/Ground

MFJ-1936T, $44.95. Push into ground up to 4 ft., attach any HF/VHF/UHF antenna with 3/8-24 connector like a hamstick or whip, attach coax to SO-239, operate! Use *QuickStik™* as *ground* and/or use included 25 ft. counterpoise wire.

MFJ Mobile HF Hamsticks

Rugged Construction. Heavy-duty 4', 3/8" diameter fiberglass base with a .125" diameter stainless steel whip. Handles 250 Watts PEP. Collapses to 4 feet for storage. 3/8x24. 75/40/30/20/17/15/10/6M. $19.95-$29.95

MFJ 10-40 Meters *Portable* Antenna

MFJ-1621, $119.95. 40-10M, telescoping whip: 54" extended, 22" collapsed. Tuner, field strength meter, 50' coax. 200W SSB/CW.

Box Fan Mag Loop

MFJ-1780, $369.95. Portable 2x2 ft. Carry handle. 14-30 MHz *continuous*. 150W SSB/CW. High efficiency *true mag loop*, no rotating contact *butterfly capacitor*, all welded. Fast/slow tune remote control.

Portable MFJ Tripods and Tripod/Masts

Black *steel* base forms strong braced equilateral triangles on a side. Non-skid feet, strong, mast locks.

MFJ-1919, $109.95. 9¾ lbs. Holds 100 lbs. 1.4" dia. mast extends 7.8 ft. Base spreads to 4.8 ft. 54"x6" dia. collapsed.

MFJ-1919EX, $179.95. Tripod *plus* 18' fiberglass mast. 5' collapsed. 1/8" wall, 3/4" dia. top, 1½" dia. bottom. 15 lbs.

MFJ-1918, $69.95. Tripod: 6' ext. 38" collapsed, 6¾ lbs.

MFJ-1918EX, $109.95. Smaller tripod with 9½' fiberglass mast. 3.8 ft. collapsed. ¾"top, 1" bottom. 6.5 lbs.

MFJ *QRPocket™* Loop Tuner

MFJ-9232, $69.95. Drape a wire around a bookcase, window, tree or other and attach to this MFJ QRP Loop Antenna Tuner. It becomes a 25 Watt multi-band transmitting magnetic loop! 40-10 Meters with included flexible wire loop. No ground, radials or needed.

QRP Antenna Tuner

MFJ-9201, $59.95. *Tunes any antenna* 80-10 Meters, 25 W. 12-position hi-Q inductor, tune/bypass, antenna and transmitting matching variable capacitors, BNC connectors. Tiny 4Wx2⅝Hx1½D inches -- MFJ-9201, rig and antennas easily fit into a backpack or briefcase for vacation, SOTA, hikes, etc.

MFJ Manual Tuner

MFJ-945E, $159.95. 1.8- 60 MHz, 300 Watts PEP. Tunes coax-fed antennas and random wires. Lighted cross-needle SWR/forward and reflected Wattmeter. Bypass switch bypasses tuner. SO-239, wing nut post for ground. Efficient, low loss airwound inductor. Small, 8Wx2Hx6D inches.

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MFJ-939, $159.95. Plug and play auto tuner for Icom, Yaesu, Kenwood and others. Automatically tunes any antenna ultra-fast! 20,000 Virtual antenna memories, matches 6-1600 Ohms, 1.8-30 MHz, 2 to 200 Watts SSB/CW. Radio interface cable included, 2-year MFJ warranty. 6½Wx1⅝Hx7½D".

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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, $99.95. 33 ft., light duty w/top tie ring.
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MFJ-1913, $109.95. 28 ft., lightweight w/top tie ring.
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MFJ-1916, $179.95. 34 ft., for heavier duty use.
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Super-strong .125" Thick-Wall Fiberglass Masts

Use for temporary or permanent wire antennas, small beams or verticals. **Best seller** is 48 ft. long, just 24 lbs.

