Build a Broadband Transformer for 1.8 – 54 MHz Page 38

QST

DIGITAL EDITION

ARRL the national association for amateur radio®
January 2021 www.arrl.org
DEVOTED ENTIRELY TO AMATEUR RADIO

Winter Pursuits

QST Reviews

FlexRadio Systems Power Genius XL Amplifier

PreciseRF HG3 Stepper Magnetic Loop Antenna

Dr.Duino Explorer Edition Arduino Project Kit

Pacific Antenna Tracer Injector Kit

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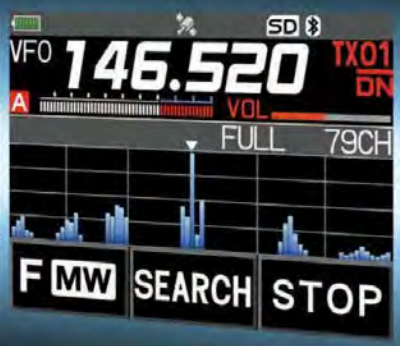

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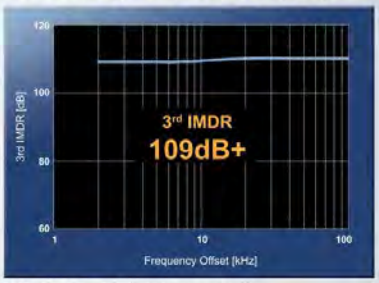
- **2kHz BDR 141 dB+**

14MHz Band Blocking Dynamic Range (BDR)

- **2kHz 3rd IMDR 109 dB+**



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R8, $599.95. Like R9 antenna but less 75/80 Meters.

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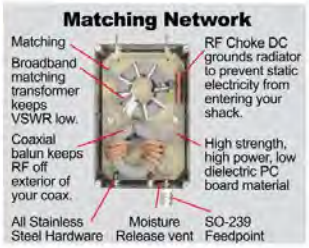
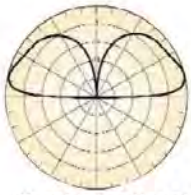
R-8GK, $79.95. Three-point guy kit for high winds.





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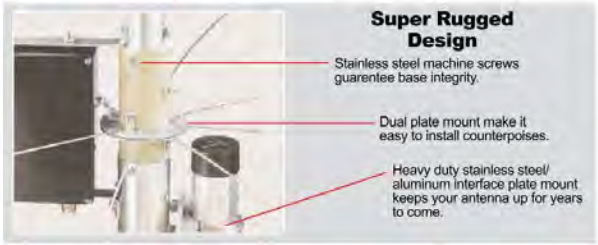
Low angle radiation gives incredible worldwide DX.



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CAA-500MarkII Antenna Analyzer

1.8-500MHz

The CAA-500MarkII combines the simplicity and accuracy of an analog instrument, PLUS…a full color LCD graphic display Resistive (R) and Reactive (X) components of impedance graphed and displayed numerically SWR readings in both graphic and numerical results.

Functions:
In addition to the display of antenna properties, SWR curves are plotted quickly, easily and accurately!

Auto band-sweep function:
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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QST

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Write for *QST*

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

Our Cover

Members of the Rochester VHF Group and local clubs participated in the January 2019 VHF Contest to help commemorate the Rochester VHF Group's 70th anniversary. This photo was taken at the four grid squares east of Syracuse, New York. Rovers around the Great Lakes often travel in packs for contests because they're allowed to work others (and each other) multiple times from different grids. They set up in key spots and work other rovers who are circling the lake on the other side, in a practice known as "grid circling." [Jeff Jensen, N2MKT, photo]

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NEW

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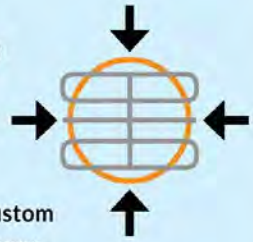
5 NEW THINGS

FROM STEPPIR IN 2021

STEPPIR PACKAGED SYSTEMS (SPS) ANNOUNCEMENT



SteppIR has for the last 20 years, custom built each individually ordered antenna, on a first in / first out, assembly line basis. Our perceived benefit to the customer was that they would be able to custom order exactly what they wanted, nothing more, nothing less. What we did not realize, was that most of our customers wanted to purchase nearly every option for an antenna anyway. Unfortunately, in order to create a new system we first had to vastly improve our inventory control, tracking and purchasing systems. After 3 years of top to bottom improvements in those areas and a lot of hard work by our team, we are proud to introduce the new SteppIR Package Systems (SPS) program! Starting in 2021, we will begin selling our antenna systems in complete packages, which will allow us to build specific antenna "groups" and create on-hand inventory, resulting in much shorter delivery lead times for our customers. Further, the SPS bundles will reflect a discounted price of 5% off list prices, resultingin both time AND cost savings to our customers.

EUROPEAN SUPPORT & WARRANTY CENTER

steppIREurope

We are pleased to announce that SteppIR Communication Systems has implemented a product support and service center, located in Italy through our partners SteppIR Europe (www.steppireurope.com). Now, current customers and new customers alike can rest assured that there is a local expert to take care of all warranty and non-warranty repairs for SteppIR customers. SteppIR Europe also offers onsite antenna assembly services and custom installations.

JOIN US FOR WINTER FIELD DAY JANUARY 30-31, 2021

Saturday January 30th – Sunday January 31, 2021, The SteppIR Amateur Radio Club (WB7IR) will be participating in a winter emergency communications contest, sponsored by the Winter Field Day Association. For more information on participating, check out their website (www.winterfieldday.com) for rules and other information. Come on out for some fun in the... snow?

What if?

Experts are saying that solar cycle 25 is upon us - which would be great news for all Ham Radio operators! With improved band conditions in mind, we have been dreaming a bit here at SteppIR about the possibilities for folks with tougher logistics when it comes to putting up antennas – could a smaller, yet still high performing Yagi, offer a remedy for those with limited space? We envision a simple, single feed, short boom 2E Yagi with elements under 20 feet in total length – covering 20m, 17m, 15m, 12m, 10m and 6m. If that sounds interesting, we would welcome feedback at sales@steppir.com

NO PRICE INCREASE IN 2021!

SteppIR had planned an unfortunate price increase on all SteppIR consumer products for 2021, due to significant upward changes in our cost on just about every item we use in the manufacturing of our products. However, reviewing our situation and also that of the world as we go through these unprecedented times, we decided we wanted to be the bearers of good news, so we are NOT raising prices in 2021, and of course in regard to our SteppIR Packaged Systems (SPS), the price will decrease by 5%.

steppIR COMMUNICATION SYSTEMS

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When it comes to quality and performance, DIAMOND ANTENNA is the worldwide leader in VHF/UHF base and mobile antennas.

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

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

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X700HNA Special Features:

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- Type-N cable connection
- Wideband performance
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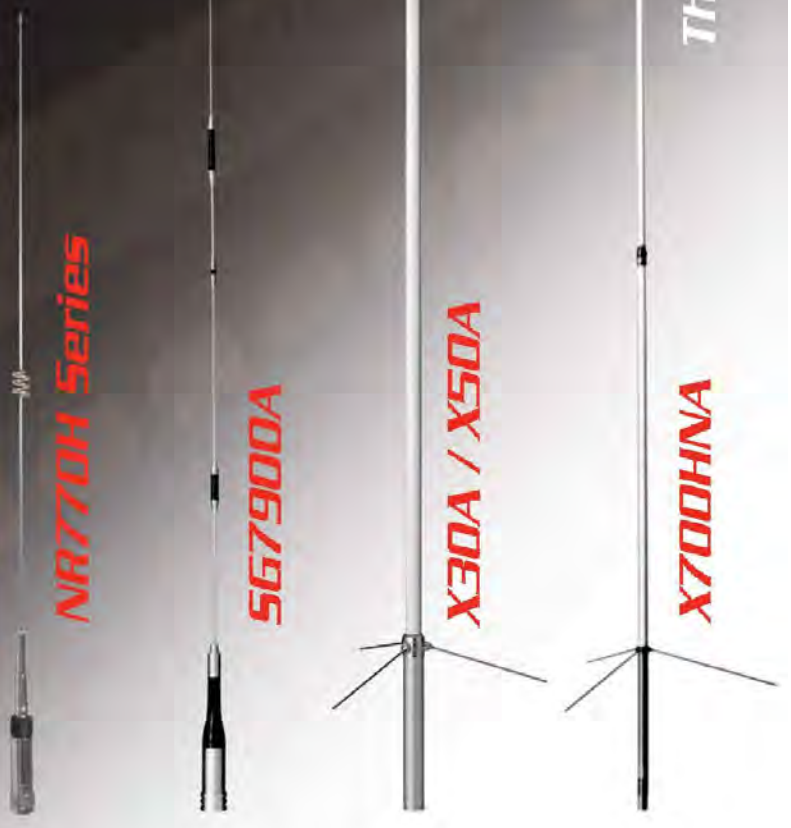
Here is a small sample of our wide variety of antennas

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



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Second Century

A Culture of "Yes"

2020 was a year that nobody saw coming. By the time you read this, that long year will be drawing to a close. We have a new year to look forward to, and ARRL has a new CEO. As I wrote on my Facebook page shortly after I was named ARRL CEO: Every day — every single day — I think about amateur radio. This isn't just a hobby to me. It is my community. It is where most of my friends are from — some spanning decades of friendship, and thousands of miles in distance. Amateur radio is where I discover new things, and it is where I dream. This is my dream job — to work with ARRL, its leadership, and its vast reach of members to continue driving excitement, involvement, experimentation, and public service in the hobby.

I am honored and blessed to take on the job of leading this wonderful organization through a digital transformation of its second century, so we can continue to attract, engage, and develop radio amateurs. ARRL is late to embrace digital transformation — but not too late. We're adapting at a time when the technology, software, and access are all well known, battle tested, and ubiquitous. As we begin to achieve this transformation, members will notice new ways to interact with ARRL across areas of entertainment, education, and information. We'll strike an appropriate and targeted balance for publishing content, whether digital or in print. We will also be looking at the community to partner in creating video content, an area in which user-generated content continues a meteoric rise.

ARRL leadership is also going through a transformation, and a rebuilding of trust with the membership. We are all aware of the issues that caused consternation in the past, and we live in a time where "If I read it on the internet, it must be true" reigns supreme. Even during this difficult year, you can be assured that the ARRL Board showed the highest levels of professionalism, resourcefulness, and tenacity in getting both the CEO and Director of Emergency Management positions filled. I am very grateful for the relationships I have built with the Board members, and especially ARRL President Rick Roderick, K5UR, for his mentoring and guidance. It's worth pointing out that ARRL officers and Board members are all volunteers; they are your "first among peers," representing you and all of the good works of ARRL — most of which our members rarely, if ever, hear or read about.

As ARRL looks forward, we're looking at everything that surfaces in our community and industry — from every product to every forum comment — through the lens of, "Is this good for amateur radio?" It's easy to look back and find reasons to be critical. Instead of merely criticizing, which closes the door on potential and opportunity, we'll be asking questions: Is FT8 attracting new interest in on-air operating? Does the proliferation of YouTubers in the hobby represent a new way of mentoring or Elmering? Can simple rule modifications to operating events and contests help to expand participation during the pandemic? Do digital radio hotspots increase the utilization of our global network of repeaters? Does curating and housing a collection of antique radios and accessories serve something valuable now and for the future? In all cases, *yes*! All of these, and more, drive up radio activity, education, entertainment (fun), and innovation in the hobby.

With that in mind, we are changing the culture of ARRL to one of boundless enthusiasm, inclusion, and a renewed focus on the needs and wants of our members, with a bias toward saying "yes" and taking action. You'll see our resolve in the introduction of new products and offerings such as changes to our website, our learning and training platforms, our expanded view into the use of computer and internet technologies in the shack, and efforts to make the hobby dramatically, intentionally more inclusive, whether it's by more effectively welcoming newcomers, providing better accessibility for hams with disabilities, or any number of things that will increase excitement about ham radio among the people who love it. This is our community, and ARRL will be doing more to show how truly great it is — with your help.

Here's where that opportunity starts: The **ceo@arrl.org** email address gets very little feedback from members. I make an effort to answer every single email I receive. I also make it a habit to reach out via email to those who express concerns publicly regarding some aspect of ARRL. I urge you to take positive action. Before ranting, reach out. Give me — give us — the chance to find a way to work with you.

In closing, for 2021, I wish you a very happy and healthy New Year, and may God bless you and your family.

David A. Minster, NA2AA
Chief Executive Officer

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AV-680

80-6 Meters

hy-gain's new AV-680 adds 75/80 Meters with no radials!

Includes 40, 30, 20, 17, 15, 12, 10 and 6 Meters operation with low 17 degree radiation angle and omni-directional world-wide coverage. No ground or radials needed. Handles full 1500 Watts key down continuous for two minutes.

Highly Efficient

The AV-680 uses quarter wave stubs on 6, 10, 12 and 17 Meters and very efficient end loading coil and capacity hats on 15, 20, 30, 40 and 80 Meters -- no traps. End loading allows efficient operation with a low profile. Resonators are placed in parallel not in series.

Each band individually tunable

Extra wide low VSWR bandwidth. End fed with broadband matching unit. Single coax cable feed. Automatic bandswitching.

Sleek and low-profile

Low 2.9 sq. ft. wind surface area. Small footprint for mounting easily on decks, roofs and patios. 26 feet, 18.5 lbs.

Built-to-last

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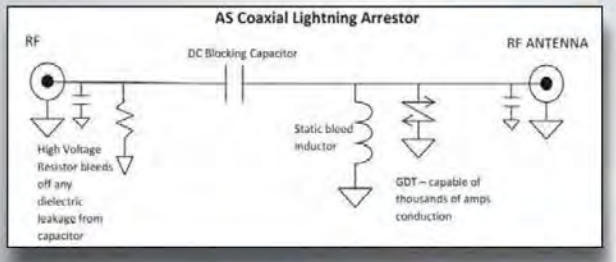
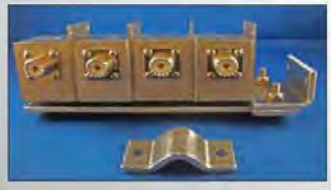
AS-303U





Hamation Station Automation

Hamation remote and Local Station Control products allow you to automatically or manually select antennas, bandpass filters, and control accessories. Accessories can be StackMatches, Antenna switches, antenna phasing systems, SteppIR controller, turning radios on and off, etc. All of this can be done directly from the Ethernet as well!

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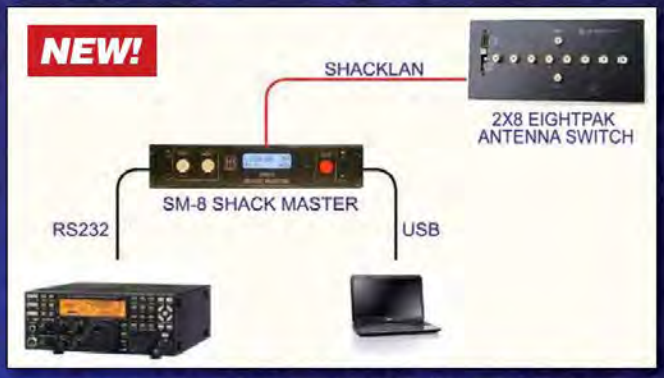

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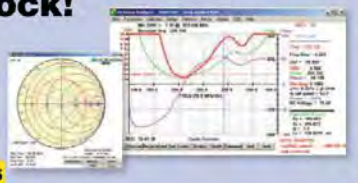

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The original, not the imitations. For phasing 2, 3, 4 and even 6 antennas. Also it can be used to combine vertical and horizontal polarized antennas to diminish fading.

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Becky R. Schoenfeld, W1BXY, bschoenfeld@arrl.org

Member Spotlight

Billy Irwin, K9OH

If the ham radio community, like the business world, made an annual list of achievers under the age of 40, Billy Irwin, K9OH, would be on it. Just a selection of his accomplishments — he's been a National Weather Service volunteer since age 12, he has three repeaters on the air in South Carolina, he's installed public safety repeaters that have been operational for 20 years, he's worked on public safety communications networks throughout North Carolina and South Carolina, and he's the South Carolina Section Emergency Coordinator. And, Billy is only 38.

Billy has been a ham for 20 years, but his interest in radio started before that, with CB and public safety scanners. Upon seeing Billy sneaking a look at a radio hidden in his jacket, his 10th-grade English teacher said, "I think you should talk to my husband." The husband turned out to be the County Emergency Manager, and by the time Billy was in 11th grade, he was doing IT work in the county's office.

"They immediately took an interest in me," Billy said. "I understood RF. I started working on some of the public safety radios and got my ham license."

Early Career and Mentors

Upon graduating high school, Billy was hired as the county's IT director. He was based at the number one dispatch center, because he was familiar with all the radios and the IT infrastructure. He also handled all the other county departments.

While working full-time, he also managed to do volunteer 911 dispatch, and become involved in ARES.

"I always held an ARES leadership position from the time I got licensed until the present," Billy said. He credits one of two ham radio mentors with getting him involved in ARES. "Lee Marion, W8CGQ, saw I had an interest in SKYWARN, and he said, 'You're my assistant emergency coordinator.' I was a young, nervous kid — 18, maybe 19. I enjoyed doing it. Lee was the one who showed me how to work with people. He's still very much around; I talked to him just the other day."

Billy's other mentor was Ralph Crossley, KG4LCW (SK), a neighbor in his 60s. They had a shared interest in radio — Ralph got licensed after Billy did — but something else brought them together. Ralph was losing his eyesight, and Billy has been visually impaired since birth.

"There was an interesting trade-off," Billy said. "I taught him how to survive visually impaired, and he taught me how to work with tools."

Navigating the World

Billy was born with a rare, degenerative retina condition called Leber's congenital amaurosis. He was diagnosed at the age of 3, and enrolled in the South Carolina School for the Deaf and Blind, where he learned how to function as a blind person, even though he could still see to a degree where he was able to learn to read. Billy has been preparing from a young age for the eventual loss of his eyesight.

As his sight has decreased, his employment has transitioned primarily to IT work — he's currently a senior network technician at Clemson University — but he has still consulted on public safety for various counties in North Carolina and South Carolina, and continued to hold ARES leadership positions.

Getting Connected

He became the South Carolina Section Emergency Coordinator in 2016, after holding several Emergency Coordinator positions in various counties, and having been the District Emergency Coordinator for the SKYWARN program at the National Weather Service Greenville-Spartanburg Office. Though he says there are challenges that come with being a visually impaired SEC, he enjoys getting the job done.

"We build a lot of really good partnerships," he said. "Our ARES program is extremely well connected at the state and local level and is constantly being integrated into the emergency plan. We're very fortunate."

Billy also feels fortunate in everything he's been able to contribute to the community. He feels that he's garnered respect despite his disability, and uses that to encourage other people toward success.

"When people tell me 'I can't do that,' I say, 'I learned to do it and I'm blind, so what's your excuse?'" he said. "Amateur radio brought me every single piece of employment I ever had. So my idea of volunteering is a way to give back to a hobby that has given me so much."

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Up Front

Keeping it in the Family

Jim Mayercak, WX8J, set up a portable operation from Columbus, Ohio, with an Elecraft KX3 and a homebrew vertical inspired by Les Cebik, W4RNL. Fascinated by the rhythm of the CW signals, Jim's 2-year-old grandson, Noah, climbed up to help with the operation.

Celebrating with Morse Code

Allen Shirley, N4NN, received several amateur radio-related gifts from his wife for their anniversary, including two call sign shirts and caps, but what won the day was the metal and leather tag imprinted with an anniversary message in code. To top it off, she wrote and signed her card in code.

An Antique Key

Joe White, KW4YW, found this setup in a local antiques mall. Initially drawn in by the Speed-X key, he also discovered the homebrew side swiper/bug key, which works but requires close attention. The reverse of the mounting board has a net control call sign inked in, along with directions to a hotel that serves sandwiches and coffee.

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Correspondence

Letters from Our Members

It's Never Too Late to Get Back on the Air

I've been a ham since 1959 and have loved every minute of it. I spend most of my time on CW, but also operate using SSB and EchoLink. When I was in ninth grade, I heard a young girl talking to a ham in South Dakota. It turned out that she and I went to the same school, although she was 2 years older than me. She invited me to come see her station — a Heathkit DX-40 transmitter and an RCA AR-88 receiver. We lost touch after I earned my license and she went away to college. Shortly after that, she let her license expire.

It wasn't until 4 years ago that I reconnected with her on Facebook. We started talking about ham radio and I was able to "re-spark" her interest in the hobby. She studied hard and passed the tests for her Technician-, General-, and Amateur Extra-class licenses all in one day, only missing one question! I'm so proud of her accomplishment. She has once again joined the ham radio ranks with the call sign KY4AV. Congratulations and welcome back, Vivian!

Bob Eveslage, W0NYA
New Ulm, Minnesota

ARRL is More Than *QST*

I've been a ham for over 60 years. Over the years, many people perceived ARRL as just a magazine, notwithstanding the many other benefits the organization offered. People didn't ask if I was a member; they asked if I "took *QST*." But there's more to ARRL membership than that. Congratulations on the new publication, *On the Air*. This publication, plus the now free online editions of *NCJ* and *QEX*, make it obvious that ARRL is so much more.

John Raydo, K0IZ
Kansas City, Missouri

Evergreen Articles in *QST*

I live in the middle of a large city and have always been plagued by noise on the 40-meter band. At times the noise level would be 20 dB over S9. A few years ago, I built a two-turn, 31-inch diameter, shielded resonant loop with a built-in preamplifier for receiving. I mounted the loop vertically, about 12 feet above ground, but even when I rotated it for minimum noise, I could only obtain about 1 S-unit of reduction.

In the "100, 50, and 25 Years Ago" column from the October issue of *QST*, the article, "A Receiving Antenna that Rejects Local Noise," written by Brian Beezley, K6STI, was mentioned as being printed in the 1995 September issue. The article states that local noise signals are primarily vertically polarized and that a horizontally polarized antenna is needed to reject noise. Beezley even shared that a horizontal small loop would effectively reject noise. That being said, I remounted my loop horizontally and was astonished by a 5 S-unit reduction in noise. The horizontal loop is omnidirectional and rejects noise from all directions. Signals that were completely covered by noise are now clearly heard. Thank you for reminding us of past articles — they are often of great value!