Heavy Duty Models: All have QuickClamps™

MFJ-1908HD, $289.95 is 48' ext., 7.75-ft. collapsed, has 2½" OD bottom, 1" OD top, seven 7.75-ft. sections, 24 lbs.
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MFJ-1904HD, $179.95 is 25' extended, 4 feet collapsed, has 2½" OD bottom, 1" OD top, seven 4-foot sections, 14 lbs.
MFJ-1904H, $159.95. 22' ext., 5' collapsed, 9 lbs. 2½" OD.
MFJ-1902H, $139.95, 10' ext., 38" collapsed, 5 lbs. 2½" OD

Standard Models: H models have QuickClamps™

MFJ-1906, $159.95/MFJ-1906H, $219.95, 33 feet, ext., 6 ft. collapsed, six 6-ft. sections, 13 lbs. 2" bottom, 3/4" top OD.
MFJ-1908, $199.95/MFJ-1908H, $259.95, 41' ext., 7.75-ft. collapsed, six 7.75-ft. sect., 16 lbs. 2" bottom, 3/4" top OD.

Mast Accessories

MFJ-1900, $79.95. Mount clamps mast to mounting pipe.
MFJ-13, $69.95. 5 Military Quick*Clamps*™. Fit 3/4" to 2" OD.
MFJ-13HD, $69.95. Extra set clamps, 1- 2½" masts.

Mast Guy Ring Sets

Fits masts 3/4" to 1¼" dia OD. **MFJ-2830X, $9.95,** *fiberglass*; **MFJ-2840X, $12.95,** *aluminum.*

Left: *Stainless Steel Hose Clamps* recommended for permanent installations. Fiberglass is slotted.

Right: UV protected Military grade *Quick-Clamps*.Guy 2 levels when fully extended.

18' Telescopic Mast/Tripod

MFJ-1919EX, $179.95. ***Put your antennas up high anywhere with this super-strong* 18 foot telescoping fiberglass mast and MFJ-1919 heavy duty steel tripod. *QuickClamps™ lower mast to 5 feet. Mast has thick 1/8 in. wall, .75" top, 1.5" bottom dia. 15 lbs. Steel tripod has braced triangle base, non-skid feet, mast lock.***

MFJ-1918EX, $109.95. **MFJ-1918** *tripod with 9.5 ft. telescoping fiberglass mast.* 3.8 feet collapsed. 6.5 lbs.

Tripods Only

MFJ-1921, $199.95, *Giant tripod* base spreads to 8 feet! Supports massive antennas. Adjustable length non-skid legs accommodates uneven ground surfaces. Optional foot anchors, *see bottom right* 14 lbs.

MFJ-1919, $109.95, *Large tripod* base spreads to 4.8 ft. Support 100 pounds. 7.8 ft, 9.75 lbs.

MFJ-1918, $69.95, *Smaller tripod* base spreads to 2.75 ft. Support 66 lbs. 6.75 lbs.

80-6 Meter Antenna

3.8 ft. fiberglass mast telescopes to a 31ft. self-supporting *high performance* 80-6 Meter vertical antenna in minutes!

1/4 wave performance on 40M, 1/2 wave on 20M. High-Q air wound loading coil. Use antenna tuner for 30/20/15/12/10/6 M. 600W SSB/CW.

MFJ-2980 **$119.95** 40-6 Meters

MFJ-2982 **$169.95** 80-6 Meters

Use as temporary, portable or permanent antenna for home, RVs, camping, field day, hamfest, DX-pedition.

Includes four 12 foot radials. Current balun reduces feedline radiation and pattern distortion.

MFJ *"HamStick" Isolated* Dipole

Build your own 80-6 Meter *mini*-dipole using two HF mobile whips! MFJ-347 *isolates* dipole elements. Lets you use a balun to give a *true balanced dipole.* Prevents pattern distortion, noise pickup and RFI radiation from RF on coax shield. Solid aluminum. Use masts up to 1¼" OD.

MFJ-347 **$24.95**

3/8-24 Hamstick Mount

MFJ-342T **$15.95** Mount 3/8-24 HF/VHF hamsticks vertically or horizontally on masts to 1 inch. Built-in SO239.

MFJ Balcony Mount

MFJ-1907 **$49.95**

Mount *multiple* HF/VHF hamsticks, verticals, dipoles vertically or horizontally on your balcony. High-strength aircraft aluminum extends out 14". Two U-bolts mount to 1½"dia.