Don Becker, K0EJV
Lincoln, Nebraska

QSLing Today

Years ago, when I was raising my kids, I was lax on sending QSL cards. Now that there's Logbook of The World (LoTW), I upload my paper logs into its database. My logs are now on LoTW, eQSL, Club Log, and QRZ. A few hundred paper QSL cards were sent via the QSL bureau before COVID-19 slowed the delivery of mail, but I enjoy seeing the old confirmations from other stations, both local and DX, that show up when I check the LoTW download.

Pat Hamel, W5THT
Long Beach, Mississippi

Benefits of the Digital Editions

ARRL members who enjoy visiting the websites found in *QST* articles will really like the digital editions of ARRL's magazines. I haven't tried them all, but the links in articles are clickable. It's a benefit to not only be able to read the article, but visit websites with one click. You can read the print edition with the digital edition open online to access the links, or just read it online. It's definitely better than typing in the URL for each link. There's real value in visiting websites that you might spend hours searching for on your own.

Mike Laird, W9LME
Logansport, Indiana

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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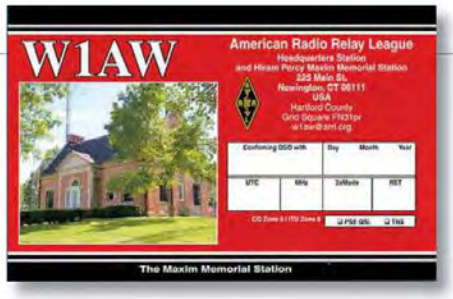

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CW-ELMER — An Advanced Morse Code Learning System

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.

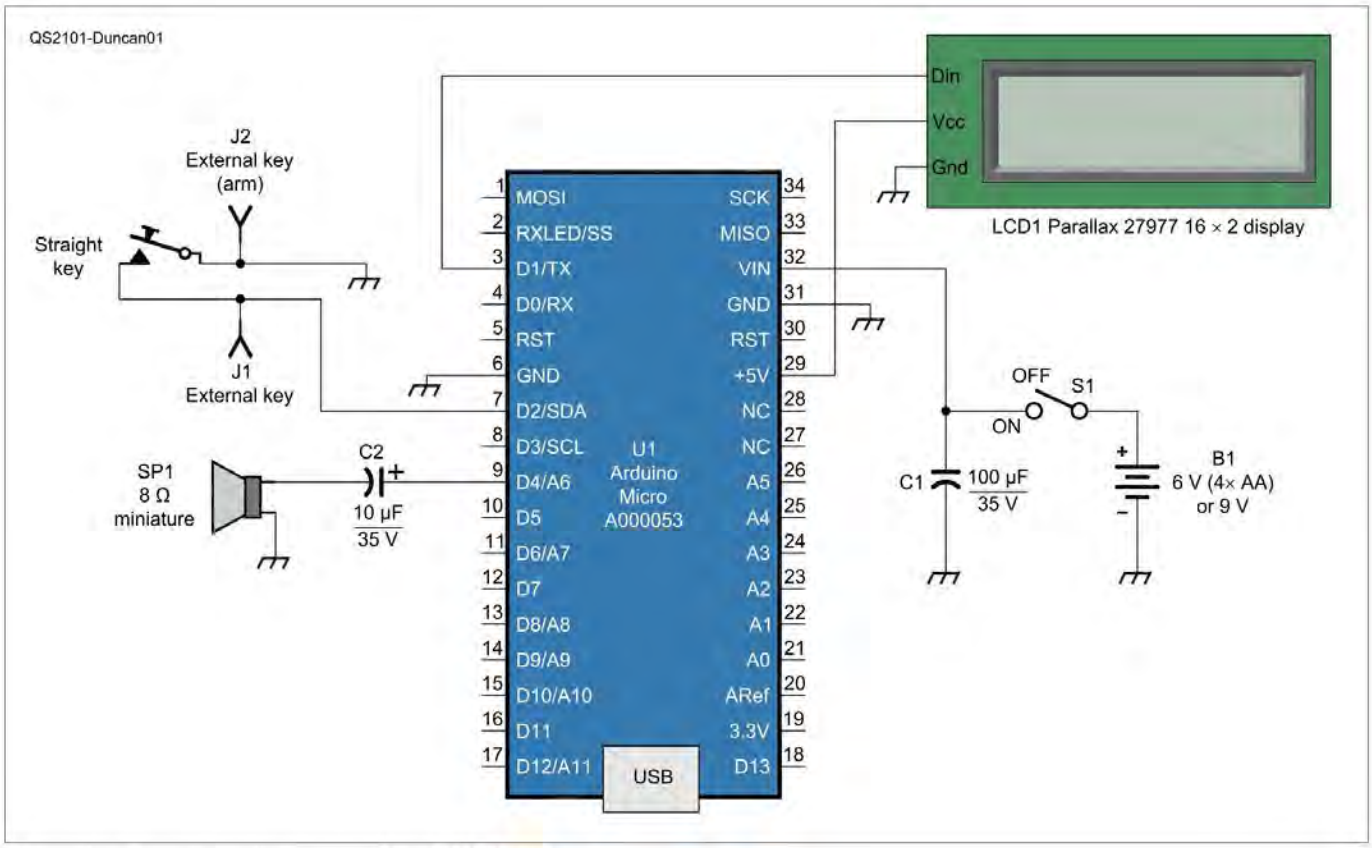

Figure 1 — The schematic diagram of the CW-ELMER.

B1 — Battery, alkaline, 4 × 1.5 V AA, or 9 V, with connector
C1 — Capacitor, 100 µF 35 V electrolytic (Digi-Key P19544TB-ND, Panasonic ECA-1VHG101I)
C2 — Capacitor, 10 µF 35 V electrolytic (Digi-Key P19549TB-ND, Panasonic ECA-1VM100I)
LCD1 — Display, LCD, 16 × 2 alphanumeric, serial interface (Digi-Key 27977-ND, Parallax 27977)
S1 — Switch, rocker, SPST (Digi-Key CH755-ND, ZF Electronics SRB22A2FBBNN)
S2 — Morse practice straight key (Ham Radio Outlet part Ameco K-1R)
SP1 — Speaker, miniature 8 Ω (Digi-Key 458-1129-ND, Mallory SonalertPSR-36N08A-JQ)
U1 — Microcontroller, Arduino Micro (Digi-Key 1050-1066-ND, Arduino A000053)
Misc. — Case, plastic, approx. 7"× 3" × 1.5" (Digi-Key HH-3400-BC-ND, Bud Industries HH-3400-BC for 9 V battery)

Figure 2 — The key is mounted on the case top, and interior houses the speaker, Arduino, and LCD. The bottom holds the battery pack and **ON/OFF** switch.

Software Setup

Consult the many available online resources about installing and using the Arduino IDE program on your computer. Once the Arduino IDE is installed, download the file *CWE30.ino* from **www.arrl.org/QST-in-Depth**. This file must be the only file located in a folder named *CWE30* for the IDE to properly recognize and load it as an Arduino sketch. Connect the CW-ELMER Arduino USB port to your computer's USB port using a suitable USB data cable, then open the IDE application, and set the IDE **TOOLS: BOARD** to **ARDUINO MICRO**. Also set **TOOLS: PORT** to whatever serial port is assigned to your CW-ELMER Arduino.

Open the CW-ELMER sketch using the IDE **FILE: OPEN** command, locate and select the *CWE30.ide* file downloaded earlier, and click **OK**. Click on the **VERIFY** button to test the sketch for errors. A message stating, "Low memory available: stability problems may occur" may appear; that is okay, as CW-ELMER will run with

the available resources of an Arduino Micro. If a message stating, "Not enough memory; …," appears, or other faults are reported, verify the correct board is selected. If a fault in the code is detected, the IDE will highlight any line on which an error is found.

When the verify test completes without error, click on the **UPLOAD** button in the IDE to transfer to your CW-ELMER and automatically begin running.

Format the EEPROM

At this point, CW-ELMER may not behave as expected, with random characters displayed and not responding correctly to the key. To correct this, the EEPROM of the Arduino must to be formatted and default parameters loaded.

To prepare the EEPROM, either press and hold the key while depressing the Arduino **RESET** button, or disconnect your CW-ELMER from the computer USB and turn the power switch off, then press and hold the key down while restoring power. When formatting is completed, the message [Format EEPROM] / [READY] will display. Release the key, and CW-ELMER should run properly and be ready for use. Repeat this procedure if needed to restore the default settings.

The default settings for CW-ELMER are:

QRZ (call sign) = *"K7DUN"*

WPM (receive and send rate) = *15 words/minute*

DitTime (duration of DIT tone) = *80 ms*

MidTime (threshold time, equals two DIT times) = *160 ms*

DahTime (duration of DAH tone, equals three DIT times) = *240 ms*

CharSet ('Alpha only', 'Alpha+Number', or 'Alpha+Number+Punctuation') = *Alpha only*

CW Pitch (DIT and DAH audio frequency) = *700 Hz*

You can use the functions in the **OPTIONS** menu to change these values if desired.

Silent Mode

A hidden feature included in CW-ELMER is silent mode, which disables audio functions that you may find distracting. Functions such as receive and CW pitch are disabled in silent mode; all other functions operate normally except for sound.

To enable silent mode, power on the CW-ELMER. When the QRZ and version text are displayed, but before QRZ sounds in Morse, press and hold the key during this 1-second delay. CW-ELMER will acknowledge with [SILENT MODE] on the display until the key is released.

Main Menu

CW-ELMER completes initialization, then starts the Main Menu. Items in CW-ELMER menus are presented sequentially, first to last, pausing for 2 seconds on each item, then loop back to first and repeats. To make a selection, press the key while the desired item is displayed.

A few menus are shown here, and the rest of the menu details are on the **www.arrl.org/QST-in-Depth** web page.

- [CW-Elmer MENU] / [SENDING]
- [CW-Elmer MENU] / [RECEIVING]
- [CW-Elmer MENU] / [ANALYZE]
- [CW-Elmer MENU] / [EXERCISES]
- [CW-Elmer MENU] / [OPTIONS]

Menu / Sending

In sending mode, press the key and CW-ELMER sounds a tone. Release the key to stop the tone. But CW-ELMER expects you to key something more or less resembling Morse code, so it attempts to interpret and display what you keyed.

A value called MidTime is set equal to two DITs at the selected WPM rate. CW-ELMER measures each key press and compares that to MidTime. A key pressed for less than MidTime is interpreted as a dit, if longer than MidTime, it considers that a DAH was intended. CW-ELMER also measures the pause time between key presses. When a pause longer than three dits is detected (end of character), CW-ELMER calculates a numerical value based on the presence and order of the dits and dahs, and uses that calculation to select a character from a lookup table for display on the lower row.

Keyed characters are also displayed on the upper row in classic dot/dash (.-.--.-) form. This may help you see where your keying was off (QSD) if the interpreted character appears incorrect.

Sending will repeat as long as characters are keyed in. However, if the key is held down for more than 5 seconds, Sending terminates and returns control to the Main Menu.

Menu / Receiving

In receiving mode, you first select the character set you want to focus on: alphabet, numbers, and punctuation; alphabet plus numbers, or alphabet only. Selecting **CANCEL** in that menu will continue with whichever set was previously used, and not save any changes to the EEPROM memory.

CW-ELMER then sounds groups of three to seven randomly selected characters at the current WPM rate. You have 5 seconds to copy the characters heard before they are revealed. After that, you have another 5 seconds to compare your copy. A prompt is displayed: [ ] / [KEY now to exit]. Press the key to return control to the Main Menu, or not to continue with another group of three to seven different characters.

Menu / Analyze

In sending mode, CW-ELMER records various statistics about your key presses as you enter code. Selecting **ANALYZE** displays this information in a number of screens, to help you develop consistent key timing, or recognize where you need practice. Each screen is displayed for 5 seconds, or it may be advanced by pressing the key.

The first four screens display information about key presses detected as dits during sending practice.

The next four screens display similar information for key-presses detected as dahs.

CW-ELMER then calculates the equivalent WPM rate using the formula

WPM = integer (2,400 / (ditAvg) + (dahAvg / 3)).

- [WPM RATE 15] / [MEASURED 15]
- [RESET KEY DATA] / [KEY to OK]

Press the key at this time to clear accumulated statistics, otherwise values will continue to accrue when you return to sending mode. Control then returns to the Main Menu.

Menu and Exercises Menu

CW-ELMER employs the PARIS timing scheme, where the basic unit of time is the dit, and a dah is three dits long. Intra-character pauses are one dit long; pauses between letters in a word are equal to three dits, and a seven-dit pause marks the end of each word. A properly keyed PARIS message, plus the end-of-word pause, is exactly 50 dits in duration, and is a standard for determining WPM rates. Available exercises are:

- [EXERCISES] / [DIT Tone]
- [EXERCISES] / [DAH Tone]
- [EXERCISES] / [IntraChar Pause]
- [EXERCISES] / [Character Pause]
- [EXERCISES] / [Word Pause]
- [EXERCISES] / [Cancel]

Menu and Options Menu

The options include settings that may be altered to make CW-ELMER operate according to your level of skill, or personalized as you wish. All options may be saved to the Arduino EEPROM, to be restored when next powered on.

- [SELECT OPTION] / [Select WPM Rate]
- [SELECT OPTION] / [Select Char Set]
- [SELECT OPTION] / [Select CW Pitch]
- [SELECT OPTION] / [Edit QRZ]
- [SELECT OPTION] / [Cancel]

Figure 3 shows the author's favorite straight key attached across the key built into the CW-ELMER.

Figure 3 — The CW-ELMER with an external key attached.

Photos by the author.

David Duncan, K7DUN, earned his Amateur Extra-class license in 2015 soon after getting his Technician-class license, KG7RFK. In 1968, he studied physics at the University of Alaska in Fairbanks. His career includes a stint as a process photographer for a book publisher. David founded Photoelectronics, a producer of measurement and monitoring equipment for photographic darkrooms. He earned journeyman CET certification in 1975, and was a service department manager in Samoa and Fiji for a reprographics equipment distributor. He joined Tektronix in 1980 as a systems staff engineer. In 1991, he joined Providence Health & Services as a biomedical technician, and retired 25 years later. You can reach David at **k7dun@arrl.net**.

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An Arduino-Based Antenna Rotator Controller

A lightweight rotator is updated with a simple digital controller.

Giovanni Carboni, IZ5PQT

Recently, I purchased a lightweight antenna rotator of the type used for TV antennas. It is a "New Old Stock" Hirschmann Hit Ro 250 (see Figure 1). I thought that I could use it to orient a simple VHF Yagi or the small untuned loop (see the lead photo) that I use for MF and HF reception. These rotators usually rely on the constant rotation speed of the driving motor to orient the antenna to a given direction. To periodically calibrate the angular position, these rotators have a mechanical stop at 0 degrees and at 360 degrees — usually corresponding to north when the antenna is installed.

I decided to build a new completely electronic unit based on the Arduino microcontroller. The new controller replaces the old one; it is totally silent, compact, and allows you to preset and read the position on a backlit LCD. The rotator position is stored in the Arduino EEPROM and is automatically recalled when the unit is switched on.

The Rotator

The operating principle is shown with reference to the dashed section of the Figure 2 schematic. The motor has a center-tapped stator winding. Power is applied between the center tap, line 1 on the three-pin terminal strip, and either side of the windings (line 2 or 3), depending on the rotation direction. A non-polarized electrolytic capacitor C3 connected across lines 2 and 3 is required for motor startup. To calibrate the controller, the rotator is initially rotated counterclockwise (CCW) until the 0° end stop, when the motor stalls. Assume that ac power is applied between terminals 1 and 2 to get CCW rotation. Then when the motor stalls, the current I3 drops from about 0.85 A to 0.65 A. This current jump is detected by a dedicated sensor U2, so that the Arduino can determine the zero position.

The rotator position is stored in the Arduino EEPROM and is automatically recalled when the unit is switched on.

Figure 1 — An inside view of the rotator.

Controls

On the front panel, there is a 16 × 2 backlit LCD, the power switch, and two momentary contact center-off SPDT toggle switches to operate the controller (see Figure 3). When the unit is powered up, it recalls the rotator direction from the internal memory and shows it on the display. Then the left toggle switch is used to preset the position (up or down) in degrees. If you go beyond the desired position, you can correct it by hitting the **UP** or **DOWN** switch again, as many times as you wish, but the motor will not move yet. The starting position and the positive or negative displacement Δ required to move the rotator to the programmed direction are shown on the display in Figure 3. When the second switch is toggled up the controller activates the motor in the proper direction (CW or CCW) for a time T_{rot} proportional to Δ. The final position is shown on the display and written to memory. If the second switch is toggled down the rotator performs a calibration going back to zero. The display in this case shows the current reading continuously, which will show the aforementioned drop when the motor is stalled. The calibration is also performed automatically when the unit is switched on for the first time or if the memorized direction is zero.

Current Measurement

U2, an Allegro ACS712 5 ampere version, is used for current measurements. I use a breakout board. The ac output of the current sensor is sent to the U3 op-amp precision rectifier circuit (**https://en.wikipedia.org/wiki/Precision_rectifier**). The resulting dc output is sent to the Arduino.

Arduino Nano

I use the Arduino Nano microcontroller board. When planning the position of the various components, leave enough space to allow plugging the USB cable into the Arduino board.

The Circuit

The complete schematic diagram is shown in Figure 2. An 18 V ac center-tapped transformer powers both the motor and the electronics. It replaces the original 16 – 17 V transformer. A full-wave rectifier (D1, D2) followed by a 7805 voltage regulator provides the voltage for all the electronics.

The controller fits inside a metallic cabinet approximately 4.8 (W) by 4 (H) by 5 (D) inches (see Figure 4). I mounted the power supply and the Arduino board on a 2 × 4.8 inch piece of perforated copper epoxy motherboard behind the front panel.

The Arduino board socket is made from two female header strips (15 contacts). A break-away 8 + 8 pin male strip mounted on the board is used to connect the LCD. Connections to the toggle switches, the relays, and the current sensor are also routed via short male pin strips, three contacts for each toggle switch, one or two for the rest. The motherboard also accommodates the LCD contrast trimmer R6. This should be set once and forgotten. The relays, the ACS712 sensor, and the precision rectifier are mounted on a separate Bakelite board and all connections to the motherboard are made with female-female jumper wires.

The 16 × 2 LCD module is mounted with four screws onto the front panel. It has 16 external connections, and I strongly suggest that you first solder a row of 16 male pins into them, and then use female-female short jumper wires (12 needed) to connect it to the motherboard.

For the two relays, RYA and RYB, I used two small single relay modules (seen in the lower left of Figure 4) intended for use with the Arduino. The modules incorporate a driver transistor, a protection diode, and LED. Capacitors C1 and C2 across the contacts are crucial to suppress transients. The U3 based precision rectifier is mounted on a small piece of Veroboard.

These rotators usually rely on the constant rotation speed of the driving motor to orient the antenna to a given direction.

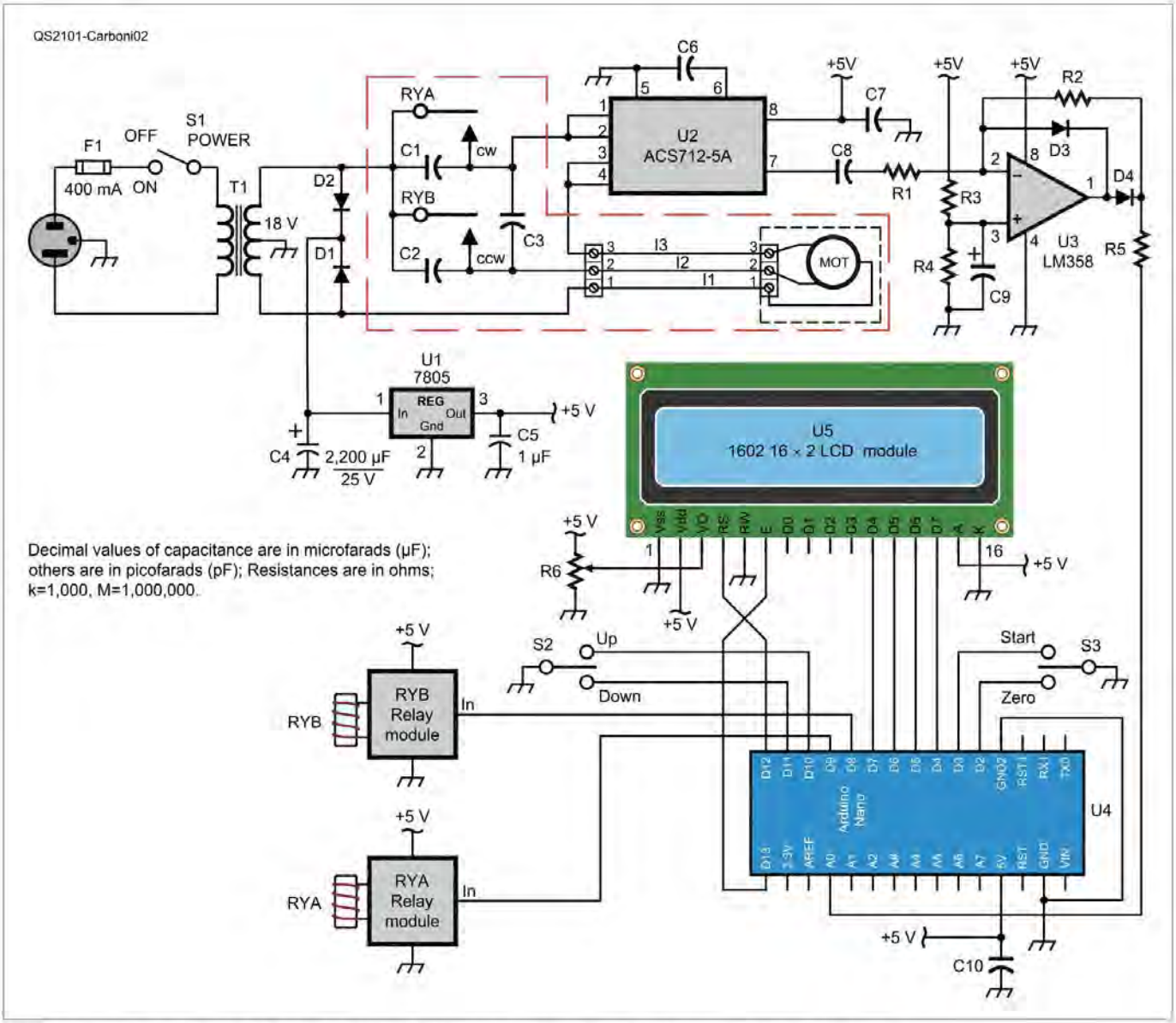

Figure 2 — The schematic of the controller. Non-electrolytic capacitors should be plastic film or ceramic.

C1, C2 — 330 nF
C3 — 120 µF, 63 V, non-polarized electrolytic (you can use two 220 µF electrolytics wired back-to-back)
C4 — 2,200 µF, 25 V, electrolytic
C5 — 1 µF
C6 — 1 nF
C7, C10 — 100 nF
C8 — 2.2 µF
C9 — 10 µF electrolytic
D1, D2 — 1N4007 diode
D3, D4 — 1N4148 diode
F1 — Fuse 400 mA
R1, R3, R5 — 10 kΩ, ¼ W
R2 — 33 kΩ, ¼ W
R4 — 4.7 kΩ, ¼ W
R6 — 5 kΩ trimmer
RYA, RYB — 5 V SPDT relay modules for Arduino or equivalent, **https://vetco.net/products/single-relay-module-for-arduino-d25/vupn5949**
S1 — Power switch
S2, S3 — Momentary contact center-off SPDT toggle switch
T1 — Power transformer, 18 V center-tapped 1 A secondary, primary adapted to line voltage
U1 — 7805 5 V regulator
U2 — ACS712 05A (5A version) current sensor IC or breakout board; **https://www.banggood.com/buy/low-current-sensor-breakout-acs712.html**
U3 — LM358 IC
U4 — Arduino Nano Board
U5 — LCD 1602 16 × 2 alphanumeric module

Figure 3 — The front-panel layout. The power switch is at the bottom right. The toggle switch on the left programs the direction (up or down). The toggle switch on the right starts the motor (up) or zeroes the rotator (down).

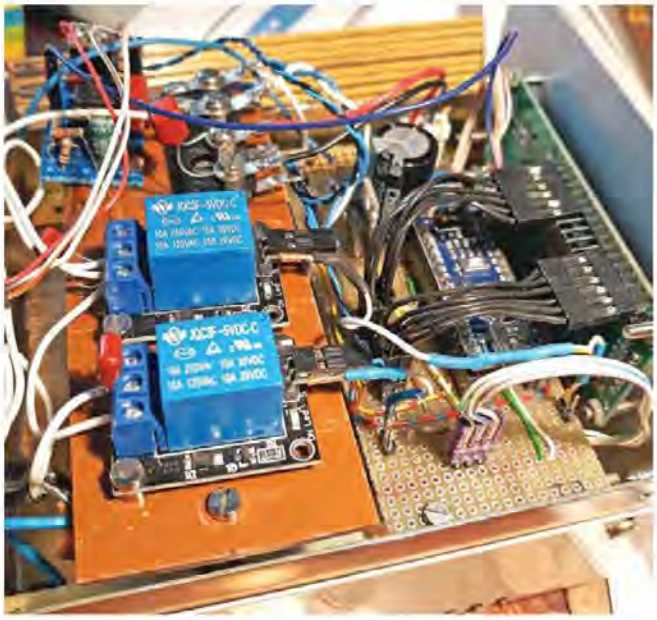

Figure 4 — Internal view shows the relay modules mounted on a Bakelite strip. All interconnections to modules and switches use jumper wires and pin connectors (no soldering). The three-conductor flat cable on the lower right goes to the toggle switch. The power transformer (not visible) is below the Bakelite strip.

The gain is set by R2/R1. The quiescent output voltage after R5 should be 1.6 V. Don't substitute a 741 op-amp for the LM358.

A word of caution: don't place the ACS712 current sensor too close to the power supply transformer, because its stray magnetic field will be detected by the Hall probe and will appear as noise on the output.

Setup and Software

Once set up, no computer connection is needed to operate the controller. There are two sketches on the **www.arrl.org/qst-in-depth** web page. The first, *myrotor_setup.ino*, will assist you in setting up the controller, and then you can forget it. The second, *myrotor_1.2.ino*, is the actual operating sketch.

Note that if Arduino Nano is not recognized when you plug the USB cable into your PC, you should probably install the relevant drivers.

For setup, load *myrotor_setup.ino* using the Arduino IDE. Once the sketch is loaded, you will see the welcome screen. Then the controller waits for you to send a command. Toggling the left switch up and down will turn the rotator CW/CCW. If the direction is wrong, swap wires 2 and 3 on the terminal board. If everything is okay, toggle the switch down. The rotator will rotate CCW toward zero, continuously reading current, *I*, and time, *T*. Take a note of the current, *I*, reading. When the rotator hits the end stop, the current will drop. Note it, then compute the average of the readings before and after the stop. This determines the parameter *Istall* to be inserted in the operating sketch.

Finally, with the rotator at 0 degrees, toggle up the left switch until the rotator reaches the 360-degree stop, and make a note of the time. Multiply it by 1,000. This gives you the second parameter *TT*.

Open *myrotor_1.2.ino* in the Arduino IDE, and edit the two parameters, *Istall* and *TT*, inserting the numbers you obtained into the sketch. Load the sketch. The controller will bring the rotator to zero and will automatically stop. Then it will be ready to operate, and you can disconnect the USB cable. The relationship between the Arduino readings and the motor current is explained on the **www.arrl.org/qst-in-depth** web page.

Giovanni Carboni, IZ5PQT, first discovered ham radio by reading the 1958 *Radio Amateur's Handbook*, but study, family, and work kept him from getting licensed until 2009. He graduated with a degree in physics from University of Pisa, and subsequently conducted experimental high-energy physics research at the European CERN Laboratory in Geneva, Switzerland. From 1995 to 2016, he was Professor of Physics in Tor Vergata University in Rome. Now retired, he lives in Pisa, where he enjoys ham radio digital modes, VHF meteor scatter, experimenting with antennas, and a wide range of homebrew projects. You can reach Giovanni at **iz5pqt@gmail.com**.

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Make use of that 75 Ω coax.

Build a 50 – 75 Ω Broadband Transformer for 1.8 – 54 MHz

Stan Johnson, WØSJ

Coax can be expensive, especially if you need a long, low-loss run. That's why I took a risk at a hamfest and purchased 200 feet of brand new, foam-core coax similar in diameter to RG8 — for just $10. Unfortunately, the coax impedance turned out to be 75 Ω. In order to preserve a 50 Ω impedance, this meant that I would need a pair of 50/75 Ω broadband transformers to be placed on either end of any 75 Ω cable run.

Design and Construction

A 50 – 75 Ω transformer has a 1.5:1 impedance ratio. This corresponds to a turns ratio of 1.225:1, as the turns ratio is the square root of the impedance ratio. My autotransformer design consists of a five-turn coil wound on a Laird 28B1540-000 ferrite core (Digi-Key 240-2319-ND) tapped at four turns, as shown in Figure 1. This 1.25:1 turns ratio is very close to the desired 1.225:1. Wind the core with four close-spaced turns of 16-gauge Teflon insulated wire, create a tap, and then add one more turn. The 10 pF 200 V dc ceramic capacitor (Digi-Key parts number 478-11012-ND) improves the input SWR. In the core's center, use vinyl tubing with an outside diameter of 9/16 inches, and add a zip tie around the perimeter to hold the windings against the core. The lead photo provides details of the physical construction. The aluminum box is a BUD CU-3002A (Digi-Key parts number 377-1089-ND) or equivalent.

Testing

Two 50/75 Ω transformers were constructed. Testing was done with a 100 W transceiver; a 50 dB, 100 W attenuator, and an HP436 power meter with an HP8482 sensor. The system was first calibrated on each band without the transformers. Then the insertion loss was measured by installing the two transformers back-to-back between the transmitter and the attenuator to convert the impedance up to 75 Ω and then back to 50 Ω.

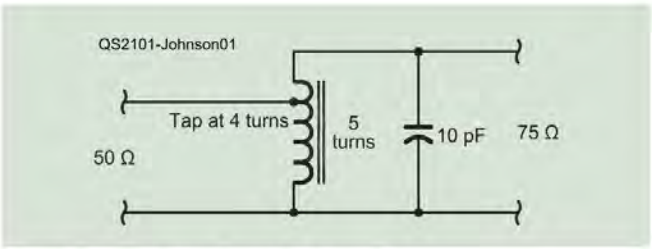

Figure 1 — The transformer schematic.

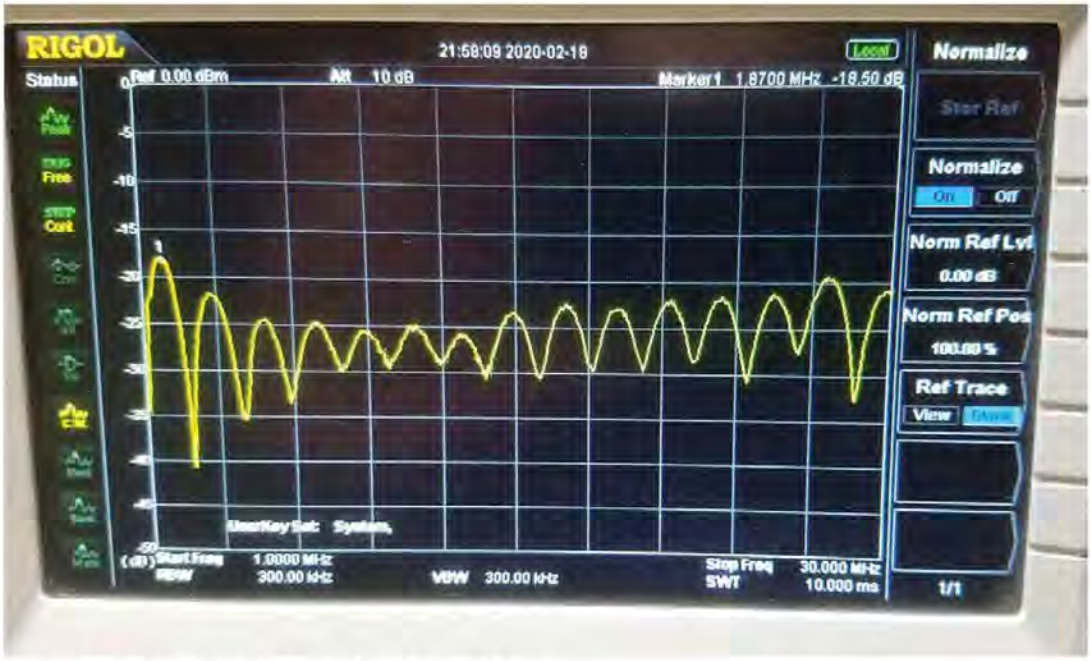

Figure 2 — The return loss sweep from 1 to 30 MHz.

Table 1 — Dual 50/75 Ω Transformers

Frequency	Insertion Loss	Return Loss	SWR
1.80 MHz	0.70 dB	20.00 dB	1.220:1
3.75 MHz	0.44 dB	24.00 dB	1.136:1
7.15 MHz	0.31 dB	28.60 dB	1.077:1
10.12 MHz	0.27 dB	32.30 dB	1.050:1
14.175 MHz	0.27 dB	38.90 dB	1.022:1
18.12 MHz	0.26 dB	44.30 dB	1.012:1
21.20 MHz	0.26 dB	38.20 dB	1.025:1
24.95 MHz	0.27 dB	32.80 dB	1.047:1
28.50 MHz	0.23 dB	29.60 dB	1.069:1
50.5 MHz	0.70 dB	19.06 dB	1.250:1

Next, a high-power directional coupler was added between the transceiver and the first transformer input to measure reflected power using an HP8508 vector voltmeter. Table 1 summarizes the measurements. As the insertion losses include both transformers, the insertion loss per transformer is half of that shown. As can be seen from the test data, the performance of the transformers is fairly well balanced between 160 and 6 meters.

The final test was to connect the transformers to the 200-foot 75 Ω coax run to see how the overall system performed. A spectrum analyzer with tracking generator and a directional coupler were connected to the input transformer to measure return loss. The results are shown in Figure 2. Note that the return loss stays below 20 dB (1.22:1 SWR), except for the 160-meter band (Marker 1) and the citizens band (not a problem). Because it is not a perfect match, peaks and valleys are seen in the return loss plot, the positions of which will change with the coax length. For best results, try to keep the load SWR below 2:1, and don't operate above 100 W, unless you go with larger ferrite cores.

Finally, if you are only interested in 160 – 40 meters, try winding 10 turns tapped at eight turns. This should improve the performance on 160 and 80 meters at the expense of 20 meters and above.

Stan Johnson, W0SJ, was first licensed in 1961 and upgraded to Amateur Extra class in 1968. He has a degree in electronics from Iowa State University and a physics degree from the University of Northern Iowa. His career began at Bell Telephone Laboratories near Chicago and ended at the John Deere Product Engineering Center in Iowa as a scientist/engineer. Since retiring in 2001, Stan enjoys building things, mostly out of junk. You can reach Stan at **w0scavengesjunk@gmail.com**.

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

Product Review

FlexRadio Systems Power Genius XL Amplifier

Reviewed by Terry Glagowski, W1TR
w1tr@arrl.net

FlexRadio Systems, best known for pioneering work in the software-defined radio (SDR) field, has added a maximum-legal-power, solid-state linear amplifier to its product line. Solid-state amplifiers have become mainstream as vacuum tubes have become more difficult to acquire and solid-state power capabilities have increased. The costs and safety issues associated with vacuum tubes are a burden, such as high voltages and multiple power supplies for plates, grids, filaments, and other components. Now it is commercially feasible for amateur radio amplifier manufacturers to provide maximum legal output power plus headroom using solid-state devices. Currently, comparable tube amplifiers are still less expensive, but that may not be the case for much longer.

First Impressions

The Power Genius XL (PGXL) is a fairly compact unit. This is especially true considering that it is capable of maximum legal power output and includes an internal power supply. It weighs about 40 pounds and is fairly easy to move around the station. In comparison, my Emtron DX-3 tube amplifier is more than twice as large and weighs 160 pounds. There is a handle built into the PGXL front panel that makes carrying the unit easy, compared to holding it like a box.

The amplifier power switch is *not* on the front panel, but the operate/standby switch is. I prefer to have the power switches on the front panel of equipment, along with the microphone, the headphones, the key, or the

Bottom Line

The Power Genius XL amplifier from FlexRadio Systems effortlessly delivers 1,500 W on 160 through 6 meters. It includes a number of clever features, including built-in support for full single-operator, two-radio (SO2R) operation.

Table 1
FlexRadio Power Genius XL, serial number 1-50/18-0074, firmware v3.4.10, updated to v3.4.16

Manufacturer's Specifications	Measured in ARRL Lab
Frequency range: All amateur frequencies in the range of 1.8 to 29.7 MHz and 50 to 54 MHz.	160, 80, 60, 40, 30, 20, 17, 15, 12, 10, 6 meters.*
Power output: 1,500 W, 2 kW capable.	Tested up to 1,500 W RF output.
Driving power required: 50 W (US version) for 1,500 W RF output.	Drive level needed for 1500 W PEP output: 1.8 MHz, 40 W; 3.5 MHz, 41 W; 7 MHz, 43 W; 14 MHz, 46 W; 18.1 MHz, 42 W; 21 MHz, 57 W; 24.9 MHz, 72 W; 28 MHz, 50 W; 50 MHz, 53 W. See Figure A.
Harmonic and spurious suppression: Not specified.	1.8 MHz, 80 dB; 3.5 MHz, 71 dB; 5.3 MHz, 71 dB; 7 MHz, 67 dB; 10.1 MHz, 61 dB; 14 MHz, 67 dB; 18.1 MHz, 61 dB; 21 MHz, 61 dB; 24.9 MHz, 70 dB; 28 MHz, 64 dB; 50 MHz, 76 dB. Exceeds FCC requirements.
Third order intermodulation distortion (IMD): Not specified.	14 MHz, 3rd/5th/7th/9th order IMD products: At 1,500 W PEP, 34/39/49/56 dB below PEP; At 1,000 W PEP, 36/42/52/61 dB below PEP; At 500 W PEP, 38/43/53/66 dB below PEP.
Keying time: At least 10 ms.	Unkey to key, 13 ms; key to unkey, 17 ms.
Primary power requirements: 90 – 250 V ac.	Tested with 234 V ac. Limited to 700 W with 120 V ac line.

Size (height, width, depth): 6 × 20 × 14 inches; weight, 39.6 pounds.

*Reminder: US amateurs must observe a limit of 200 W PEP output on the 30-meter band, and 100 W PEP relative to a ½-wave dipole on 60 meters.

paddle jacks. Other connections should be on the rear panel.

The amplifier operated as expected without any quirks. It provides pure, powerful RF output on any frequency with about 50 W of drive.

Important Features

The Power Genius XL RF deck and power supply are housed in a single desktop enclosure. It covers all amateur bands from 160 through 6 meters, and Military Auxiliary Radio System (MARS) operation is possible with the standard firmware. The amplifier uses a pair of MRF-1K50H LDMOS power transistors and had no trouble making 1,500 W output on all bands with about 50 W of drive.

Band switching is automatic, controlled via transceiver interface or by sensing the frequency of the RF input signal. Integration with the FLEX-6000 series transceivers is seamless, but the manual includes detailed setup information for integration with transceivers from Elecraft, Kenwood, Icom, and Yaesu. There are appropriate connectors on the rear panel, and transceiver type and communication parameters are set from a menu.

The PGXL can be set up for use with two transceivers and antenna systems for SO2R (single-operator, two-radio) operation. (This includes SO2R operation with the FLEX-6600M and other FLEX transceivers that are capable of SO2R operation with one radio.) Isolation between the two transceiver inputs is about 70 dB.

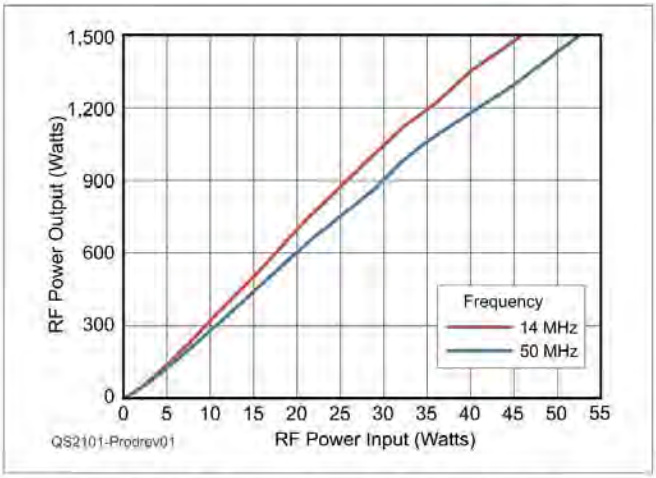


Figure A — FlexRadio Power Genius XL RF input versus RF output.

The operator interacts with the amplifier via a color LCD touchscreen on the front panel (see Figure 1). The LCD provides meters and other information about operating conditions, as well as access to various menus and control buttons. Meter settings include RF power output, SWR, temperature, ac line voltage, and

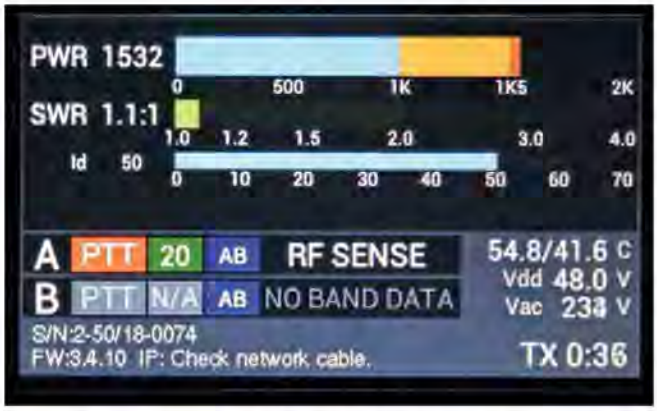


Figure 1 — The colorful PGXL display shows operating conditions at a glance. The amplifier output is 1,532 W into an ARRL Lab dummy load with a 1.1:1 SWR. The lower bar display is drain current. Drain voltage and ac line voltage are shown at the lower right. The lower half of the display indicates that radio A is connected, PTT is engaged, the band is 20 meters determined by RF sensing, and the PGXL is operating in class AB. No radio B is connected. If the PGXL were connected to a LAN, the IP address would be shown at the bottom. Amplifier serial number and firmware version are shown as well.

LDMOS power transistor drain voltage and current. You can also communicate with the amplifier using *Power Genius XL Utility* software. Directions for downloading and installing the software are found in the manual and easy to follow.

The *PGXL Utility* software can also be used for upgrading the amplifier firmware. Download the firmware ZIP file from the FlexRadio website, extract the contents, and then use the *PGXL Utility* to upgrade the firmware. As with other FlexRadio products, new firmware is released periodically to add features, improve operation, or fix bugs. During the review period, we received firmware version 3.4.16, along with a revised manual as a PDF and another PDF with details of what had changed.

Separate bias settings can be used for linear modes and nonlinear modes to increase efficiency when possible. Class AAB (more linear, less efficient) is intended for AM, SSB, and PSK modes, while class AB (less linear, more efficient) is intended for FM, CW, RTTY, and other digital modes. Bias selection is automatic when the amplifier is paired with a FLEX-6000 series transceiver. It can be selected manually from the front panel or using the *PGXL Utility* software.

A maximum efficiency algorithm (MEffA) can be selected for class AB operation to maximize efficiency, while maintaining signal quality. According to the manual, the MEffA adjusts drive voltage and bias settings based on the type of input signal. MEffA operation requires a simple setup procedure to establish the best drive level for the desired RF output.

The PGXL offers excellent harmonic suppression. In addition to the low-pass filters typically found in amateur radio amplifiers, the PGXL uses additional high-pass filters to direct unwanted harmonic energy into an internal 400 W resistive dummy load, called the *harmonic load*. This technique removes unwanted energy from the output stage, improving linearity and thermal management and allowing the transmitter to achieve the same fundamental power output with lower peak drain voltage. The harmonic load is mounted on a dedicated heatsink, with a temperature sensor and fan controller.