Tripod Anchors

MFJ-1905, $34.95. Securely anchor your tripods to the ground with these 3 *stainless steel* foot braces and your stakes. For high winds, unlevel ground. Fits legs to 1½"OD.

New!

Portable Mast Supports

MFJ-1912, $119.95. Just drive your car or truck tire over the stainless steel base of the mount. You're ready for virtually any antenna. Fits up to 2.25" masts.

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Fully featured amplified DSP noise canceling in-line module - Separate mono or stereo input and outputs - Headphone socket - Latest bhi DSP noise canceling technology - Suitable for all radios, receivers and SDR - Use with headphones and a speaker at the same time

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New improved NES10-2MK4 - 5W audio power - Latest bhi DSP noise canceling - Up to 65dB tone reduction - Function switch on top of speaker for ease of use - Power on, filter on and audio overload LED

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DSP noise canceling base station speaker - Now with latest bhi DSP noise canceling technology for even better receive audio - Easy to use rotary controls - 8 DSP filter levels - "Real time" audio adjustment - Suitable for all radios incl' SDR

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2-Meter/440 MHz

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This antenna is perfect for your dual band mobile or HT. Powerful 3½ inch magnet holds firm at highway speeds, rubber guard, 19" black stainless steel whip, low SWR, excellent gain, 300 Watts PEP, 12 feet coax with PL-259. Free BNC adapter.

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Clearest speech you ever heard!
3" speaker, 8W, 8 Ohms, 6' cord, 3.5 mm plug.

MFJ-1729

Power*Gain™

MFJ-1729 **$49.95**

Ham Radio's most powerful dual band antenna gives whopping gain on 440 MHz and 2-Meters! Low SWR. 27½" stainless steel Slimline™ radiator minimizes wind vibration for less SWR flutter for longer range, better readability. 12' coax, PL-259, Heavy duty magnet mount.

MFJ-1728B

5/8 Wave 2/6 Meter Mobile

MFJ-1728B **$34.95**

Full 50-inch 5/8 Wave gives you maximum possible gain of any single element antenna on 2-Meters. On 6-Meter "magic band" you get a powerful signal with its high-performance low SWR full 1/4 Wave. 300 Watts PEP, heavy duty magnet, 12 feet coax, stainless steel radiator.

MFJ Super-Strong Magnet Mounts with Coax/PL-259

MFJ 5-inch Magnet

Best Seller!
These jetblack 5-inch super strong magnet mounts have 17' coaxial line terminated with PL-259 connectors. SO-239 (BS) or NMO (BM) for your VHF/UHF antennas or 3/8-24 threaded (BT) for your HF hamstick antennas with a 3/8-24 threaded connector.

$19.95 Each

MFJ-335BS – SO-239
MFJ-335BM – NMO
MFJ-335BT – 3/8 - 24 For HF sticks

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3-inch Black Magnet Antenna Mounts
17-foot coax is terminated with PL-259 connector. Choose SO-239 (BS) or NMO (BM). For VHF/UHF lightweight antennas.
MFJ-333BS Pictured

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Release strain on your HT's antenna connector! 3 ft. flexible, mini coax with SO-239 connector.

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Goliath™ – Ultimate Strength Magnet
Three super-strong 5-Inch Magnets make up this MFJ Goliath™ Tri-Magnet Mount. 1/4" thick steel triangle base. 17' coax. Select SO-239, NMO, 3/8-24 antennas.
Caution: once on, it's difficult to get off!

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MFJ-336S – SO-239
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Use separate HF/VHF and 440 MHz UHF antennas with single transceiver OR use two separate HF/VHF and 440 MHz UHF transceivers with a single HF/VHF/UHF antenna. Heavy-duty diecast enclosure houses low/high pass networks that separate/combine HF/VHF/UHF signals. Low loss SO-239s. 50 Ohm ports. **MFJ-916BC, $59.95** 3 ft. coax pigtails on 2-port side.

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Compact 1.8-200 MHz SWR/Wattmeter has HUGE 3" Cross-Needle meter. Read forward/reflected power and SWR simultaneously. Perfect for mobile/portable. 30/300 Watt ranges. Built-in meter light. SO-239s. 3¼W x 3¼H x 3¼D". **MFJ-842, $69.95** covers 140-525 MHz, 15/150 Watts.

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A. MFJ-1402, $39.95.
VHF/UHF RuffRiderJunior™. Premium, short 16½" antenna fits in any garage on any auto. ¼ Wave on 2 Meters, ½ Wave, gain on 440 MHz. 100W. No foldover. B or C.

B. MFJ-1412, $39.95.
VHF/UHF RuffRider High Power™. Just 40" long handles full 200 Watts. Great for high power mobile amp. ½ Wave, gain on 2 Meters, ⅝ Wave, great gain on 440 MHz. Black or chrome.

C. MFJ-1422, $44.95.
VHF/UHF RuffRider High Gain™. 41½ inch long antenna gives extra gain with little height increase. Handles 150 Watts. ½ wave with good gain on 2 Meters, ⅝ wave, excellent gain on 440 MHz. Black or chrome.

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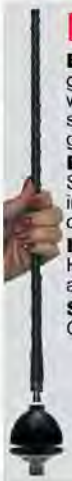
MFJ Mobile HF Ham Sticks



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MFJ-1615T - 15 Meters
MFJ-1612T - 12 Meters
MFJ-1610T - 10 Meters
MFJ-1606T - 6 Meters

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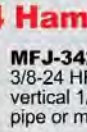

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In addition to the display of antenna properties, SWR curves are plotted quickly, easily and accurately!

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Switch to the amateur band of choice and press "Sweep Center". The chosen band is swept and the SWR graphed in seconds!

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Select the band, select the center frequency, and select the bandwidth. Manually sweep the chosen frequency range and display the SWR graph.

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Manually graph the user defined bandwidth multiple times and see the results overlaid in 5 selectable colors! Make antenna length, position, height above ground, gamma match adjustments, etc…and graph each adjustment in seconds, in a new color, without losing the previous graph!

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Determine velocity factor, coax cable loss in dB, length of coax and distance to short/open.

Read SWR, return loss and reflection coefficient at any frequency simultaneously.

Read inductance (uH) and capacitance (pF) at RF frequencies.

Large easy-to-read two line LCD screen and side-by-side meters clearly display your information.

Built-in frequency counter, Ni-MH/Ni-CD charger circuit, battery saver, low battery warning, smooth reduction drive tuning.

Super easy-to-use! Just set the bandswitch and tune the dial -- just like your transceiver. SWR, Complex impedance displayed instantly!

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MFJ-249D does everything MFJ-259D does with digital display only.

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New and improved. Now covers 280 KHz to 230 MHz and 415 to 470 MHz and 2200 Meter band!

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Read SWR, return loss, reflect-ion coefficient, match efficiency at any frequency simultaneously.

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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).*

New! MFJ-269D **$419.95**

Coax Calculator™ calculates coax line length in feet given degrees and vice versa for any frequency, velocity factor.

Measure SWR and loss of coax with *any* characteristic impedance (280 KHz to 230 MHz) from 10 to over 600 Ohms.

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12-bit A/D converter gives much better accuracy and resolution than common 8-bits -- *MFJ-269D exclusive!*

Built-in frequency counter, battery saver, low battery warning, Ni-Mh/NiCd charge circuit. 4Wx2Dx6¾", 2 lbs. Use ten aA batteries or 110 VAC with MFJ-1312D, $19.95.

MFJ-269DPRO™ SWR Analyzer

MFJ-269DPro, $459.95. Like MFJ-269D, but UHF range covers *430 to 520 MHz*. For commercial work.

MFJ-223 1-60 MHz Color Graphic VNA Analyzer

MFJ-223 **$319.95**

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, it's packed with VNA features and performance you need!

- **Single-frequency** and *swept-frequency* operation
- **Truly accurate** SWR, R, X, and Z measurements
- **Seamless DDS** coverage, 100-Hz resolution from 1-60 MHz
- **Smooth "skip-free"** encoder tunes fast or slow without missing a step
- **Powerful +5-dBm** stimulus generator
- **Field-strength meter**
- **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

MFJ-225 **$339.95**

Out in the field, the MFJ-225 is a compact completely *self-contained handheld 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 de-tailed data analysis and print out stunning color-graphic plots to document your work! Built-in back-lighted *3-inch LCD graphic* display. Make fine adjustments using full-screen easy-to-view SWR bargraph, capture vivid swept displays for SWR, impedance, re-turn loss, phase angle, more. DDS generator.