The Power Genius XL features a predistortion sampler output for transceivers that can use that signal for predistortion processing to reduce transmitted intermodulation distortion products. There are separate predistortion samplers for the two transceiver inputs.

The PGXL will operate at full power with an antenna system SWR up to about 2:1. Output power folds back between 2:1 and 3:1. Above 3:1, the amplifier stops transmitting. The unit does not include an antenna tuner.

Setup

For this review, I used the Power Genius XL with the FLEX-6600M transceiver reviewed in the February 2020 issue of *QST*. I also used an MFJ-998 automatic antenna tuner for antennas that exceed the amplifier's SWR limits. My antennas include Yagis for 40 through 10 meters and wires for 160, 80, and 60 meters. I am a US Air Force MARS operator, and I used the amplifier with an Icom IC-756PROIII to test operation using RF-sensed band selection on MARS frequencies.

Installation is very easy and straightforward. For best results with the PGXL (or any legal-limit amplifier), plan to use a 240 V ac line capable of 20 A or more. The amplifier includes a detachable power cord, and the user must install the appropriate connector for their station outlet. PGXL firmware version 3.4.16 improved support for operation from 120 V ac. Maximum power output is limited to 700 W, and the power meter scales change to reflect this. Drive power is also attenuated to minimize the possibility of overdriving the amplifier.

Figure 2 shows the PGXL rear-panel connections. A unique feature of the PGXL is the ability to operate with two transceivers in single-operator, two-radio (SO2R) configuration. Two transceivers can share the amplifier using two separate inputs, outputs, and PTT controls (all labeled for radio A or radio B), but only one at a time can transmit. RF input and output connectors are SO-239 types. For non-FlexRadio trans-

Figure 2 — The PGXL rear panel. RF input and output and predistortion sampler connections are in the upper center, with band data/CAT and PTT connections below. [Photo courtesy of FlexRadio Systems]

ceivers, connect the PTT control to the appropriate PTT phono connector. Connect the transceiver CAT cable to the appropriate amplifier DB-9 CAT connector (optional if you plan to use RF sensing). That's it.

Note that the manual indicates that your transceiver should be set to delay RF output for at least 10 milliseconds after PTT output contact closure to allow the PGXL to switch to transmit. This setting is often available in a TX delay or similar menu. (The ARRL Lab measured this keying time at 13 milliseconds for the review unit.) If a TX delay adjustment is not available, you can use a foot switch to key the amplifier, and then key the transceiver from the PGXL's **PTT OUT** jack. The PGXL does not support full-break-in (QSK) CW operation.

Like the FlexRadio transceivers, the PGXL has an RJ-45 ethernet jack for connection to a local area network. If you're using a FLEX-6000 series radio that is also connected to the network, the amplifier will find the radio on the LAN. Of course the ethernet connection means that the amplifier can be used as part of a remote station as well as locally.

I found setup to be relatively simple for the amplifier, just configuring the interface screen for the transceivers I wanted to use. This was my first time using the FLEX-6600M transceiver, and that required some reading of the manual. You can view the contents of the amplifier LCD screen on your computer using the *Power Genius XL Utility*.

Operational Experience

I used the Power Genius XL on all bands from 160 through 6 meters and all modes except digital. I have no doubt that it would work well there, too. Most of the time, I used the FLEX-6600M with the amplifier, and got excellent reports during regional and transglobal contacts. I used the amplifier with my Icom IC-756PROIII on the MARS frequencies from 2.0 to 30 MHz on a dummy load, and it easily produced 1,500 W output. (Note that the 26.0 and 27.9 MHz MARS frequencies are locked out per FCC regulations because of proximity to the citizens band.)

When using the FLEX-6600M, the amplifier tracked the band using the ethernet connection. When using the IC-756PROIII, the amplifier sensed the frequency and selected the proper band. This required a brief pulse of RF from the transceiver, then release of the PTT, VOX, or CW keyer, and then the amplifier would operate normally following a band change. Virtually any transceiver that provides a PTT output to control an amplifier will work with the PGXL. The PTT control is optically isolated and very low voltage and current, so it will work with any transceiver.

The PGXL has fans in the power supply unit, the RF deck, and the filter compartment. The firmware manages the fans independently based on information from sensors in each compartment. As with other solid-state, legal-limit amplifiers, fan noise is higher than with typical comparable tube-type amplifiers. To help manage that, the PGXL offers several user-selectable fan profiles. In standard mode, recommended for casual SSB, CW, and digital operation, the fans run at low speed, increasing speed with temperature, but optimized for lowest fan noise. Contest mode is recommended for contesting or other operating activities with a lot of transmissions. The fans run at a higher initial speed than in standard mode, increasing with temperature and turning off when the amplifier cools down. In broadcast mode, the fans run continuously at high speed, regardless of temperature. This mode is intended for extended high-power RTTY and

digital-mode operation, high-duty-cycle SO2R contesting, or situations in which the amplifier is located away from the operating position.

In standby mode, the PGXL fan is quiet after it cools down. In operational mode and receiving, the fan is only moderately noisy. As with other solid-state, legal-limit amplifiers, after a lengthy full-power transmission, it does get rather loud as it tracks the internal temperature and more cooling is needed. I did some informal testing with a sound pressure level meter and measured 40 dBA in standby mode (but perfectly quiet when the fans are not running), 70 dBA in operating mode with light transmissions, and 85 dBA under full power. My Emtron DX-3 tube amplifier is slightly quieter with the stage 1 fan operating at 66 dBA, although stage 2 is much more.

Summary

The FlexRadio Power Genius XL is a great solid-state, maximum-legal-limit amplifier for 160 through 6 meters. It integrates seamlessly with FLEX-6000 series radios, but it also works well with other transceivers with or without band data connections. It effortlessly produces 1,500 W output on any band with about 50 W drive, something that cannot be said about just any amplifier. MARS operation from 2 to 30 MHz is also available. Although not inexpensive, it has outstanding performance. The manual and other documentation is available from the FlexRadio website.

Manufacturer: FlexRadio Systems, 4616 W. Howard Lane, Suite 1-150, Austin, TX 78728; **www.flexradio.com**. Price: $6,999.

PreciseRF HG3 Stepper Magnetic Loop Antenna

Reviewed by Phil Salas, AD5X
ad5x@arrl.net

In the June 2019 issue of *QST*, I reviewed the PreciseRF HG-1, a small magnetic loop antenna that has the option of being tuned remotely. PreciseRF recently released the HG3, a stepper-controlled magnetic loop antenna that includes remote tuning only, as well as additional features. The stepper motor provides an accurate and repeatable tuning system.

Description

The HG3 covers 7 to 30 MHz. Maximum power ratings are between 25 W and 100 W depending on operating mode (duty cycle) and frequency (see Table 2). Optional 80-meter and 60-meter high-voltage/high-current resonating capacitors, or a new 60/80-meter tunable resonating capacitor may be purchased for operation on those bands. However, the maximum power rating on 80 and 60 meters is reduced to 10 W PEP.

Bottom Line

The HG3 is designed for both portable and fixed station operation. The remote-tuned stepper-controlled tuning results in precise, repeatable operation.

Table 2
PreciseRF HG3 Manufacturer's Specifications

Parameter	14 MHz at 10 W Input	29 MHz at 10 W Input
SWR/Return Loss	1.01:1/41.09 dB	1.14:1/23.40 dB
Bandwidth (2:1 SWR)	31.2 kHz	279 kHz
Quality factor (Q)	448	104
Rrad	0.074 W	1.36 W
Rloss	0.093 W	0.134 W
Power radiated	4.44 W	9.10 W
Efficiency	44% (–3.5 dB)	91% (–0.4 dB)
Max Power (with 25-foot RG-8 feed line)		
PEP SSB	55 W (75 W with CMB-300 balun)	
CW 50% duty cycle	35 W	
RTTY (digital) and AM	25 W	
Max Power (with 50-foot RG-8 feed line)		
PEP SSB		75 W (100 W with CMB-300 balun)
CW 50% duty cycle		50 W
RTTY (digital) and AM		35 W

Environmental: 0 – 35 °C, <80% relative humidity. Water resistant, not waterproof.

PreciseRF offers three configurations of the HG3. Most users will purchase either the EXPRESS or PRO configuration. The EXPRESS and PRO configurations include:

- a 38-inch-diameter radiator loop made from LMR 600 coaxial cable;
- a copper tube induction loop at the feed point;
- a tuning capacitor adjusted by a high-resolution, remotely tuned 2,000-position stepper motor;
- a loop tuning controller;
- a three-section PVC mast;
- and a 9 V dc power supply, universal tripod adapter, 25 feet of RG-58 feed line, 25 feet of CAT6 controller cable, and a comprehensive, illustrated user guide.

The PRO version includes a USB key that adds functions to the HG3 controller, with auto-assisted tuning, an integrated SWR bridge, an equivalent radiated power (ERP) display, and the ability to control the optional PreciseRF AR-1 remote 12 V dc antenna rotator.

There is also a LAB version intended for experimental use. It is available in kit form, requiring some assembly and soldering. It supports a NEMA 17 ultra-resolution, 8,000-position stepper motor, as well as the features of the PRO version.

Finally, the manual and website mention a future high-power (QRO) version of the HG3 that is currently in development. No information was available at the time of this review, other than it supports a NEMA 21 ultra-resolution, 8,000-position stepper motor, as well as all PRO version features.

Installing the HG3

If you wish to operate on 80 or 60 meters with the optional resonators, you must open the tuning unit's case and bridge two solder pads to connect the tuning capacitor to the external 60/80-meter banana jacks. This impacts 10-meter tuning, however. The 60/80-meter resonators plug into the top of the tuning unit.

The HG3 is designed to be installed in portable or permanent locations. The included tripod adapter permits the HG3 to be easily mounted on a camera tripod. As with other magnetic loop antennas, if there is any breeze the tripod can fall over. The tripod legs need to be well secured, or the antenna guyed using anchors and cord included in the HG3 package.

As mentioned earlier, the PRO version of the HG3 provides control for the optional AR-1 12 V dc rotator through the HG3 controller. However, the AR-1 rotator is designed for temporary, portable deployment only. Also, the optional aluminum mast is required when the AR-1 is used.

For a more permanent mount, the three-section PVC mast should be replaced with the optional aluminum mast, which can be attached to a more secure mount using U-bolts (not included). For this review, I mounted the HG3 at about the 15-foot level to a mast attached to the side of my house and rotated it with my U105 TV antenna rotator, as shown in Figure 3. Because the HG3 is bidirectional, only a 90-degree rotation capability is required.

The CAT6 stepper control cable and AR-1 rotator control cable are weatherproof. Although 25-foot cables are provided, cable lengths up to 50 feet have been tested by PreciseRF. All RF connections on the HG3 controller and antenna interface are BNC female. The included 25-foot RG-58 cable is terminated with BNC male connectors.

Finally, like all small transmitting loops, the HG3 maximum radiation occurs in the plane of the loop, with deep nulls perpendicular to the loop when vertically mounted. Keep this in mind, and always position yourself perpendicular to the HG3, especially when in close proximity to the antenna when transmitting. PreciseRF recommends that the antenna be placed so that there is at least a 15-foot clearance around it,

Figure 3 — The HG3 mounted on a pole attached to the author's house and turned with a U105 TV antenna rotator.

and that the operator should be at least 20 to 25 feet from the antenna.

Operating the HG3

The HG3 controller is powered by 9 to 13.8 V dc applied through a standard 2.1 × 5.5 millimeter power connector. If you do not use the included 9 V dc power adapter, you will need to provide your own dc cable. This is what I did, because it was convenient for me to power the controller from my 13.8 V dc station power supply.

Figure 4 — The HG3 PRO controller with the startup screen shown. The buttons below the screen change function, depending on the screen selected.

Operation of the HG3 is quite straightforward. When the controller is powered on, it briefly displays the firmware version and configuration as determined by the absence or presence of the USB key. Next, it defaults to the basic operating screen and sets the band to 40 meters. There are four soft keys labeled **F1** through **F4**. The display indicates the function of these keys, and changes when keys are pressed to indicate the functions associated with the current display. The basic startup screen is shown in Figure 4.

Pressing the **BAND** (**F1** key) on the controller changes the display to permit you to decrement (**F1**) or increment (**F2**) the bands (see Figure 5). Once in the desired band, press **OK** (**F4**). When changing bands, the HG3 controller always sets the tuned frequency to just below the lower band edge. So when changing bands, you will always rotate the **TUNE** control clock-

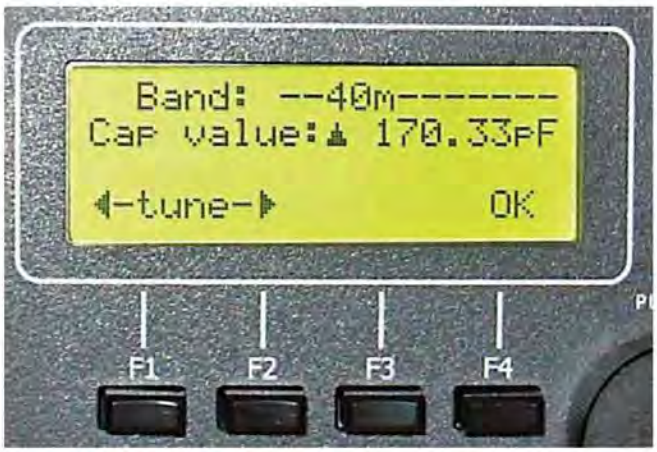


Figure 5 — Pressing **BAND** on the startup screen brings up this screen for changing to a different frequency band by using the arrow buttons (**F1** and **F2**).

wise to find the maximum noise level. I found tuning particularly easy by observing the noise level on my Xiegu G90 transceiver's spectrum display.

I almost always wound up with close to a 1:1 SWR using this tuning method. Whether you look at a transceiver spectrum display or listen to the noise level, once noise is peaked, you can transmit a low-power signal and then fine-tune the HG3 for lowest SWR. Tapping the **TUNE** button changes the stepper tuning increments from coarse to fine, making it easy to tweak the SWR performance. Also, the HG3 controller displays the tuning capacitor value, so I found it easy to return to a favorite frequency by tuning to a previous capacitor setting.

With the PRO version, there is an auto-assisted tuning feature. The controller automatically scans for a low SWR, starting at slightly below the maximum-noise-tuned frequency. To enable autotune, tune the controller for maximum noise on your transceiver. Then press **AUTO** (**F2**). The controller will display "Connect Radio" and "Transmit 1 – 3 Watt CW." Transmit a low-power carrier, and press **OK** (**F3**). If the power is not correct, you will be prompted to increase the power level. The HG3 is automatically tuned in small steps while the controller continuously updates the capacitance value, SWR, ERP, and bar graph displays. Automatic tuning stops when the lowest SWR point is found, and the process can be canceled at any time by pressing **CANCEL** (**F4**).

This entire process takes only a few seconds and works very well. I wound up with a 1:1 SWR on 40 through 12 meters, and a 1.5:1 SWR on 10 meters when using this method. This worked great on 20 through 10 meters with my Xiegu G90 portable transceiver. I had to use my Elecraft K3 transceiver to verify auto-tuning on 40 and 30 meters, as the G90 automatically cuts back power for an SWR of 3.6:1 (maximum protection setting) even when transmitting a low-level signal. Because the HG3 controller starts below the maximum noise tuned frequency, the starting SWR is usually greater than the G90's 3.6:1 SWR-protection point on 40 and 30 meters.

The **MODE** (**F3**) button enables the optional AR-1 rotator control (with the PRO version only), and also displays external 80/60-meter resonator information if it is used. I did not try these optional features. The **HELP** (**F4**) button provides instructions on tuning.

I operated on 40, 30, and 20 meters due to band conditions during the review period. The 17- through 10-meter bands were completely inactive. Transmit power was 20 W with my Xiegu G90. I operated CW (my preferred mode) on 30 meters, but focused on SSB on 40 and 20 meters. I could pretty much work anyone I could hear.

I also made many comparisons between the HG3 and my 43-foot vertical. On average, I found the HG3 to be about two S-units below the 43-foot vertical. This was not unexpected — after all I'm comparing a 3-foot diameter antenna to a 43-foot vertical. However, I did experience a surprising number of occasions where the HG3 actually outperformed the 43-foot vertical on 20 meters. I was also pleasantly surprised by the significantly improved signal-to-noise ratio of the HG3 when compared to the 43-foot vertical. On the 43-foot vertical, all sorts of spurious signals from neighborhood electronics equipment are present, but they were not heard on the HG3.

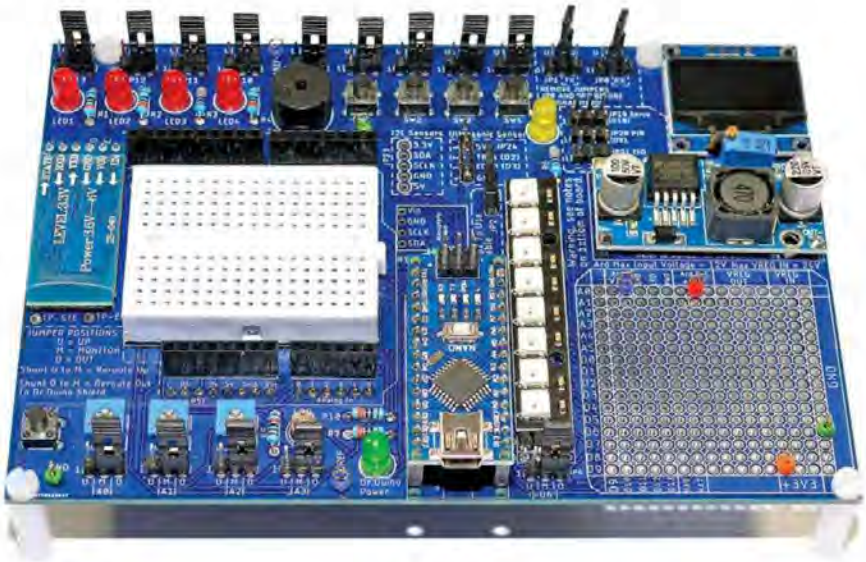
Conclusion

The PreciseRF HG3 is an effective antenna worth considering for restricted antenna locations and portable operation at power levels up to about 50 W PEP. Because it is remotely tuned, the high-intensity RF field can always be kept well away from the operator. Finally, you can view the HG3 operation manual, the HG3 installation guide, and an informative video on the PreciseRF website.

Manufacturer: PreciseRF, 960 S. Gribble Rd., Canby, OR 97013; **www.preciserf.com**. Price: HG3 EXPRESS, $935; HG3 PRO, $1,195; AR-1 antenna rotator, $275; aluminum antenna mast, $119; 60M-1 resonator, $65; 80M-1 resonator, $65; variable 60 – 80 meter resonator, $75; LAB 8K tuner kit, $275.

Dr.Duino Explorer Edition Arduino Project Kit

Reviewed by Glen Popiel, KW5GP
kw5gp@arrl.net



Unless you make your own, I have not been able to find many choices for a good Arduino development and prototyping platform. While I do like using the Phase Dock WorkBench (reviewed in the April 2020 issue of *QST*) for prototyping larger projects, sometimes that platform is overkill for smaller proof-of-concept prototype Arduino projects.

The bigger brother to the Dr.Duino Pioneer (reviewed in the November 2020 issue of *QST*), the Dr.Duino Explorer Edition looks to fill the bill for that "grab-it-and-go" development platform. It has a number of commonly used components integrated on the board and was obviously created with developing and troubleshooting Arduino projects in mind. However, just because it has a few more bells and whistles than the Pioneer Edition doesn't mean that the Explorer can't be used as a learning platform as well. In fact, quite the opposite is true. The Explorer Edition comes with free access to a Facebook group, where Dr.Duino users can ask questions and share ideas. The educational focus is also clear in the inclusion of a postcard-sized "cheat sheet," with resistor color codes printed on one side, and some basic Arduino programming information on the other (see Figure 6).

The Explorer board comes with a practical mix of components mounted on board that you can use in creating your own projects. On the 4 × 6 inch PC board, there are four LEDs, four pushbutton switches, three potentiometers, a light-dependent resistor (LDR), a 128 × 32 organic LED (OLED), a strip of eight red-green-blue (RGB) LEDs, a Bluetooth LE (low-energy) module, and a 3-to-20 V, 3 A dc/dc converter. The board also has a socket for the included Arduino Nano. In addition, there are connectors that allow the Explorer to be used as a shield for an Arduino Uno, as well as providing a mounting point for your own shield assemblies. The Explorer also has two prototyping areas, a 178-pin breadboard area, and a solder-pad area you can use to permanently add components.

Bottom Line

The Dr.Duino Explorer Edition is a well-designed development, prototyping, and troubleshooting platform with a good mix of onboard components for creating a wide variety of Arduino projects.

Building the Kit

The Explorer ships as an easy-to-assemble kit, as shown in Figure 7. I was able to build mine in a single afternoon. The Explorer comes with five demo Arduino projects, along with an automatic test procedure (ATP) sketch that lets you put the board through all of its paces to verify that it is fully functional.

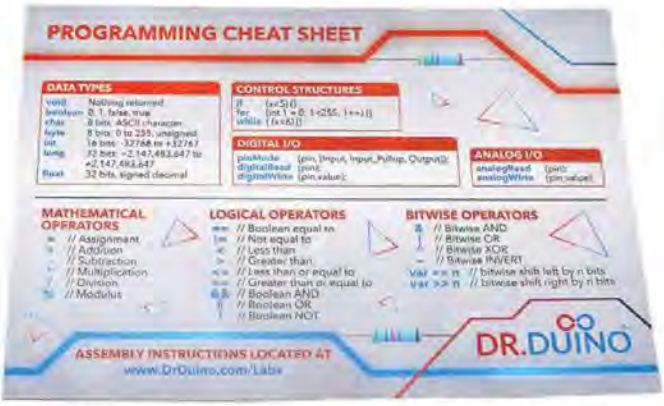


Figure 6 — The included *Programming Cheat Sheet* shows common Arduino programming commands on one side and resistor color codes on the other.

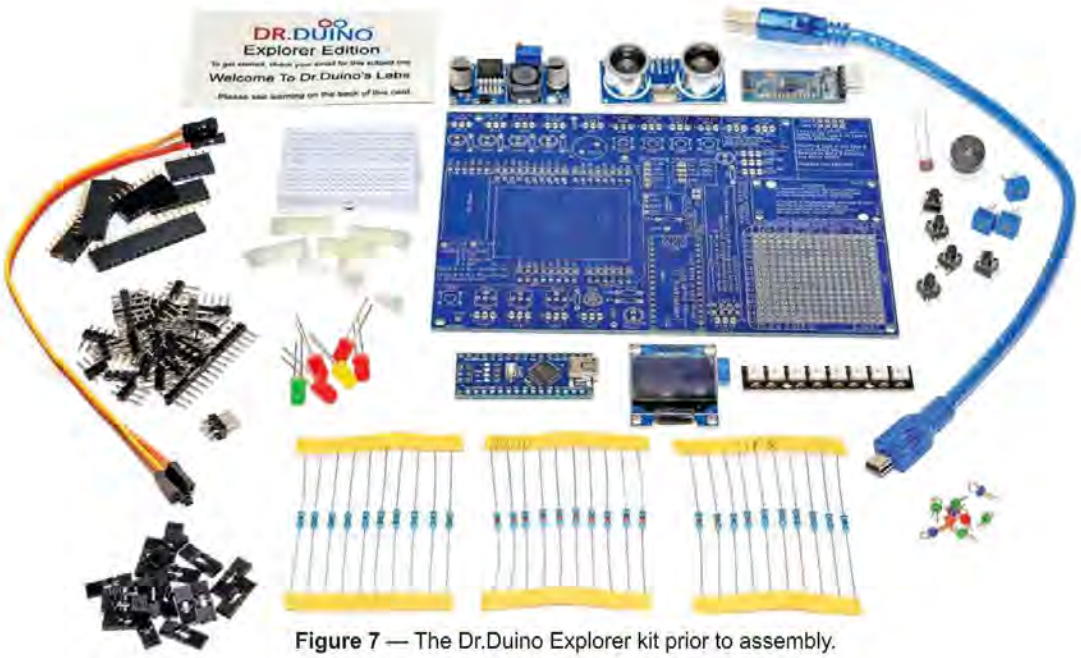


Figure 7 — The Dr.Duino Explorer kit prior to assembly.

The only negative I had about the assembly process is that the 154-page manual is online. I'm old-school and like to work from either hard copy or a PDF. The manual itself is a well-written step-by-step assembly and user guide. One of the most notable things about the assembly manual is the emphasis on support. It's nice to see a company that focuses on their customers as much as they do on their products.

The circuit board itself is well laid out and easy to use. I like that the pulse-width-modulation (PWM) capable pins are stenciled with a tilde (~) on the board. No more trying to remember which pins do PWM and which ones don't. For testing and troubleshooting purposes, there are nine test points on the board. You're even provided with a schematic of the board if you want to dig deep and see how things work.

One key feature of the Explorer board is Dr.Duino's Re-Route It Technology. A series of three-pin headers and jumpers allow you to route signals from the Arduino to the onboard I/O pins and components, or route the signals off-board via the Arduino shield connector.

I have mixed feelings about the solder-pad prototyping area itself. While I like that all of the board's I/O and power pins are brought out to this area, I'm not sure that I would feel comfortable using this semi-permanent prototyping area. If I were to use it, it would most likely be to add some of the components that I use most often in my designs and would want them available permanently.

Expansion Pack

As with the Pioneer Edition, Dr.Duino offers a PLUS version with an expansion pack. The PLUS edition includes an inertial measurement sensor, a micro servo, a voice recorder/player with speaker, an atmospheric sensor, and a passive IR sensor, along with 120 breadboard and header connecting cables. The PLUS edition adds instructions for four more projects designed to demonstrate the use of these components. The projects are practical and fun, and they can be a great way to get your kids involved with the Arduino. Using basic construction techniques with paper and cardboard cutouts, the projects are designed to be housed in the plastic box the Expansion Pack ships in.

As with the Pioneer, an Education Package for the Explorer is offered during the checkout process. This package adds five more projects as well as a PDF of "Arduino Course for Absolute Beginners," by Michael James, which is one of the better Arduino tutorials I have seen.

As a finishing touch, the Explorer board uses four nylon standoffs to raise the board above your work surface. These standoffs are high enough to allow an Uno to be installed underneath without touching the work area.

All in all, the Explorer makes a great addition to my arsenal of Arduino development and prototyping tools.

Manufacturer: Dr.Duino, **www.drduino.com/hamradio**. Price: Dr.Duino Explorer, $159; Explorer PLUS Edition, $199; Education Package, $29.

Pacific Antenna Tracer Injector Kit

Reviewed by Paul Danzer, N1II
n1ii@arrl.net

This shirt pocket-size (1.8 × 3.5 inch) device acts as a wide-range resistance/continuity checker, which is useful for troubleshooting circuits on the workbench. Although not obvious from its catalog description, I found that it can be used to detect very low levels of conduction from corrosion. The Tracer Injector is a kit built on a single PC board. Red and black test leads are included, but not an enclosure.

Figure 8 shows the finished PC board. The unit puts out a signal from the lower left-hand (red) jack. To check continuity, the test lead from the upper (black) jack is connected to the other end of the circuit. With its high gain (adjustable), the Tracer Injector can confirm continuity over circuit paths ranging from 0 Ω (a short circuit) to greater than 1 MΩ.

This device can make your bench testing a bit easier. If you have ever tried to see if there was continuity (more than just 0 Ω) with a standard multimeter and a pair of probes, you may have found that you need two sets of eyes. The first set is needed to make sure the probes are on the circuit points you are testing, and the second set is needed to read the meter. The Tracer Injector uses audio to confirm conditions over a circuit path, and the gain adjustment allows you to decide just how high or low the path resistance should be.

Building the Kit

This kit and the accompanying instruction sheets (available as a PDF file from the Pacific Antenna website) are a good choice for the inexperienced builder or as a club project to introduce members to PC board soldering and kit construction. All of the components are through-hole parts.

The instructions start off with a listing of tools that might be required and some hints and brief instructions for board assembly in general. A parts listing follows, with a column to check off as you insert and solder a component. The board has clearly printed part numbers corresponding to the numbers in this list. As usual, a magnifier of some sort will help you confirm values printed or color-coded on the component.

Each instruction for mounting a component or a group of components is accompanied by a set of pictures. Printing the manual in color would be a good idea to make full use of illustrations. Figure 9 shows a typical instruction step. This example is for mounting two electrolytic capacitors and includes pictures of the parts, the section of the board that receives the capacitor, and what this board section should look like after you have mounted and soldered the part.

The final assembly step suggests you mount the supplied rubber feet to prevent shorts if you are not going to place the unit in an enclosure. The unit is powered by a 2032 coin battery, and the board assembly includes an on/off switch. The 2032 battery is com-

Figure 8 — The kit comes with two 24-inch color-coded test leads. The connector on the right is the headphone jack.

How Does it Work?

The Tracer Injector consists of two individual circuits, powered by the same coin-sized battery and have a ground connection in common. One dual-section TLC27L2CP operational amplifier (op-amp) and one 2N3904 transistor are used.

One section of the op-amp is set as an oscillator at about 800 Hz, with a positive and negative symmetrical triangular waveform output connected to the red jack. The waveform is rich in harmonics and puts out approximately 2 V peak-to-peak with an open circuit.

The other half of the IC is configured as a high-gain audio amplifier with a gain control in the feedback leg. It drives the audio amplifier transistor, whose output is connected to the audio output jack.

Bottom Line

The Pacific Antenna Tracer Injector kit worked as expected, and other uses for this very small, self-contained, battery-operated unit will probably occur to you. The excellent instructions would make it a good first project.

Next, install the 10uF electrolytic capacitors in locations C4 and C8

Note that there is a + symbol on the layout.

This is the pad for the longer lead on the capacitor. Usually, the – lead is labeled on the capacitor body as well

Figure 9 — Each component, or group of components, to be installed has a short section in the assembly manual. Written instructions are accompanied by pictures of the component(s), the relevant area of the PC board, and the section of the board with the component(s) soldered in place. Shown here is the step for installing two electrolytic capacitors, also included is information on positioning the leads correctly.

monly used in toys and home electronics, so it is readily available.

A Few Tests

When I finished putting the kit together, I found I had not taken down any notes; I did not find a single error in the instruction sheets, nor was there any difference between the instructions and the hardware. There are two hints I would suggest. First, on the PC board, the outline of the single integrated circuit is shown with a semicircular cut at one end (the Pin 1 end), as well as a dot. Many ICs (including the one with the kit) just have the dot near Pin 1. Second, as usual the LED outline shows a flat side for orientation, but it's not always easy to find the flat side on the part itself. As noted in the instructions, mount the LED with the shorter lead adjacent to the "LED1" label on the printed board.

Using the Tracer Injector

The Tracer Injector is basically an ohmmeter with an audio output that is monitored with a set of stereo headphones or an amplified speaker plugged into the ⅛-inch jack on the PC board. (You will need to provide the headphones or speaker.)

Sensitivity is decreased by turning the volume control on the Tracer Injector PC board clockwise (the opposite of my usual experience with volume controls). The sensitivity is controlled to some extent by the sensitivity of your headphones or speaker.

At maximum volume, with the test leads separated, I could not hear any leakage audio tone with my headphones. The unit is specified to be able to test circuits with resistance of 0 Ω to 1 MΩ, but I could hear a faint tone when connected to a 40 MΩ resistor.

As usual, I had a few other projects under way at my home. One of them was to install two identical CAT5 multiconductor cables. This meant that at each end, there were four pairs of wires to sort out in each cable. I found that I did not have to look at both an ohmmeter and a pair of wires while my wife shorted out pairs at the other end. Using the audio tone to confirm pairs sped up the process.

One additional use of the Tracer Injector might be to detect corrosion conduction. After discovering that an audio tone could be heard with a path resistance of 40 MΩ, I suspect corrosion paths that are past the range of typical ohmmeters might be identifiable.

Manufacturer: Pacific Antenna, P.O. Box 10301, Fayetteville, AR 72703; **www.qrpkits.com**. Price: $25 plus shipping.

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

The Doctor is In

SWR Looks Different, Depending on Where You Measure

Q Tony, N4RCK, asks: I have a transceiver, followed by an amplifier, then fed via coax to a matching transformer at the antenna feed point. I noticed the SWR at the radio reads 2.1 with amplifier off. If I turn the amplifier on, the SWR at the radio barely flickers above a 1.1 SWR.

Does this mean the system is perfectly matched, with all power radiated when the amplifier is on?

A With the amplifier off, you are reading the SWR of the antenna system (slightly modified perhaps by the connections through or around the bypassed amplifier). With the amplifier on, your radio is indicating the SWR of the input to the amplifier — not significant, but usually close to 1:1. If you moved your SWR meter to the output of the amplifier — also the input of the antenna system — you would likely read the same 2:1 as if connected directly to the antenna (see Figure 1).

An SWR of 2:1 is not an issue with most HF systems, and virtually all the power will be radiated. The SWR just indicates some reflections between the systems, but most of the power reflected back toward the amplifier will be re-reflected outward toward the antenna.

Q Chris, W9BKR, asks: I have a question on SWR readings. My antenna is remotely selected at the tower to minimize coax runs into the house, so only one feed line is needed. The feed line comes into the house to a manual four-position switch. I have the switch in-line mainly to allow me to bypass the antenna tuner and the HF amplifier. This way, I can switch the VHF transceiver to run directly to the antenna feed line from the tower.

The HF side goes through the tuner, amplifier, and radio. So, my quandary is that if I measure the SWR at the radio output, it reads a 1.9:1 SWR going to my power meter and then continues to the main feed line. If I put the main feed line to the tuner-amplifier then radio, the tuner's cross needle meter reads about 1.6:1, while the radio's SWR bar graph indicates 2.0:1

So far, I have approximately 1.9:1, 1.6:1, 2.0:1 (same power level, frequency).

If I run an analyzer on the feed line end in the shack, the SWR reads 1.9 – 2.0 and the impedance reading is 28 Ω. So, with all the ways to

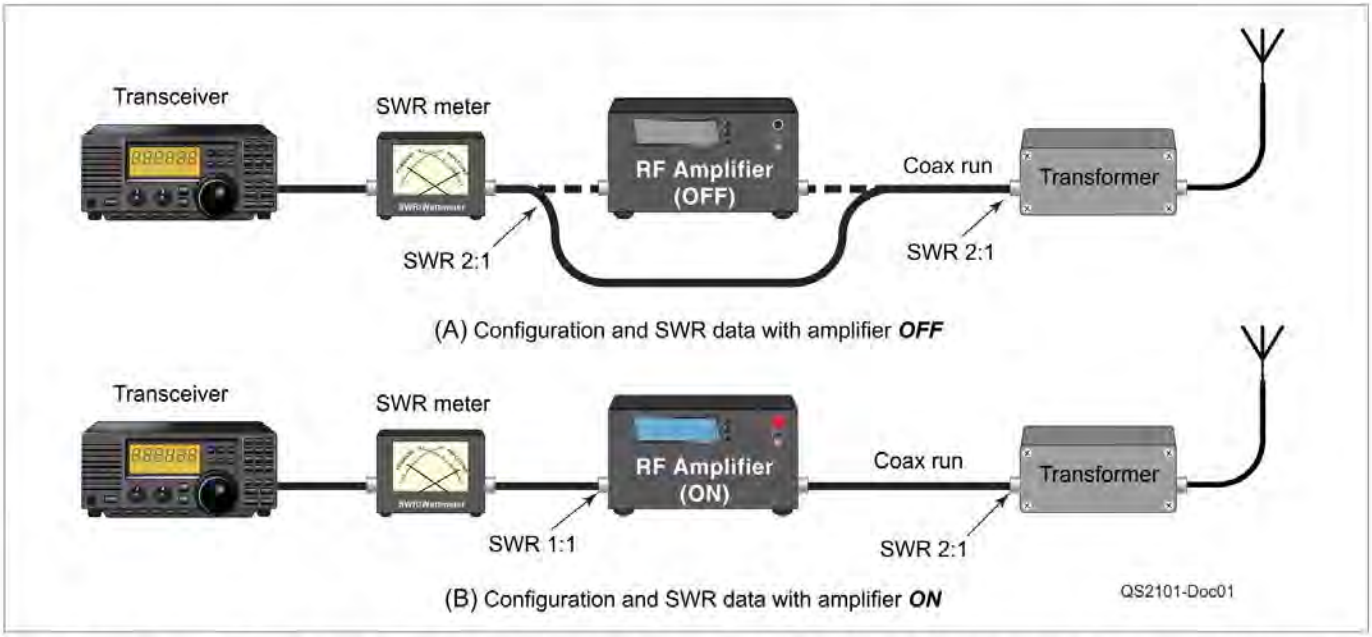


Figure 1 — The SWR at points in the chain between transceiver and antenna. This is typical of what is found in many cascaded systems. Frequently, the SWR going to the antenna is higher than between subsystems in the transmit chain.

look at my SWR, which is the best? Why are there such differences?

A With the amplifier off, you are reading the SWR of the antenna system (slightly modified perhaps by the connections through or around the amplifier). With the amplifier on, your radio is indicating the SWR of the input to the amplifier — not particularly significant, because they are usually pretty well matched, and the losses between the transceiver and amplifier in the usually short jumper cable are small. If you moved your SWR meter to the output of the amplifier — also the input of the antenna system — you would likely read about the same 2:1 as you do at the direct input to the antenna.

A 2:1 SWR is not an issue with most systems, and virtually all the power will be radiated. The SWR just indicates some reflections between the systems, but most of the power reflected back toward the radio will be re-reflected back toward the antenna to combine with the forward-going power.

Q Jim, NB6TE, asks: I have pulleys and Dacron lines in place for use as antenna halyards located 125 feet up on redwood trees about 600 feet apart. I have all the materials to make almost any antenna. Our tree climber/trimmer is staying with us for 2 weeks doing various antenna-related jobs for the local radio crowd. Do you have any antenna project suggestions?

A I guess it depends on whether or not your interests are more focused on working DX or working into your local nets, and whether the antenna would be pointed in a direction that could be useful for desired destinations on 40 meters. You might try running the HFTA program and see what elevation angles you need from your location to reach your destination objectives.[1]

But if the directions and terrain make sense, I think you could have a 40-meter DX antenna that other hams would drool over.

Q Eddy, K6SDW, asks: If I didn't have an SWR bridge available, nor a relative RF power output indicator, but I did have an RF ammeter to use, would I always tune my antenna tuner for maximum output RF current to get the most efficient power output to my antenna?

A That sounds good, but there is a downside. It is possible to adjust the tuner so that it presents a load to the transmitter that is different than 50 Ω. If the load is at a different impedance that is lower than 50 Ω, the transmitter may actually put out more current, and thus more than its rated power at that load. That will make you louder at the other end, but at the same time, the transmitter will be drawing more than its rated current and thus exceeding its ratings — possibly to the point that it sustains damage.

So the best approach, in my opinion, is to adjust the tuner so the radio sees a 50 Ω load (1:1 SWR). The transmitter will then put out its rated power, and all will be well, but you will also know that you are operating within the intended design parameters.

Q Ted, K6HI, asks: Tell me about ⅜-wave long verticals. You mentioned their use in a four-element array at the Trans World Caribbean AM station. I can't find much on ⅜-wave verticals. I know of ¼-, ½-, and ⅝-wave verticals, but ⅜ is a strange animal to me. Why do you think that AM station selected a length of ⅜ wave for their vertical elements?

A Well the ¼-wave vertical monopole is perhaps the most common — serving on most taxis and VHF mobile stations, as well as many fixed locations at both VHF and HF, not to mention MF broadcast stations.

The magic of ¼-wave monopoles fed against a ground system is that they provide a convenient load of around 36 Ω resistive, so they are easy to feed with low loss. Using 50 Ω coax, they offer an SWR of about 1.4:1, if fed directly, so they are easy to drive without much fancy matching required, in most cases. If there are ground losses, and there are almost always some, they show up as additional series resistance, making the match even better — at a cost of somewhat reduced efficiency due to the added ground loss.

As a monopole is lengthened from ¼ wave, the impedance (Z) increases, and it becomes non-resonant until it reaches an electrical length of ½ wave, at which point it has quite a high resistive Z, typically in the thousands of ohms range.

The longer antennas typically have a higher low-angle gain (at least until they are longer than ⅝ wave long), but they require more complicated matching to the complex feed impedance. So while it is possible to use longer than ¼-wave vertical monopoles, and ⅝ is quite popular on higher frequency bands where the lengths are reasonable, providing about 4 dB gain over the ¼ wave, the additional matching network results in a complication that is sometimes avoided by just settling for the easier to feed ¼-wave vertical.

[1]The High Frequency Terrain Analysis program was developed by retired ARRL Handbook Editor Dean Straw, N6BV. It determines where shortwave signals go after they leave the antenna, taking into account the actual terrain based on the USCGS terrain details for the area near the actual antenna.

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Hints & Hacks

New Power for a Vintage Handheld; a Vacuum Tube Breadboard, and an Alternative for Spade Bolts

Replacing an Old Battery Pack

I really like my old Kenwood TH-21AT 2-meter handheld, even if it's more than 30 years old. The radio continues to work well even after all these years, but the old NiCad batteries only last for so long (see Figure 1). When it's time to replace the battery pack in a radio this old, you might be fortunate enough to find that replacements are still available from the manufacturer. However, those replacements can be expensive. The alternative is to rebuild the battery pack yourself.

Most of the old battery packs rely on a collection of individual AA batteries. The packs aren't really designed to be opened; the idea is that manufacturer would sell you an entirely new pack. It takes a bit of work, sometimes with a blade or Dremel tool, but once the seal is broken around the battery cover's perimeter, it's easy to open (see Figure 2).

Companies like Batteries America (**www.batteriesamerica.com**) sell complete cell packs that will fit within the case. Just unsolder the two connecting wires, remove the old pack, solder the wires onto the new pack, then pop it into place. Reattach the pack cover with a small line of quick-bond glue around the edges and you're all done. Note that you may have to use a different charging system for a different battery chemistry (for example, replacing NiCD batteries with NiMH). — *73, Dino Papas, KLØS,* **kl0s@cox.net**

Figure 1 — The Kenwood TH-21AT and its battery pack with the cover surgically removed. The batteries are not the originals. [Dino Papas, KLØS, photo]

Figure 2 — The old (yellow) batteries above and the new (white) replacement batteries below. Use quick-bond glue to reattach the case cover. [Dino Papas, KLØS, photo]

A Breadboard for Vacuum Tube Projects

Vacuum tube technology may be more than 100 years old, but designing and building with tubes is still fun. Tube circuits can accomplish a lot with a small number of parts, and they produce that satisfying orange glow.

A major step in any project is breadboarding: knocking together a temporary implementation that's easy to change and adjust. Breadboarding is easy with semiconductor circuits when you use breadboards designed for that purpose. Breadboarding tube projects is more difficult. It generally involves soldering parts. In this project, I adapted a semiconductor breadboard to developing tube-based circuits.

The unit is shown in Figure 3. It holds several tube sockets and a semiconductor breadboard. Its back panel holds a connector (a four-pin Jones Plug in this case) for filament voltage, B+, and ground. The latter two connect directly to the breadboard. Connections from the sockets' pins are brought to SIP sockets on a length of protoboard. These enable connections from tubes to components on the breadboard.

Exceptions are the pins that connect to tubes' filaments. This unit is designed for seven- and nine-pin miniature tubes with 6.3 V filaments. In seven-pin tubes, Pins 3 and 4 connect

Figure 3 — The vacuum tube breadboard. [Bryant Julstrom, KCØZNG, photo]

to the filament, and in nine-pin tubes, Pins 4 and 5. These pins are connected to the power plug on the back panel.

Additionally, the unit supports nine-pin dual triodes like the 12AU7, 12AT7, and 12AX7. In these tubes, the 6.3 V filaments of the two triodes are connected in series between Pins 4 and 5, for a total of 12.6 V, and Pin 9 is connected between the two filaments, so that they can be operated in parallel at 6.3 V.