SWR Analyzer Accessories

A. **MFJ-29D/MFJ-39D, $24.95.** Carrying Pouch for MFJ-259D/269D.

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-7737, $5.95.** PL-259 to BNC Female.

G. **MFJ-7727, $5.95.** PL-259 to SMA Female.

H. **MFJ-5510, $9.95.** 12VDC cigarette lighter adapter.

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The MFJ-993B *IntelliTuner*™ lets you tune any antenna *automatically -- ultra fast.*

MFJ-993B **$299.95** *Full Digital Power!*

It's a comprehensive automatic *antenna tuning center* complete with SWR/Wattmeter, antenna switch for two antennas, wire connection 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.

You get a highly efficient L-network, 6-1600 ohm matching at 300 Watts SSB/CW and digital or *extra-wide* 6-3200 Ohm matching at 150 Watts SSB/CW and digital, 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. 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!* 10Wx2¾Hx9D inches. Use 12-15 VDC/1 amp or 110 VAC with **MFJ-1316, $29.95**. Radio interface cables, remote control available. See ***www.mfjenterprises.com***

made in USA

600 Watt MFJ Automatic Antenna Tuner

MFJ-994B, $379.95. Like MFJ-993B but handles 600 Watts SSB/CW/Digital, matches 12-800 Ohms. 10,000 memories. Doesn't have LCD, antenna switch, balun, audio SWR meter. 10Wx2¾Hx9D inches.

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 . . .

1500 Watt *Legal Limit*

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Roam the entire HF spectrum 1.8- 30 MHz *hands-free* with full *1500 Watt* legal limit on SSB/CW/Digital and near-perfect SWR! Lighted LCD/Cross-Needle Meter.

MFJ-998 **$739.95** *Full Digital Power!*

300 Watt ...Extra Wide Range

SWR/Wattmeter, 10000 VA Memories

Extra *wide matching range at less cost.* MFJ's *exclusive* dual power level: 300 Watts for 6-1600 Ohms; 150Watts for 6-3200 Ohms. Cross-Needle SWR/Wattmeter.

MFJ-991B **$259.95** *Full Digital Power!*

200 Watt ...Compact

Digital Meter, Ant Switch, Wide Range

MFJ-929 **$269.95** *Full Digital Power!*

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. Bright LCD Display.

200 Watt *MightyMite*™

Matches IC-706, FT-857D, TS-50S

Full Digital Power!

MFJ-939KIY **$169.95**

200W SSB/CW and Digital. Low-profile automatic tuner is great for those tiny new rigs. Just tune and talk! Includes interface cable, 2-year warranty. 6½Wx2⅞Hx8⅜D".

MFJ *Remote* AutoTuners

Get greatly reduced losses and high efficiencies with long coax runs and high SWR antennas. *Full Digital Power!*

MFJ-926B, $329.95. 200W.
MFJ-993BRT, $339.95. 300W.
MFJ-994BRT, $459.95. 600W.
MFJ-998BRT, $869.95. 1.5 kW.

G5RV Antennas

Cover 160-10 Meters with antenna tuner. 102 ft. long. Use as inverted vee or sloper, 160 Meters as Marconi. 1500 Watts. Super-strong fiberglass center/feedpoint insulators. *Glazed ceramic* end insulators.

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MFJ-1778M, $59.95. 52'. 40-10M.