Associated with each nine-pin socket, then, is a DPDT switch that toggles between two arrangements. In one position, Pins 4 and 5 lie across the filament lines, for nine-pin tubes that require 6.3 V, like the 6U8 and 6T9. The other position connects Pins 4 and 5 together and Pin 9 to the other filament line, to power 12.6 V dual triodes. Figure 4 shows the filament circuit. The three bolts at the unit's front allow temporary panels to hold controls and larger components.

Tube B+ voltages are high compared with the semiconductor voltages we're more accustomed to, so exercise caution. In addition, the semiconductor breadboard is not designed for high voltages, so keep the B+ low. — *73, Bryant Julstrom, KC0ZNG,* **kc0zng@arrl.net**

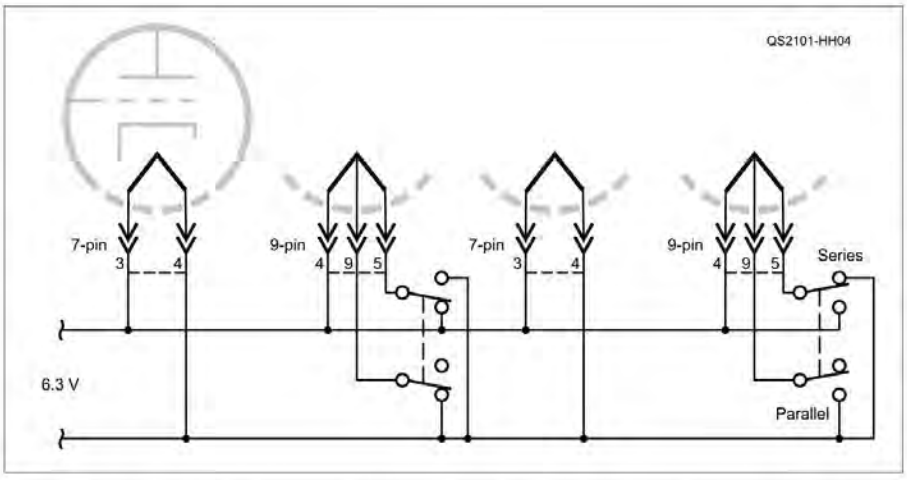

Figure 4 — A schematic diagram of the breadboard's filament connections.

A Spade Bolt Alternative

I was recently working on a restoration project that required some spade bolts to attach a coil shield to a chassis. Some people will remember them as the attachment bolts for IF and RF cans in old radios. These once common attachments are virtually unobtainable, and the price is through the roof for the few available, so I decided to make some myself.

I used a ¾-inch copper pipe cap for the shield and made the spade bolts using a wire terminal connector and a number-6 machine bolt. The head of the machine bolt needs to be filed down on one side to slip inside the terminal connector and lay flat on the side that's adjacent to the pipe cap (see Figure 5). I used a small sheet metal screw to attach them to the shield can, but they can be soldered or riveted. They function exactly like the old spade bolts. — *73, Michael Janis, KE3OQ,* **mjanis@ptd.net**

Figure 5 — A ¾-inch copper pipe cap serves as the shield and the spade bolts are made from wire terminal connectors and number-6 machine bolts. [Michael Janis, KE3OQ, photo]

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Paul Wade, W1GHZ, w1ghz@arrl.org

Microwave Club Projects From Home

Due to the social distancing guidelines presented by the Center for Disease Control (CDC), many radio club meetings and ham conferences have been canceled. Some clubs have held meetings using Zoom or other video conferencing tools, and have welcomed remote attendance. I've participated in several and have seen some interesting presentations.

More time at home has enabled more time on the air. Microwavers in the Midwest have taken advantage of many thunderstorms for 10 GHz rainscatter, as well as good DX opportunities due to a tropo event related to Hurricane Laura. A hurricane creates intense low atmospheric pressure, which can cause an adjacent area of very high pressure. The high-pressure area can have good tropospheric propagation. I experienced this type of propagation once during a 10 GHz contest, as a hurricane approached the New England coast.

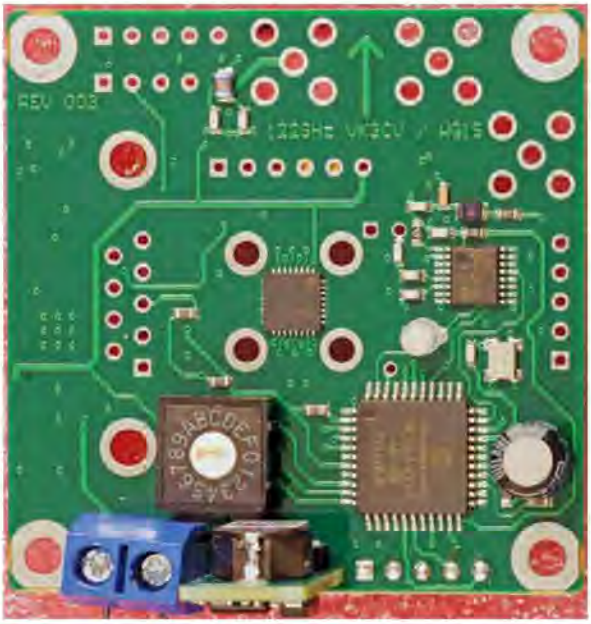
A popular activity for some clubs is a club project — when all the club members build the same thing. Collaborating allows for the utilization of different skills. Microwave gear involves a number of skills, including design, testing, metalwork, soldering, and surface-mount assembly. Few of us have all the skills needed, which is why working as a group can be helpful. Parts procurement is also important, because most parts are less expensive in high quantities and some may be hard to find. Buying as a group can potentially provide significant savings.

Group Project Adjustments

The Microwave Group of San Diego was in the midst of a club multiband microwave transverter project when gatherings were ceased due to the pandemic. Each participant was building a multiband transverter using a printed circuit board for each band (I was able to supply the PC boards). The heart of the system is an inexpensive Chinese frequency synthesizer controlled by an Arduino, programmed by Drew Arnett, N7DA, to switch to the appropriate local oscillator frequency for each band. Then, transverter boards may be added for additional bands.

Microwave project work in Kerry Banke's, N6IZW, garage before COVID-19, with Paul Williamson, KB5MU; Dan Bubke, K6NKC; Tom Sneden, K6VCR; Brian Comer, KF6C; Kerry Banke, N6IZW; Carl Ferree, WA6PPG; Bill Calderwood, K1CT, and Drew Arnett, N7DA. [Greg Bailey, K6QPV, photo]

Bill Calderwood, K1CT, soldering surface-mount parts under a microscope. [Greg Bailey, K6QPV, photo]



A transceiver board for 122 GHz, designed by Andrew Anderson, VK3CV. The microwave chip is in the center, surrounded by four holes which attach the antenna coupler. [Paul Wade, W1GHZ, photo]

A dish antenna for 122 GHz, built by Don Twombly, W1FKF, with dual-mode feed horn and a Cassegrain sub-reflector. Paul Wade, W1GHZ, made the hyperbolic Cassegrain sub-reflector using a computer numerical control (CNC) lathe at the Foundry Makerspace. [Don Twombly, W1FKF, photo]

Assembly was progressing in group sessions with club members working together on each step of the process in the test equipment-filled garage of Kerry Banke, N6IZW. Some of the delicate operations were performed by the more skilled members. Work has slowed, with kits of parts being distributed by mail.

122 GHz Transceiver Kit

Andrew Anderson, VK3CV, designed a 122 GHz transceiver kit that has become an ambitious distributed group project. The transceiver uses a chip designed for short-range radar, with all the microwave components inside the chip (the antenna coupler attaches to the chip). The kit attaches the chip to a printed circuit board containing the support circuitry, and is simple enough to duplicate with published instructions.

A group of Australian hams led by Tim Tuck, VK2XAX, arranged for the manufacturing of a number of the kits with pre-assembled printed circuit boards, funded by microwavers subscribing with advance orders.

Contacts on 122 GHz using transceivers from these kits are now being reported from several countries. The kits were popular enough that another batch is being contemplated.

Antennas that will work at these high frequencies can be a problem, as most dishes don't have good enough surface accuracy. One inexpensive possibility is a 12-inch dish (shown above) from **www.edmundoptics.com**, which has a near-optical surface that seems to work well.

Looking Ahead

Microwave Update 2020 was postponed, but a 47 GHz cumulative contest for the entire year of 2021 is being sponsored by Microwave Update to encourage activity on this band. Visit **www.microwaveupdate.org** for more details.

Working on shared projects remotely is still a challenge, but perhaps we can create Zoom demonstrations or YouTube videos to make it easier moving forward.

Strays

QST Congratulates...

The Dodge County Citizen Corps Council received the 2020 Citizen Corps Council of the Year Award for its work responding to severe flooding in the Fremont, Nebraska, area in 2019, and its volunteer work during the COVID-19 pandemic. The Dodge County Citizens Corps Council is made of groups who respond to the needs of the community during times of emergencies. Groups who are members of the council include the Amateur Radio Emergency Service (ARES), Radio Emergency Associated Communication Teams (REACT), the Community Emergency Response Team (CERT), Community Organizations Active in Disaster (COAD), and the Civil Air Patrol (CAP).

The Dodge County Citizen Corps Council is led by Tom Smith, the Emergency Management Director for Dodge County. Steve Narans, WBØVNF, is the Dodge County Emergency Coordinator and current representative on this team. He's following the leadership that was in place from Dave Theophilus, WØNRW, who served on the group previously.

Technical Correspondence

Dressing Up Your Station

We all want a great-looking station with all wiring completely hidden, or at least neatly contained. Getting everything sorted out can be a time-consuming task, but there are several ways to tackle this job.

Safety First

Before you start working with any wiring, make sure the power is off. Disconnect any power supplies, batteries, or solar connections. Next, make sure your work area is safe. If your station is up against a wall, you may want to move it away to have room to work. Get help if you need to move a heavy desk.

Labeling is Key

Decide what type of labels and record-keeping you want to employ. If you plan on adjusting the length of any cable, then a temporary label with colored tape or a number may be in order. The easiest way I have found is the "from and to" method. I use sheet labels that can be run through a printer or written on.

Start by tracing the cables one at a time, labeling each and recording where they connect. An example would be the antenna connection from the radio to the amp, and then from the amp to the antenna. The coaxial cable would attach to the radio on, say, the **ANT 1** port, and then to the **INPUT** of the amplifier. From the amplifier, a coaxial cable attaches to the **RF OUT** port and goes to the antenna.

At my station, I use a Kenwood TS-570D transceiver with an Ameritron ALS-600 amplifier. So I created a label that says **TS 750D ANT 1** at the top, and **ALS 600 RF IN** underneath it, with space between the two designations, to make them easier to read. This label goes just behind the connector nearest the TS-570D. The next label has the order reversed. I put **ALS 600 RF IN** at the top of that label. Then I skipped a line, and typed **TS 750D ANT 1**. This label goes behind the connector near the RF IN connection of the amp. This way, you can read one label on any side and know where both ends of the cable are (see Figure 1). You'll find labels similar to the ones I used at **www.cablelabelsusa.com/lsl-78**.

Figure 1 — The label on the left will go on the coax connection nearest the Kenwood TS-570D transceiver. The one on the right will go next to the amplifier's **RF OUT** port. This way, by looking at any end of the cable, you know where both ends are connected. [W. Derek Meche, WM5TS, photo]

Figure 2 — Using lacing cord for power wires. [W. Derek Meche, WM5TS, photo]

Building the Wiring Harnesses

I would suggest purchasing a product to hold the wires as you tie them. If getting behind your station is an issue, you will want to leave enough slack on your wire and cables so any piece of equipment can be safely pulled toward you and disconnected should the need arise.

There are several products you can use for tying and mounting your harnesses:

Zip ties: These are for permanent installs. Make sure you use the right size for the cables you are securing. Zip ties should not be overtightened.

Lacing cord: An inexpensive alternative to zip ties, this waxed cord has been used by telecom companies for many years. This cord is strong and just as permanent as zip ties (see Figure 2).

Spiral wrap: Easy to get on and off. If you think you'll be moving cables around, this is one to consider.

Hook-and-loop fasteners: Better known by the trade name Velcro™,

these are the easiest to use. The material can be purchased in a roll and cut to length. Space these out evenly and make sure to leave enough to go around the cable at least one and a half times for a tight bundle.

Management rail: These rails are for use on either a 19- or 23-inch telecom equipment rack. Your cables can be made to look very neat with these.

Wire way: There are several brands and sizes of slotted and solid plastic wire ways that hold cables in place. Wires can emerge near the equipment they connect to and tied the remainder of the way (see Figure 3).

Cable tie mounts: These are plastic "button" type mounts that screw to the back of a desk. Make sure to use the screw type as, after a short time, the adhesive ones fall off.

Grounding

Ground wires should flow evenly into a common ground bar with one ground leading to each piece of equipment. A larger-diameter wire should go from the ground bar to the earth ground connection. I use #10 AWG from the equipment to the ground bar and #6 AWG from the ground bar to the ground connection. For the grounds, I would use zip ties or lacing cord in combination with either one of the mounting choices listed.

Power Wires

The dc power lines coming from a fuse block or distribution strip should be bundled together. Make one power bundle and run it toward the radios. The pairs that reach the first radio will be on the outside of the bundle and the first to drop out. The farthest run is going to be positioned at the back side of the bundle.

Figure 3 — A slotted wire way (left) with wires attaching to nearby terminals. [W. Derek Meche, WM5TS, photo]

I use two-conductor wire so the positive and negative wires for the same unit are together. I wrap the wires through ferrite core on the ends closest to the radios.

If you use monitors or other accessories that run on ac power, these should be tied separate from the dc wires. Zip ties and lacing cord are best for power wires. Any mounting choice works well with these.

Interconnecting Cables

All the other cables are "interconnect cables." These are the USB, CAT 5, amplifier interface, microphone, monitor, and all other cables. This harness is going to be looser than the others. In cases where multiple cables are coming from one piece of equipment, bundle those cables together.

RF Cables

These are the largest cables, and the ones that will be running away from the others toward the antennas. Connect these last and to the outside of the others if part of a harness. Tying these together may not be practical. If you are going straight from the radio to the antenna feed line, then there is nothing to bundle. — *73, W. Derek Meche, WM5TS,*

Technical Correspondence items have not been tested by *QST* or ARRL unless otherwise stated. Although we can't guarantee that a given idea will work for your situation, we make every effort to screen out harmful information.

Materials for this column may be sent to ARRL, 225 Main St., Newington, CT 06111; or via email to **tc@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 a work, please send the author(s) a copy of your comments. The publishers of *QST* assume no responsibility for statements made herein by correspondents.

New Products

SSB Electronics Germany SP 400 Low-Noise 70 MHz Preamplifier

SSB Electronics in Germany has announced their new SP 400 mast preamplifier for the 4-meter band. When using sequence control, the maximum transmission power is 750 W PEP and 400 W CW/FM/WSJT. The preamplifier can be powered remotely via the coax cable through its output and supply voltage. The preamplifier is low-noise and has a coax relay for transmit/receive switching. For more details or to purchase, contact **sales@ssb-electronic.com** or visit **www.ssb.de**.

Steve Ford, WB8IMY, wb8imy@arrl.net

Eclectic Technology

Hunting Signals with *Artemis*

There are so many signals on the bands these days, it's a challenge just to figure out what you might be hearing. Hams and many other nonamateur listeners have been building a repository of identified signals at a website known as Sigidwiki and have created an online Signal Identification Guide, at **www.sigidwiki.com/wiki/Signal_Identification_Guide**. The identification guide is massive and contains verified examples of signals from VLF all the way to UHF, including sound samples.

Figure 1 — You can use *Artemis* to browse a wealth of verified signal samples and search for mysterious signals appearing at specific frequencies.

The only issue with navigating Sigidwiki is its sheer size. That's recently been made much easier with a front-end application known as *Artemis* (see Figure 1). Yes, that's the Greek goddess of the hunt, the wilderness, wild animals, the moon, and chastity, but it's hunting we're most concerned with here.

The *Artemis* Front End

It's fair to say that *Artemis* acts as a "front end" to Sigidwiki, sorting signals into straightforward categories that you can browse. For each signal, *Artemis* provides a sound sample as well as a waterfall image for those who are using software-defined radios (SDRs).

Artemis also has a handy search feature. Just type in the frequency of the signal you're hearing, and *Artemis* will query Sigidwiki to see what sorts of signals have been reported recently at that frequency. Commercial and military signals tend to repeat on the same frequencies, so this function is particularly useful for those candidates.

Finally, *Artemis* offers a nice display of current space weather conditions, including propagation forecasts.

Free Download

Artemis is free to download at **https://aresvalley.com/Artemis**. The software is available for Windows, Mac OS, Linux, and Raspberry Pi.

This application doesn't install to your computer with the usual routines. Instead, you extract the Zip file to wherever you would like the application to reside. Then, you simply start the application. My station PC runs Windows 10, so after extracting the files to a folder of my choice, I navigated to the folder, right-clicked on the application icon, and sent a shortcut to the desktop.

When you start *Artemis*, it is best to go to the **UPDATES** menu in the upper-left corner and request the latest data. People are adding signals to Sigidwiki all the time. In fact, you can use *Artemis* to add signals you've found. You'll also need to update for the latest geomagnetic conditions when you access the **RX/TX CONDITIONS** menu. Just click on the **CLICK TO UPDATE** button in the lower-right corner.

Strays

QST Congratulates...

Dr. Fred Regennitter, K4IU, who was awarded the 2020 Leadership of the Year Award from the University of Iowa Dental Alumni Association and the College of Dentistry. The award recognizes Fred's 45 years of work with patients, the military, students, and research.

One Million QSOs
PJ2T
Celebrates 20 Years

This DX contest station continues to thrive after 2 decades.

Geoff Howard, WØCG/PJ2DX

If you're a contester, you'll recognize the call sign PJ2T. Even if you don't, chances are you've contacted us. We logged our 1,000,000th Logbook of The World (LoTW) contact in November 2019, during the CQ World Wide DX Contest. Alex Murashkin, UT3V, had the honor of being that contact, on 20 meters. Outside of LoTW, we've made hundreds of thousands of contacts before and after contests, and before the inception of LoTW. It's hard not to work PJ2T.

PJ2T is a contest club in Curaçao. Unfortunately, the COVID-19 pandemic has kept us off the air for most of 2020, but the November 2020 CQ WW Contest weekend marked 20 years since the club's first contest contact, made with Gary Caldwell, VA7RR, on 10 meters in the November 2000 CQ WW Contest.

The Caribbean Contesting Consortium's home view from one of the towers. [Geoff Howard, WØCG, photo]

Station Sustainability

Establishing and maintaining a large DX contest station is tough. Curaçao is in the southern Caribbean, and is difficult and costly to get to. Theft and vandalism are a concern when no one is at the station. We're at the end of a very long supply chain. Equipment vendors and expert repair are far away. Shipping is difficult and expensive. The government can be challenging to work with. For those and many other reasons, large overseas contest stations come and go fairly quickly if their owners run out of patience, energy, or resources. PJ2T has beaten the odds and survived all these years because of our unique organizational model.

PJ2T runs thanks to the effort and support of 25 members who pay annual dues and contribute a lot of work and donated resources. We're an ARRL chartered club called the Caribbean Contesting Consortium (CCC). We formed CCC in 1995, based on our mutual excitement for the fantastic contest operating conditions from the islands. After 5 years of nomadic contesting in the Caribbean, we were fortunate to buy a house in Curaçao, naming it Signal Point.

Starting with what John Thompson, W1BIH (SK), established in Curaçao in 1970, we now have a stable operating location. Building a large, permanent contest station was only possible because of our group structure. In 2000 and 2001, CCC members painted, plumbed, wired, weeded, and mowed to make Signal Point habitable. They donated transceivers, tower sections, antennas, computers, tools, money, and a lot of work. By fall of the 2001 contest season, we had towers 60, 80, and 100 feet high and a lot of Yagis, wires, and receiving antennas in place. We never imagined that this would go on for 20 years and eventually top a million contacts. As the years went by, we expanded to multi-multi contesting capability; improved the house amenities; hauled in more equipment; built an inventory of tools, spare parts, and test equipment, and have continued to have fun.

We had to figure out how to sustain the club from a combination of small sources. Initially, CCC members paid annual dues of $400. We also instituted a model where we "rent" the location from ourselves, and operators put money into a pot during each contest; however, we've stopped doing that because of the complexity of today's station. Much of our equipment has been donated or given to us on a long-term loan. In our early years, most of our equipment was provided by Tom Kravec, W8TK. Now, much has been donated by estates and CCC members.

It takes tremendous logistics and discipline to manage a big station and all its equipment from a distance. Through careful recordkeeping, diligent labeling of the thousands of items stored in almost 500 numbered containers, and careful coordination of shipments back and forth to the US, everything keeps running smoothly. CCC members Gene Shea, KB7Q, and Gary Hembree, N7IR, handle the computer and remote operation chores, and keep everything in the shack working. We have two CW *Skimmer* gurus (Jim Galm, W8WTS, and Jeff Maass, K8ND), two experienced tower and antenna guys (Geoff Howard, WØCG, and Jason Joens, NRØX), and a slate of club officers led by our CCC President, Mark Beckwith, N5OT. We're also grateful to Joseph Arcure, Jr., W3HNK, who has tirelessly processed thousands of PJ2T QSL cards over the years.

A Typical Contest Week

We exchange hundreds of emails over many months in order to build a team of operators for a particular contest, help them arrange their travel to Curaçao, and figure out an on-the-air operating plan. Everyone arrives on Tuesday before the contest weekend, rents cars at the airport, and gets settled into Signal Point, as well as in a rental house that's a 5-minute walk from PJ2T.

Geoff Howard, WØCG, and Gary Caldwell, VA7RR, with a plaque commemorating the first contact in PJ2T history, made 20 years ago. [Geoff Howard, WØCG, photo]

Alex Murashkin, UT3V, made the 1,000,000th LoTW contact with PJ2T. [Alex Murashkin, UT3V, photo]

Our teams are almost always a mix of CCC members and guests. The guests are a huge help when we can't find enough members to staff a contest, and many eventually become members. We spend the 3 days before the contest re-familiarizing with the station and logging software and working on maintenance. At 8 PM (local) on Friday night, the contest begins. Operator shifts average about 4 hours, and we often log our first 1,000 contacts in less than 2 hours. The contests usually end Sunday evening, having made as many as 16,000 contacts. Reluctantly, the crew makes their way to the airport on Tuesday to fly home. In the past 2 decades, we've been privileged to host operators from many nations around the globe and make new friends at every turn.

The cohesion among our PJ2T members comes from a shared passion for HF DX contesting, but that's not all we do. There are many long, casual contacts made from Signal Point outside of the contest weekends. Our members also enjoy EME, satellite work, nets, and VHF. We have also happily hosted young operators participating in the Dave Kalter Memorial Youth DX Adventure. But for us, the fun is often making over 10,000 contacts in a weekend and usually achieving Five-Band DXCC in only 48 hours. Contests provide the best opportunity for you to work new countries, zones, and grid squares quickly.

Celebrating 20 Years

We're excited to have reached our 20th anniversary last November. Until COVID-19, we had only missed one major contest. Regrettably, the pandemic has kept us off the air since mid-March 2020. We'll be back in a big way as soon as possible. We hope you'll work us in the contests and any other time you hear Signal Point operators on the bands.

This anniversary honors many key people. John Thompson, W1BIH and PJ9JT (SK), was the original owner of our Curaçao home, and we stand on his shoulders. We also remember and celebrate our CCC members who are now Silent Keys: Noel Kindt, W9EFL; Joe Schroeder, Jr., W9JUV; Wayne McKenzie, K8LEE; Keith Wishmeier, WA9S, and our former QSL Manager Scott, N9AG.

If you haven't tried a contest, jump in! Contact new countries, have fun, and be sure to say hi to PJ2T.

Geoff Howard, W0CG/PJ2DX, is an ARRL Life Member and is an electrical and professional engineer. He is a retired systems professor at Kent State University in Ohio and served 30 years in the US Air Force. Geoff is the leader and organizer of the PJ2T contest station in Curaçao and has been a legal resident of the island for 2 decades. First licensed in Wheeling, West Virginia, in 1963 as WN8KUW, he fell in love with CW and DXing. When he's not contesting, he lives in Coeur d'Alene, Idaho. Geoff can be reached at **ghoward@kent.edu**.

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

Feedback

- In the November 2020 article, "Frequency Measuring Test — November 2020," by Ward Silver, N0AX, the solar eclipse graphic should have identified the receiver as belonging to W8EDU. *QST* regrets the error.
- Several technical errors have been addressed regarding Dave Casler's, KE0OG, article, "Exploring Radio Mathematics," which appeared in the November 2020 issue of *QST*. An updated version of the article is now available on the *QST* in Depth web page, at **www.arrl.org/qst-in-depth**, and in the November 2020 digital edition of the magazine.

The Harris County ARES® NVIS Workshop

Find out how this Texas county manages its critical need for emergency communications.

Russell Richter, WP2AHG

On November 3, 2019, members of the Harris County Amateur Radio Emergency Service (ARES) gathered in Houston, Texas, for a Near Vertical Incidence Skywave (NVIS) mini-Field Day. They met beneath a 500-foot radio tower behind the Harris County Office of Homeland Security and Emergency Management.

Over the last several years, Harris County has been the target of widespread natural disasters: Hurricanes Imelda (2019), Harvey (2017), and Ike (2008); the Tax Day Flood (2016); the Memorial Day Flood (2015); Tropical Storm Allison (2001), and unnamed flooding events in 2009, 2012, and 2014. These natural disasters threatened the communications infrastructure in the region. Harris County ARES members were activated to serve as emergency communicators.

Walt Sepaniac, N5TQ, a Liaison AEC for District 14 of Harris County ARES, made contacts using his go-kit.

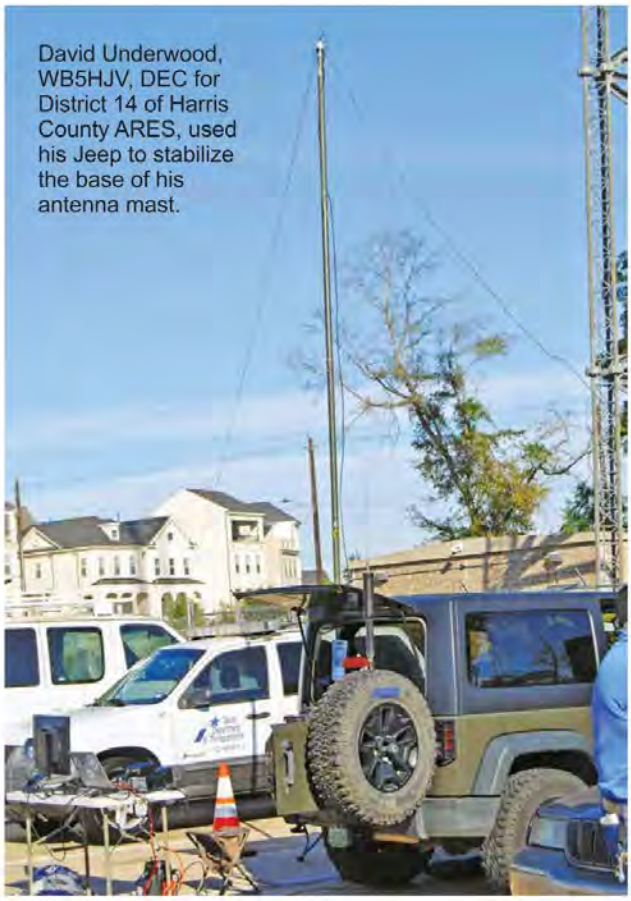
Peter Aronstam, KW5PA, set up an inverted **V** Buddipole antenna for NVIS.

Linda Kangas, W5LDK, ADEC for District 14 of Harris County ARES and a Training AEC in the southwest unit, contacted a station in St. Louis, Missouri. It was her first contact on the 40-meter antenna she built that morning.

Event Details

The event challenged ARES members to test various designs of rapidly deployable amateur radio stations using portable power, as well as HF antennas that would be used in a communications emergency for passing traffic to stations outside a disaster-affected area. NVIS propagation is ideal for disaster communications due to its relatively short range, compared to skywave propagation used for DXing. The event involved 12 participants, seven antennas, and scores of contacts. Here are some highlights of the event:

- Event organizer and Operations Assistant Emergency Coordinator (AEC) for District 14 of Harris County ARES, TJ Butler, N5CFT, set up a battery- and solar-powered Yaesu FT-817ND transceiver with an end-fed 40-meter antenna from Par EndFedZ®, and a 40/80-meter cross-dipole antenna. He worked a low-power station in Oklahoma.
- Sherwin Klemp, K5SEK, an Operations AEC for District 14, set up a Buddipole on 80 meters, making several contacts as far away as northern Oklahoma on his Yaesu FT-817ND.
- Linda Kangas, W5LDK, built a 40-meter dipole on site. The first station she contacted was 690 miles away, in St. Louis, Missouri. Linda is an Assistant District Emergency Coordinator (ADEC) for District 14 and a Training AEC in the southwest unit.
- Walt Sepaniac, N5TQ, a Liaison AEC for District 14, brought his go-kit to the event and set up a dipole antenna, contacting a station 20 miles north of Lawton, Oklahoma.
- Peter Aronstam, KW5PA, an ADEC for District 14, brought his radio, PACTOR modem, and Buddipole. He contacted stations on 40 meters.



David Underwood, WB5HJV, DEC for District 14 of Harris County ARES, used his Jeep to stabilize the base of his antenna mast.

TJ Butler, N5CFT; Walt Sepaniac, N5TQ, and Mike Dome, KG5NOV, erected a 40-meter NVIS Par EndFedz antenna.

- David Underwood, WB5HJV, District Emergency Coordinator (DEC) for District 14 of Harris County ARES, brought his Icom IC-7300 and Jeep-mounted screwdriver antenna to contact digital stations.

Sherwin Klemp, K5SEK, set up a Buddipole antenna for 40 meters.

Summary

Each station during the event was running 100 W or less, because the point was to test antenna designs for emergency communications, rather than making contacts. All the stations that were contacted were within the expected range of NVIS propagation, showing the efficacy for emergency communications of each antenna type that was deployed. Served agencies in Harris County can be assured that in the event of a communications emergency, Harris County ARES hams can set up off-the-grid radio stations and contact hams outside the affected area.

All photos by the author.

Russell Richter, WP2AHG, earned his Novice-class license while working at RadioShack in 1991, and earned his Amateur Extra-class license in 2013. Since 1993, he has worked as a business analyst at HP Inc. Russell enjoys working public service events with his older daughter, KG5IRE, and going on long walks with his younger daughter. Russell is currently the ARES Emergency Coordinator for Harris County's Southwest Unit. He can be reached at **wp2ahg@gmail.com**.

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

VOTE
If you enjoyed this article, cast your vote at www.arrl.org/cover-plaque-poll

Rick Lindquist, WW1ME, ww1me@arrl.org

Happenings

ARRL Asks FCC to Waive Proposed Amateur Application Fees

Commenting in November on an FCC proposal to impose a $50 fee for every amateur radio application, ARRL urged the Commission to waive the fee schedule, spelled out in a *Notice of Proposed Rulemaking* (*NPRM*) in MD 20-270. The fees, directed by Congress, affect all FCC services, not just amateur radio. They are intended to recover the FCC's costs of handling and processing applications. ARRL noted that the FCC has explicit authority to waive the fees if it would be in the public interest, and maintained that is the case for the Amateur Radio Service. ARRL argued that the Amateur Radio Service is all volunteer and largely self-governing, with tasks such as exam preparation, administration, and grading — once handled by the FCC — now performed by volunteers. Amateur volunteers and organizations also administer club station licenses and call signs for special events. ARRL noted that amateur radio volunteers also support FCC enforcement through the Volunteer Monitor program.

"By these volunteer services, the amateur community is directly involved in lessening the regulatory burden — including the application burden — on the Commission's resources and budget in ways that other services are not," ARRL said. ARRL further argued that the public interest in amateur radio-provided emergency and disaster communication, STEM education, and other volunteer services justifies the requested fee exemption.

"The FCC should exercise [its] authority and exempt amateur applications from application fees generally," ARRL said. Failing that, ARRL said, the FCC should waive fees for applicants age 26 or younger.

ARRL Comments in Orbital Debris Mitigation Proceeding

ARRL targeted two specific areas of concern in its comments on a *Further Notice of Proposed Rule-making* (*FNPRM*) in IB Docket 18-313 — mitigation of orbital debris in the new space age. In an earlier phase of the proceeding, ARRL filed comments and met with FCC staff to discuss the proposed rules. In comments filed on October 9, ARRL focused on the areas of indemnification and maneuverability/propulsion. Indemnification places the liability for any possible damage from a satellite on an individual or entity. ARRL reiterated its assertion that, as a practical matter, an indemnification requirement "would seriously impair the ability of amateur and university experimenters to launch and operate satellites under US auspices" due to the potential liability and high insurance cost. ARRL argued that if the FCC does adopt an indemnification requirement, it should allow either the owner or the licensee of an amateur space station to provide indemnification. In the Amateur Satellite Service, a licensee can only be an individual. An individual licensee is unlikely to accept liability for a satellite, but a satellite owner might.

The FCC proposal would also require that all space stations deployed in low-Earth orbits higher than 400 kilometers (about 250 miles) be able to maneuver with the use of some sort of onboard propulsion system. ARRL urged adoption of an exception for "a limited number of amateur and similar experimental satellites" that are below a specified size and mass and either standalone spacecraft or in a constellation of no more than four or five individual satellites.

In concluding its remarks, ARRL asked for "reasonable accommodation," given the public benefit of the Amateur Satellite Service, rather than lumping small experimenters and researchers with large corporate entities.

ARRL Asks FCC to Reconsider Order to Remove Amateur Radio from 3.4 GHz Band

ARRL has petitioned the FCC to reconsider its order removing the secondary amateur allocation at 3.3 – 3.5 GHz and requiring that amateur operations in the 3.450 – 3.500 GHz band cease "on a date consistent with the first possible grant of flexible use authorizations to new users."

"Continued operation of amateur stations similarly should be permitted in the vacant portions of this spectrum that otherwise will go unused," ARRL said, asserting that the public interest is in using the spectrum, not in leaving it vacant waiting for some future application. "The Commission's decision in this proceeding undermines its long-standing policy objective to provide for and encourage more intensive use of spectrum," ARRL said.

ARRL said that weak-signal point-to-point amateur communication often applies new technologies, methodologies, and coding to improve the communications capability of equipment. Hams also operate beacons to study propagation, contributing to a better understanding of propagation, use the band for moonbounce, repeaters, and satellites, and for digital high-speed data mesh networks.

"Design of and work with mesh networks has attracted an ongoing stream of computer-literate youth to the amateur ranks," ARRL contended. "The networks themselves are commonly employed for digital experimentation with a wide range of technologies and services, with a bedrock purpose of emergency readiness and availability during actual emergencies.

In Brief...

- **Robert Bankston, KE4AL, of Dothan, Alabama, is the new president of AMSAT.** The AMSAT Board of Directors elected Bankston at its annual meeting on October 18, to succeed Clayton Coleman, W5PFG. Bankston is a Life Member of both ARRL and AMSAT.

- **Charles Clifford "Cliff" Kayhart, W4KKP, died on October 26, a few days past his 109th birthday.** An ARRL member, Kayhart, of White Rock, South Carolina, was the oldest known US radio amateur and possibly the oldest ham in the world. In November 2019, Roanoke Division Director Bud Hippisley, W2RU; Vice Director Bill Morine, N2COP, and South Carolina Section Manager Marc Tarplee, N4UFP, jointly presented Kayhart with ARRL's Centurion Award, which honors centenarian members who have at least 40 years of ARRL membership. First licensed in 1937, Kayhart earned a degree in aeronautical engineering. During World War II, Kayhart joined the US Army Signal Corps, serving on Iwo Jima, shortly after the US victory there, setting up equipment for long-range radio communication and broadcasting. Kayhart remained active on the air until shortly before he died.

- **A giant in the field of low-frequency DXing and contesting, John Devoldere, ON4UN, of Merelbeke, Belgium, died on November 9.** An ARRL Life Member, he was 79 and had been in failing health. In addition to his enthusiasm for operating, Devoldere may be best known as the author of the popular book *ON4UN's Low Band DXing*, published by ARRL, as well as other books, including *Ethics and Operating Procedures for the Radio Amateur*, which he co-authored with Mark Demeuleneere, ON4WW. "Ham radio, and especially low-band DXing, were my father's lifelong passions," his daughter, Marleen, said. Royal Union of Belgian Radio Amateurs (UBA) President Claude van Pottelsberghe de la Potterie, ON7TK, called Devoldere "a radio amateur in heart and soul" who will always be remembered. "We are grateful for his contribution to [amateur radio] and for his efforts within the UBA," he said. Licensed in 1961, Devoldere went on to demonstrate an impressive record of contesting and operating skill. He was elected to the CQ Contest Hall of Fame in 1997 and the CQ DX Hall of Fame in 2007.

ARRL Pacific Division Director Jim Tiemstra, K6JAT, SK

ARRL Pacific Division Director Jim Tiemstra, K6JAT, of Oakland, California, died on October 30. An ARRL Life Member, he was 65. Tiemstra was ARRL Pacific Division Vice Director from 2009 through 2017, sitting on the Board's Administration and Finance and Programs and Services committees. He became ARRL Pacific Division Director in January 2018. He was a member of the Administration and Finance Committee, the Legal Structure Review Committee, chair of the Legislative Advocacy Committee, and an advisor to the Amateur Radio Legal Defense and Assistance Committee, among other Board assignments.

Licensed in 1970, Tiemstra became N6OIK and later K6JAT after moving to California in the 1970s. Primarily a contester and DXer, Tiemstra had been a DXpedition member and had long been involved in the public service aspects of the hobby. As a member of the Oakland Amateur Radio Emergency Service (ARES) group, he was among those responding to the Loma Prieta earthquake in 1989 and the Oakland Hills firestorm in 1991, receiving a Certificate of Appreciation from the American Red Cross.

Tiemstra worked with his ARES group to gain RACES recognition, wrote the RACES Operations Manual, and was instrumental in drafting a formal Letter of Understanding with the City of Oakland. He served as Oakland's RACES Radio Officer for more than 14 years and was ARRL East Bay Section Emergency Coordinator. Tiemstra retired in 2018 as a federal practitioner in the private practice of law.

Vice Director Kristen McIntyre, K6WX, of Fremont, California, assumed the office of ARRL Pacific Division Director, and will serve as Director for the remainder of the current term, which expires on December 31, 2022.

Section Manager Nomination Notice

To all ARRL members in Maryland/DC, Nevada, New Hampshire, Northern New Jersey, Rhode Island, San Joaquin Valley, Utah, and West Texas. You are hereby solicited for nominating petitions pursuant to an election for Section Manager (SM). Incumbents are listed on page 16 of this issue.

To be valid, a petition must contain the signatures of five or more full ARRL members residing in the Sections concerned. It is advisable to have a few more than five signatures on each petition. A sample nomination form is available on the ARRL website at **www.arrl.org/section-terms-nomination-information**. Nominating petitions may be made by facsimile or electronic transmission of images, provided that upon request by the Field Services Manager, the original documents are received by the manager within 7 days of the request. 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 sent to you by ARRL (or downloaded from the ARRL website). The form must be exact on both sides (ie, 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 March 5, 2021. If more than one member is nominated in a single Section, ballots will be mailed from Headquarters no later than April 1, 2021, to full members of record as of March 5, 2021, which is the closing date for nominations. Returns will be counted on May 18, 2021. Section Managers elected as a result of the above procedure will take office July 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 July 1, 2021. If no petitions are received from a Section by the specified closing date, such Section will be resolicited in the July issue of *QST*. A Section Manager elected through the resolicitation will serve a term of 18 months. A Section Manager vacancy occurring between elections is filled through appointment by the Field Services Manager. — *Bart Jahnke, W9JJ, Field Services & Radiosport Department Manager*

Rick Lindquist, WW1ME, ww1me@arrl.org

Amateur Radio World

IARU Administrative Council Addresses Wide-Ranging Agenda in Virtual Meeting

The International Amateur Radio Union Administrative Council (AC) met in a virtual session on October 8 – 10. Consisting of the three IARU international officers and two representatives from each of the three IARU regional organizations, the council is responsible for IARU policy and management.

Recently appointed EMC Coordinator Martin Sach, G8KDF, reported on work being done to address the need for reasonable standards to limit the proliferating threat of radio spectrum pollution from digital devices and wireless power transmission (WPT).

IARU Beacon Project Coordinator Peter Jennings, AB6WM/VE3SUN, reported on the status of the NCDXF/IARU beacon network, explaining recent and planned upgrades, as well as the network's many applications.

Satellite Advisor Hans Blondeel Timmerman, PB2T, described the work of the Satellite Frequency Coordination Panel. He reported that steps are being taken to address the growing number of non-amateur satellites that use amateur satellite spectrum.

Special Advisor for Emergency Communications Rod Stafford, W6ROD, explained his work representing the IARU in the ITU Development Sector (ITU-D), particularly with regard to disaster communications. He highlighted an opportunity to promote amateur radio in ITU-D as a training platform for youth.

Preparations are already under way for World Radiocommunication Conference 2023 (WRC-23) of the International Telecommunication Union (ITU), currently expected to be held in 2023. A team of some 20 IARU volunteers from all continents is engaged in the conference preparations of the ITU and the regional telecommunications organizations. The AC reviewed a draft of IARU's positions on WRC-23 agenda items of concern.

ARRL Comments on FCC Draft WRC-23 Recommendations

ARRL has submitted comments on two draft recommendations approved in October by the FCC's World Radiocommunication Conference Advisory Committee (WAC). The comments focus on draft recommendations for World Radiocommunication Conference 2023 (WRC-23) Agenda Item (AI) 1.2. AI 1.2, which will consider the identification of frequencies in the 3.3 – 3.4 GHz and 10.0 – 10.5 GHz bands, among others, "for International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis," in accordance with WRC-19 Resolution 245. ARRL urged no change to the 3.3 – 3.4 GHz international secondary allocation to the Amateur Service in ITU Regions 2 (the Americas) and 3 (Oceania), and no change to the 10.0 – 10.5 GHz worldwide secondary amateur allocation.

ARRL said it wanted to reaffirm that these secondary amateur allocations continue to be important and useful and that WRC-23 should not consider changing either one.

ARRL noted that radio amateurs utilizing the secondary spectrum at 3.3 – 3.4 GHz and 10.0 – 10.5 GHz "have developed and honed their equipment and capabilities to share with the existing services."

In Brief...

- **Radio amateurs in New Zealand lost access to 60 meters, effective on October 24.** Amateur use of the band in New Zealand was provisional, allowing hams there to use two frequencies in the band — 5353.0 kHz and 5362.0 kHz — as part of a "trial."
- **A new IARU Region 2 Emergency Coordinator has been appointed.** The International Amateur Radio Union Region 2 (IARU-R2) Executive Committee has named Carlos A. Santamaria, CO2JC, as the new Region 2 Emergency Coordinator (EMCOR). He succeeds Cesar Pio Santos, HR2P, who retired after 12 years of service. Santamaria has extensive experience serving as Federacion de Radioaficionados de Cuba (FRC) National Emergency Network Coordinator.
- **Canada will retain amateur privileges on the 3.4 GHz band.** Although the FCC has announced plans to delete the secondary amateur radio 3.3 – 3.5 GHz allocation, that amateur allocation will remain in place in Canada. Radio Amateurs of Canada (RAC) said that the FCC action raised concerns among Canadian amateurs, but does not directly affect Canadian amateurs, who continue to have a secondary allocation on this band.

Rick Palm, K1CE, k1ce@arrl.net

Public Service

The ARRL Director of Emergency Management's Vision

I recently interviewed Paul Z. Gilbert, KE5ZW, of Cedar Park, Texas, in his new role as ARRL Director of Emergency Management. ARRL selected Gilbert this past summer, in the middle of one of the most active tropical weather seasons on record. He has 30 years of experience as an emergency management professional and an Amateur Radio Emergency Service (ARES) member. As a volunteer, he served as a liaison between Division leadership and local, state, and federal emergency management. He was active before and during his time served as South Texas Section Manager amid hurricanes in the West Gulf region, and assisted with the government campaign of hardening the public safety communications infrastructure and reducing interoperability issues that plagued the government's responses to the September 11 terrorist attacks and Hurricane Katrina.