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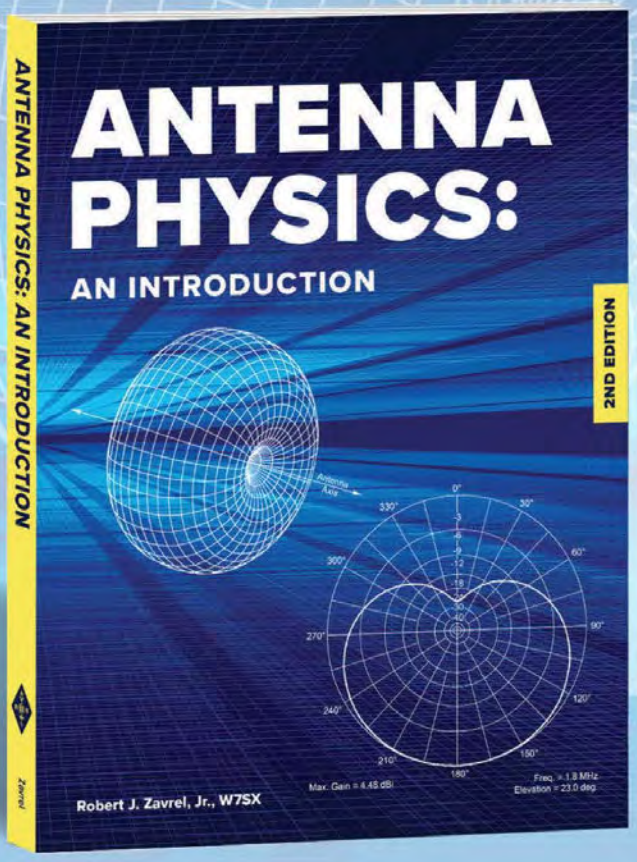

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Ham Radio's Most Popular 300 Watt Antenna Tuner

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Why? Because the world's leading tuner has earned a worldwide reputation for being able to match just about anything.

Full 1.8-30 MHz Operation

Tune your antenna for minimum SWR! Works 1.8-30 MHz on dipoles, verticals, inverted vees, random wires, beams, mobile whips, shortwave receiving antennas...Use coax, random wire, balanced lines. Has heavy-duty 4:1 balun for balanced lines.

Custom inductor switch

Custom designed inductor switch, 1000 volt tuning capacitors, Teflon® insulating washers and proper L/C ratio gives you arc-free no worries operation up to 300 Watts PEP transceiver input power.

MFJ-949E $219.95

The MFJ-949E inductor switch was custom designed to withstand the extremely high RF voltages and currents that are developed in your tuner.

8-Position Antenna switch

Antenna switch lets you select two coax fed antennas, random wire/balanced line or dummy load through your MFJ-949E or direct to your transceiver.

Lighted Cross-Needle Meter

Full size 3-inch lighted Cross-Needle Meter. Lets you easily read SWR, peak or average forward and reflected power simultaneously. Has 300 Watt or 30 Watt ranges.

QRM-Free PreTune™

MFJ's QRM-Free PreTune™ lets you pre-tune your MFJ-949E off-the-air into its built-in dummy load! Makes tuning your actual antenna faster and easier.

Plus Much More!

Full size built-in non-inductive 50 Ohm dummy load, scratch-proof Lexan multi-colored front panel, $10^5/_8$ x $3^1/_2$ x 7 inches. Superior cabinet construction and more! **MFJ-948, $189.95.** Econo version MFJ-949E. Has all features except for dummy load.

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More hams use MFJ tuners than all other tuners in the world!

MFJ-989D Legal Limit Tuner

MFJ-989D $469.95

New, improved MFJ- 989D legal limit antenna tuner gives you better efficiency, lower losses and a new true peak reading meter. Easily handles full 1500 Watts SSB/CW, 1.8-30 MHz, including MARS/WARC bands. Six position antenna switch, dummy load. New 500 pF air variable capacitors. New improved AirCore™ Roller Inductor. New high voltage current balun. New crank knob. $12^7/_8$W x 6H x $11^5/_8$D inches.

MFJ-986 Two knob Differential-T™

MFJ-986 $419.95

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. $10^3/_4$W x $4^1/_2$H x 15 in.

MFJ-962D Compact kW Tuner

MFJ-962D $359.95

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. $10^3/_4$ x $4^1/_2$ x $10^7/_8$ 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 $259.95

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, $149.95.** Tuner Kit -- Build your own!

MFJ-941E $169.95

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 8 x 2 x 6 in. Lighted Cross-Needle SWR/Wattmeter. Lamp and bypass switches. Covers 1.8-30 MHz and 6 Meters. 300 Watts PEP. **MFJ-20, $9.95**, mobile mount.

MFJ-945E $159.95

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 x $6^1/_2$ x $2^1/_2$ in.

MFJ-971 $149.95

MFJ-901B Smallest Versa Tuner

MFJ's smallest (5 x 2 x 6 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 $119.95

MFJ-902B Tiny Travel Tuner

Tiny $4^1/_2$ x $2^1/_4$ x 3 inches, full 150 Watts, 80-6 Meters, has tuner bypass switch, for coax/random wire. **MFJ-904H, $169.95**. Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. $7^1/_4$ x $2^1/_4$ x $2^3/_4$ inches.

MFJ-902B $129.95

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 2 x 3 x 4 in.

MFJ-16010 $79.95

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, $59.95**

MFJ-9201 $59.95

MFJ-921/924 VHF/UHF Tuners

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8 x $2^1/_2$ x 3 in.

MFJ-921/924 $109.95

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, $249.95**, Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

MFJ-931 $129.95

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The control head is detached and comes with remote cable for easy installation. The TM-D710G is a true dual-band operation radio so VHF+VHF/VHF+UHF/UHF+UHF operation is possible.

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MFJ Dummy Loads & SWR/Wattmeters

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, $59.95.** With type "N" connector.

MFJ-260C $49.95

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, $109.95.** With type "N" connector.

MFJ-264 $89.95

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, $69.95.** No transformer oil.

MFJ-250 $79.95

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, $69.95.** PL-259. 35 Watts continuous, 200W for 5-seconds. SWR< 1.2;1 DC-1 GHz.

MFJ-261 $34.95 *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 $249.95

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, $19.95**.

MFJ-251 $169.95

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.

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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 $179.95

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, $69.95.** 140-525 MHz, 15/150W.

MFJ-822 $69.95

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, $199.95.** No meter, ampr bypass, control relay.

MFJ-828 $269.95

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, $89.95.** 1.6-60 MHz. 30/300/3000 Watt ranges. **MFJ-874, $129.95.** 1.8-525 MHz. 5/20/200 Watt ranges.

MFJ-870 $89.95

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, $19.95.** 7W x 5½H x 5D in. SO-239s.

MFJ-868B $179.95

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 $49.95

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, $114.95.** 125-525 MHz, 0-120W. **MFJ-849, $189.95.** Large 3.5" bright orange LCD displays SWR, forward/reflected power. 1.5-525 MHz, 200W, HF/VHF-UHF switch.

MFJ-845 $114.95

MFJ-849 $189.95

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 $49.95

VHF/UHF SWR/Wattmeter

Lighted Cross-Needle,SWR/Watts,144/220/440 MHz, 30/300W Forward power, 6/60W Reflected power.

MFJ-862 $79.95

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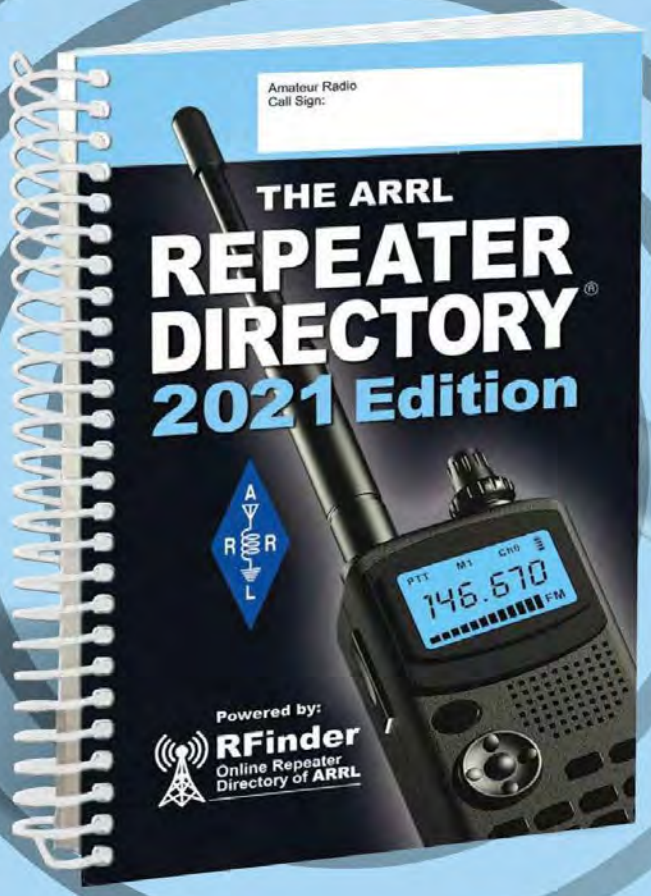

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Turn your SDR into a panadapter to see entire bands on frequency/waterfall displays...

New!

An inexpensive wide-band SDR dongle receiver lets you see entire bands on frequency/waterfall computer displays!

MFJ-1708B-SDR
$119.95

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-1708B-SDR 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 switches MFJ-1708B-SDR. For HF/VHF/UHF. Monitor multiple bands with multiple SDRs and a multi-coupler.

MFJ-1708B-SDR-S, $129.95. SMA connector for your SDR.

MFJ-1708SDR, $99.95. 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 500 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.

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Receives 25-1300 MHz

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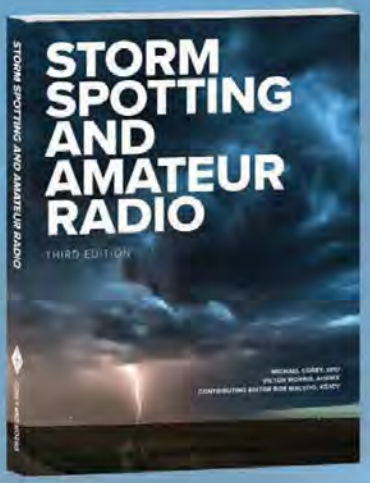

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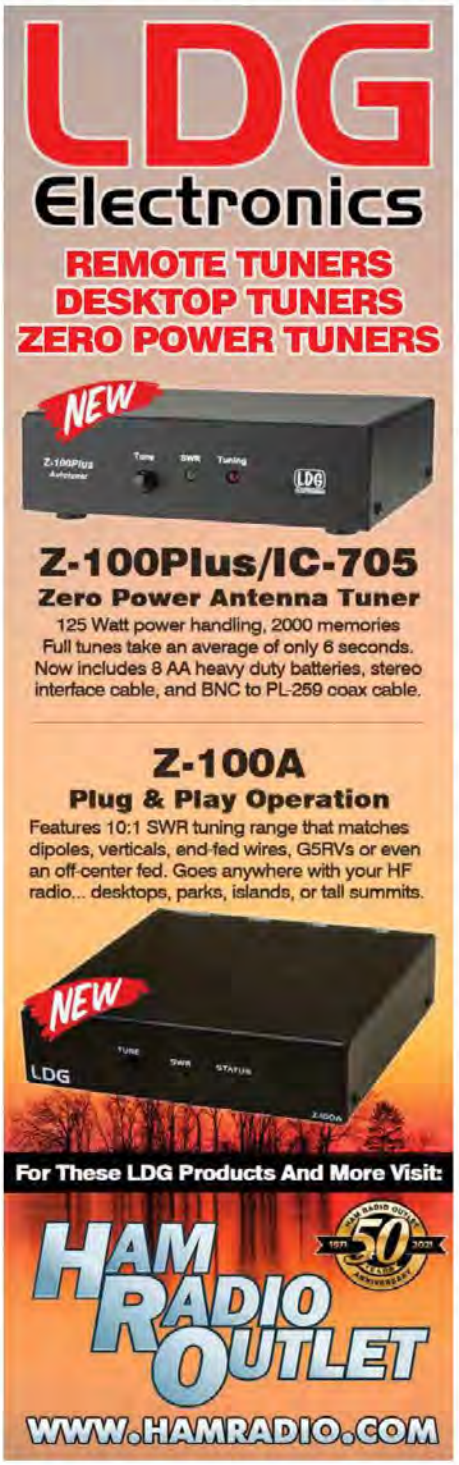

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