Gilbert holds the rank of Captain as the Radio Officer, HQ Staff, for the Texas State Guard, and was a Public Safety Radio Coordinator for the State of Texas, charged with overseeing large-scale disaster communications response and identifying and eliminating in-state interoperability issues.

Gilbert is a member of the US Army Military Auxiliary Radio System (MARS), and is a COML, COMT, COMT Instructor, and AUXCOM Communicator. He's a member of the Federal Emergency Management Agency (FEMA) Regional Emergency Communications Coordination Working Group (RECCWG) and was a founding member of the Texas Division of Emergency Management Communications Coordination Group.

ARRL Director of Emergency Management Paul Z. Gilbert, KE5ZW, in his office. [Rick Palm, K1CE, photo]

He was a volunteer fireman in Texas, and when the department needed a radio technician, the fire chief — a radio amateur — knew immediately who to pick for the job. Gilbert appreciates the importance of the role of ARRL Public Information Officers and media relations, because he has 20 years of experience as a news media professional.

Q How did radio technical knowledge and proficiency get into your blood?

A My family owned a radio station, and that's how I got my technical background at an early age, working on stuff on the workbench.

Q You've had a trial by fire (and hurricane) since becoming part of the ARRL Headquarters staff. What has your job been like these last few months?

A It has been like drinking from an open 5-inch fire hose — that is to say, busy. I've spent a lot of time in communication with ARRL officials at the local, Section, and Division levels, drafting situation reports for distribution to the HQ staff and officials in the field.

Q I'm sure the modernization of ARRL emergency communications programs is high on your list of priorities. What else is on your agenda for the near future and long-term?

A My primary long-term mission is to make ARES a premier emergency communications program and thus a premier asset to our served partner agencies. Near-term objectives include outreach for recruitment of new ARES and ARRL members, and emphasizing the importance of training, certification, and professionalism; that is, acting and looking like the professionals we serve. There are some 60,000 ARES registrants (with 15,000 active members) across the country and we would like to double that number. That will involve outreach and special campaigns such as Each One, Bring One, where existing ARES members are asked to reach out and recruit a new member.

Our goal is force augmentation, which includes expanding radio amateurs' abilities to perform non-traditional tasks such as operating a public safety-band radio when called upon by an emergency manager, adding value to our presence in the Emergency Operations Center (EOC) or the Red Cross shelter or regional office.

The ARRL ARES Connect registration, training, and activity tracking platform will also receive a review, along with other ARES resources such as the *ARES® Emergency Communicator Individual Position Task Book*.

Q What agencies do you see as our key partners in emergency response and how do you relate with them?

A All of them are important, but lately I've been working with FEMA and the FCC on special rules waivers such as the PACTOR 4 Special Temporary Authorization (STA) for an increased data speed or symbol rate limit. The FCC granted ARRL's request to facilitate relief communications during the Hurricane Laura emergency. We had pointed out that ARES members and other amateurs would be working with federal, state, and local emergency management officials to assist with disaster relief and may use radio modems capable of both PACTOR 3 and PACTOR 4 emissions. The higher data rates that PACTOR 4 offers are critical to sending hurricane relief communications, including lists of needed and distributed supplies.

Others are the Salvation Army and the Salvation Army Team Emergency Network (SATERN), the American Red Cross, and the National Voluntary Organizations Active in Disaster (National VOAD). I work with and support state, county, and local RACES; ARES, and other Auxiliary Communications Services (ACS) groups, helping them with their relationships where the rubber meets the road.

Q Do you agree with the need for super high frequencies for greater bandwidth that affords higher speed data transfer and a wider array of data modes, including seamless streaming of video to keep pace with the ever-increasing needs of served agencies?

A Yes, for two reasons. First, served agencies' own telecommunication systems have become faster and more versatile; we must keep pace with them or face becoming irrelevant. And second, we must use our extremely valuable spectrum at the region or risk losing it. For example, the FCC recently decided to delete the amateur service from the 3.3 to 3.5 GHz band. That decision should represent a call to use our microwave frequencies or lose even more.

Q What would you like to say to the members of the ARRL Field Organization, National Traffic System, and especially the Amateur Radio Emergency Service and other amateur emergency service providers?

A There is so much to say, but I'll leave you with this suggestion: Encourage your fellow amateurs to join ARES and take the wide array of training available to render us as quasi-professionals in the EOC or Red Cross shelter. A perfect example is the Auxiliary Emergency Communications Course (AUXCOM) offered by the Department of Homeland Security, which is considered to be an official certification. The AUXCOM course prepares radio amateurs to check their home associations' names and credentials at the front door of the EOC, so that once inside, all amateur operators become unified into one group — the auxiliary communications service. Become an AUXCOM communicator!

Field Organization Reports

October 2020

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**.

615
W7PAT

550
N9VC

537
WA7PTM

500
WA3EZN

430
KD8TTE

428
KE8BYC

350
ND8W

349
AD8CM

320
WA2CCN

315
WØPZD

260
KW9EMG

259
KC8YVF

255
W9GRG

250
KD2NMG

240
KT2D

220
WO2H

215
WB9WKO
ALØY

210
KC9FXE

205
KI5GRH

200
K3JL

193
KB8LKH

191
WA2CCN
AC8NP

190
N8SY

175
WD8USA

172
KD2QAR

170
W2PH
K8AMH

168
N3KRX

167
KV8Z

165
KB8RCR

160
KL7RF
KC8WH

156
AD4DO

155
WA2BSS
K9LGU

152
N2WGF

151
WM2C

150
AG9G
ACØKQ
KD8UUB
N1PZP
KØRCJ

146
AB3WG

145
AD3J
W4DNA

142
W8DJ

140
W8MAL
K4IWW
NI2W
KK3F
KA8ZGY

139
KD2LPM
KY2MMM

135
W3YVQ
N5MKY

134
AI9F

133
WB9QPM

132
WB8YYS

130
KDØHHN
W7EES
N2JBA
WB8SIQ
KD8UOT
KW1U
N4CNX
WK4WC
NA7G
W3GWM
KF5OMH
N1LL

127
KB9LXH

126
K1CFI

125
KF5IOU

120
WA4VGZ
W4NWT
WC4FSU
NX9K
K2TV
W9RY
K2RMF
N7IE
WØLAW
KY2D
KA9QWC

119
K8RDN

118
NØUMP

115
W2PAX
KN9P
K1XFC
N1TF

114
W4CMH
K3FAZ

112
KD2GRS

110
K6HTN
KO4OL
W1KX
WA3QLW
WB8YLO
K8MDA
K8KRA
KB1NMO
N1IQI
W1RVY
KA9MZJ
KA2ZNZ

KD2IWN
N2LJM
K3IN
AB1AV
N3SW
AF4NC
KI7TIG
KB2QO
KD8ZCM
WB8TQZ
KA5AZK
KG5NNA
WF2Y

108
N2DW

106
W8IM

105
K1HEJ
KB3YRU
K8ED

103
WX2DX

100
WB4RJW
KZ8Q
AC8RV
KA1G
N8CJS
K3RC
N1LAH
K2EAG
KB2YAA
AA3SB
WA1MXT
W7PHX
KA2GQQ
W3CJD
KE5YTA

98
KØFBS
KBØDTI

97
KA2JFU
W9EEU

95
KE1ML

94
KB8PGW

93
K7OED

92
WA1URS
KC1HHO

90
KM4WHO
WB4ZDU
N2TSO
KB8HJJ
KC1KVY

WA1LPM
K3MIY
N4ZM
AA7BM
K2MJF
KA2HZP
W2AH
WB8WKQ
AB9ZA

89
K9GDF
W1INC

88
K6JT

87
WJ3P
WS4P

86
N7IET

85
AA3N
W4TTO

84
KN4AAG
KF7GC

82
N3RB

81
WV5Q

80
N8MRS
KC1MSN
W4EDN
K2JPS
KG7QWR
W9BGJ

79
W5XX

77
W8DW

76
W4INK
K7ASA

74
NV1N

73
K6RAU
W3ZR

72
N3JET

70
WB2VUF

The following stations qualified for PSHR in September, but were not reported in this column: KT2D 220, KD2NMG 202, WA2BSS 147, WO2H 145, N2JBA 130, N1PZP 110, WM2C 107, WA1MXT 100, AB1AV 106, N2TSO 90, K1CFI 72.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AK, AR, AZ, CO, CT, DE, EMA, ENY, EPA, IL, IN, KS, KY, LA, LAX, MDC, ME, MI, MN, MO, MS, MT, NC, ND, NFL, NH, NLI, NM, NNJ, NV, OH, OR, SC, SFL, SJV, SNJ, STX, TN, UT, WCF, WI, WMA, WNY, WPA, WV, WY.

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: AR, CT, ENY, EWA, GA, ID, IN, KY, LA, MI, MN, MO, MS, MT, ND, NLI, NM, NNJ, NV, OH, OR, PAC, SCV, SFL, SJV, SNJ, STX, TN, UT, VI, VT, WI, WPA, WTX, WWA, WY.

Brass Pounders League

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

KK3F 1,238, K6HTN 954, KW1U 815.

Maria Somma, AB1FM, ab1fm@arrl.org

Exam Info

FRNs at Exam Sessions

The FCC has indicated VEC organizations and their VE teams should discontinue the practice of accepting Social Security numbers at exam sessions. Examinees should register in the FCC Commission Registration System (CORES) and receive a Federal Registration Number (FRN) before exam day.

The FCC also advised VE teams to make it clear to candidates that some information about them will be made publicly available on the FCC's website, including their name, mailing address, and felony conviction status.

Dorothy Stifflemire, the Associate Division Chief of the WTB Technologies, Systems, and Innovation Division, told VECs that new license applicants should create an FCC user account and register their Social Security number in the FCC CORES system before attending exam sessions. Registrants will be assigned an FRN, which will be used in all license transactions with the FCC.

She explained that auto-registration in CORES for examinees using a Social Security number will be going away. In addition, because no mail is being sent due to the COVID-19 pandemic, applicants will not receive their auto-created password and FCC FRN information and will not be able to access their personal license record in the FCC Universal Licensing System database or their FRN record in CORES. Going forward, she said, VECs should make sure all applicants have an FRN before the day of the exam.

Additionally, FCC Mobility Division (MD) Deputy Chief Tom Derenge recommended that VECs make it clear to applicants that their address will be public information when the new license is issued. He suggested advising examinees that an alternative address, such as a PO Box or work address, would be acceptable. Derenge pointed out that once an address is in the FCC database, it's nearly impossible to be permanently removed.

We urge our VE teams to change procedures before the FCC turns off the Social Security number auto-registration feature. Otherwise, this could cause a delay in processing applications to the FCC later. Examinees can be directed to this information on our website, at **www.arrl.org/what-to-bring-to-an-exam-session** (see item 4), or directly to the FCC website, at **www.arrl.org/fcc-licensee-privacy**. To register on the FCC CORES site, visit **https://apps.fcc.gov/cores/userLogin.do**.

ARRL VE Exam Maker Software Being Phased Out

The *ARRL VE Exam Maker* test-generating software will no longer be supported after December 2020. Adobe Flash Player was discontinued at the end of 2020, which was the software's installation platform.

An already downloaded and installed copy of *Exam Maker* should continue to work on users' computers. The program runs in its own environment on the computer, whereas the Flash Player problem is in web browsers during download. Even though the program will continue to function, the ARRL VEC will not be able to push out any important updates to the software, question pools, or questions. Current *Exam Maker* users should contact ARRL VEC at **vec@arrl.org** for alternative software system information.

Video-Supervised Online Examinations

Remote video exam sessions are conducted using an online videoconferencing platform and a web-based examination system with on-screen tests.

To be selected to participate in the remote video sessions program, ARRL VE teams must be long-standing, well established teams with a history of adhering to the highest degree of examination integrity, that consistently submit accurate exam documents consistent with ARRL VEC standards, and follow FCC rules and VEC policies.

Time and experience with in-person exam sessions is invaluable when transitioning to video sessions. Team leader experience at in-person sessions and/or training with an established team as a team leader for video sessions is required.

Interested ARRL VE team leaders must contact the VEC department at **vec@arrl.org** for approval and to receive the complete video-supervised online testing procedures and instructions.

Resources for ARRL VEs

Information discussed in Exam Info columns or VE Newsletters can always be found on the ARRL VEC VE Resources page at **www.arrl.org/resources-for-ves**. The support page offers easy access to instructions and information needed to conduct exam session business.

Session Documents Upload Web Page

Due to delays with the US Postal Service, some exam session packages have been unexpectedly delayed. Uploading completed sessions as a PDF file (scanned documents) via the web allows for quicker processing to the FCC. Please email **vec@arrl.org** for information on e-filing exam session documents through our secure upload page. Authorized VEs will be sent the upload page URL, which is hidden from the public.

The VE team must only accept FRNs at the session. Social Security numbers are not permitted on any exam documents or session files that are uploaded. Candidates will have to be registered in the FCC system and have FRNs already issued.

FCC Basic Qualification Question (Felony Question)

Applicants are required to answer the FCC basic qualification question if they are filing for any of the following purposes: New, Amendment, Modification (upgrade or call sign change), Renewal, or Renewal/Modification. Applicants filing for any other purpose (ie, address change) are not required to answer this question.

If an applicant answers "Yes" to the basic qualification question (felony question), they must submit the required documentation directly to the FCC. Follow the outlined FCC procedures at **www.arrl.org/fcc-qualification-question** and reference the application file number.

Applicants must take action within 14 days of the application filing date, or the application will be dismissed by the FCC. An examinee that answers "Yes" at an exam session should not communicate any information or documents to the Volunteer Examiner team or the VEC.

2021 ARRL VEC Examination Fee Remains at $15

Visit the ARRL VEC exam fee page at **www.arrl.org/arrl-vec-exam-fees** for exam fee and VE reimbursement information.

Eric Casey, KC2ERC, ecasey@arrl.org; www.arrl.org/hamfests-and-conventions-calendar

Convention and Hamfest Calendar

Abbreviations

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

WEST CENTRAL FLORIDA SECTION CONVENTION

December 11 – 12, Plant City, FL
D F H Q R S T V
Fri. 1 – 6 PM, Sat. 8 AM – 4 PM. *Spr:* Florida Gulf Coast ARC. Florida Strawberry Festival Grounds, Expo Building, 301 Berryfest St. Tampa Bay Hamfest. *Adm:* Advanced $9, door $10. **www.tampabayhamfest.com**

Maryland (Cheltenham) — Dec. 12 D F H R T V
8:30 AM – noon. *Spr*: American Legion and Prince George's ERA. American Legion Youth Camp, 9201 Surratts Rd. *Tl:* 145.23 (110.9 Hz). *Adm*: $6. **www.pgares.org**

New York (Marathon) — Jan. 9 F H R V
7 AM – noon. *Spr*: Skyline ARC of Cortland, NY. Marathon NY Civic Center, 16 Brink St. *Tl*: 147.18 (71.9 Hz). *Adm*: $5. **www.skylineradioclub.org**

NEW YORK CITY – LONG ISLAND SECTION CONVENTION

January 9, Brookville, NY
S
7:30 AM, forums start at 9 AM. *Spr:* Ham Radio University ARC. Ham Radio University, Virtual Hamfest. *Adm:* free. **www.hamradiouniversity.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 **January 1** to be listed in the **March** 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**.

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

Contest Corral

January 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 Date-Time		Date-Time		Bands	Contest Name	Mode	Exchange	Sponsor's Website
1	0000	1	0100	3.5	AGB New Year Snowball Contest	CW Ph Dig	RST, serial, mbr (if any)	qsl.net/eu1eu/agb_nysb.htm
1	0800	1	1100	3.5, 7	SARTG New Year RTTY Contest	Dig	RST, serial, name, happy new year in native language	sartg.com/contest/nyrules.htm
1	1500	1	1800	3.5-28	QRP ARCI New Years Sprint	CW	RST, SPC, mbr or power	qrparci.org
2	0000	2	2359	3.5-28	PODXS 070 Club PSKFest	Dig	RST, SPC	www.podxs070.com
2	1200	3	1200	1.8-28	WW PMC Contest	CW Ph	RS(T), PMC abbreviation or CQ zone	www.s59dcd.si/index.php/sl
2	1500	3	1500	3.5-14	Original QRP Contest	CW	RST, serial, power category	qrpcc.de/contestrules/oqrpr.html
2	1800	2	2359	3.5-14, 18, 21, 24, 28, 2 repeaters	ARRL Kids Day	Ph	Name, age, QTH, favorite color	www.arrl.org/kids-day
2	1800	3	2359	3.5-28	ARRL RTTY Roundup	Dig	W/VE: RST, state/province. Non-W/VE: RST, serial	www.arrl.org/rtty-roundup
2	2000	3	0700	1.8	EUCW 160-Meter Contest	CW	RST, name, EUCW club info or "NM"	www.eucw.org/eu160.html
4	0000	4	0100	3.5-14	K1USN Slow Speed Test	CW	Name, SPC, 20 WPM max.	k1usn.com/sst.html
5	0200	5	0400	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqrp.blogspot.com
6	1300	6	1400	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
6	1700	6	2000	144	VHF-UHF FT8 Activity Contest	Dig	4-character grid square	ft8activity.eu/index.php/en
6	1900	6	2000	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
6	2000	6	2100	3.5	UKEICC 80-Meter Contest	Ph	6-char grid square	www.ukeicc.com
6	2300	10	2300	1.8-7	AWA Linc Cundall Memorial CW Contest	CW	RST, eqpt year, input power	antiquewireless.org
7	0300	7	0400	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
7	1800	7	2200	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	nrrlcontest.no
7	2000	7	2200	1.8-50	SKCC Sprint Europe	CW	RST, SPC, name, mbr or power	www.skccgroup.com
9	0000	9	2359	3.5-28	YB DX Contest	Ph	RS, serial	ybdxcontest.com
9	0500	9	0900	3.5-28	Old New Year Contest	CW Ph	RST, sum of operator age and years on the air	radio.ru/cq/contest/rule-results
9	1200	10	1200	3.5-28	UBA PSK63 Prefix Contest	Dig	RSQ, UBA section or serial	uba.be/en/hf/contest-rules
9	1200	10	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
9	1800	10	0559	1.8-28	North American QSO Party, CW	CW	Name, state/DC/province/country	www.ncjweb.com
10	0630	10	0830	3.5,7	NRAU-Baltic Contest, SSB	Ph	RST, serial, 2-letter Fylke/ Lan/Province/Region	www.nraubaltic.eu
10	0900	10	1059	28	DARC 10-Meter Contest	CW Ph	RS(T), serial, DOK (if DOK)	www.darc.de
10	0900	10	1100	3.5,7	NRAU-Baltic Contest, CW	CW	RST, serial, 2-letter Fylke/ Lan/Province/Region	www.nraubaltic.eu
11	0000	11	0100	3.5-14	K1USN Slow Speed Test	CW	Name, SPC, 20 WPM max.	k1usn.com/sst.html
11	0100	11	0300	1.8-28	4 States QRP Group Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqrp.com
13	1700	13	2000	432	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
16	1200	17	1159	1.8-28	Hungarian DX Contest	CW Ph	RS(T), 2-letter HA county or serial	ha-dx.com/en/contest-rules
16	1200	17	1159	3.5-28	PRO Digi Contest	Dig	RST, serial, "/M" if member	procontestclub.ro/PDC%20Rules.html
16	1800	17	0559	1.8-28	North American QSO Party, SSB	Ph	Name, state/DC/province/country	www.ncjweb.com
16	1800	17	0559	1.8-28	NA Collegiate Championship, SSB	Ph	Name, state/DC/province/country	w9smc.com/nacc
16	1900	16	2300	1.8	WAB 1.8 MHz Phone/CW	CW Ph	RS, serial, WAB square or serial	wab.intermip.net
16	1900	18	0359	50 and up	ARRL January VHF Contest	CW Ph Dig	4-character grid square	www.arrl.org/january-vhf
16	2000	17	0559	1.8-7	Feld Hell Sprint	Dig	RST, mbr, SPC, grid	sites.google.com/site/feldhellclub
17	2300	18	0100	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
18	0000	18	0100	3.5-14	K1USN Slow Speed Test	CW	Name, SPC, 20 WPM max.	k1usn.com/sst.html
21	0130	21	0330	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
23	1200	24	1200	3.5-28	BARTG RTTY Sprint	Dig	Serial	bartg.org.uk
23	1200	24	1200	3.5-28	UK/EI DX Contest, CW	CW	RST, serial, district code (if UK/EI)	www.ukeicc.com
25	0000	25	0100	3.5-14	K1USN Slow Speed Test	CW	Name, SPC, 20 WPM max.	k1usn.com/sst.html
27	0000	27	0200	1.8-28	SKCC Sprint	CW	RST, SPC, name, mbr or power	www.skccgroup.com
27	2000	27	2100	3.5	UKEICC 80-Meter Contest	CW	6-char grid square	www.ukeicc.com
28	0130	28	0330	1.8	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
29	2200	31	2200	1.8	CQ 160-Meter Contest, CW	CW	RST, SP or CQ zone	www.cq160.com
30	0600	31	1800	3.5-28	REF Contest, CW	CW	RST, French dept/prefix or serial	concours.r-e-f.org/contest/
30	1300	31	1300	3.5-28	UBA DX Contest, SSB	Ph	RST, serial, ON province (if ON)	uba.be/en/hf/contest-rules
30	1900	31	1900	All	Winter Field Day	No FT4/8	Category, ARRL section (or "DX")	winterfieldday.com

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.*

Melissa Stemmer, KA7CLO, mstemmer@arrl.org

At the Foundation

The ARRL Foundation Board of Directors is pleased to announce three new scholarships established to assist amateur radio operators with college or university costs.

The Amateur Radio Digital Communications (ARDC) Scholarships

ARDC has established 19 scholarships to be awarded through the ARRL Foundation: two $25,000 awards, thirteen $10,000 awards, and four $5,000 awards. These scholarships are open to all radio amateurs. US licensure, US residence, and US citizenship are not requirements. Applicants must be licensed for at least 1 year prior to the date of application submission. Applicants must show proof of amateur radio activity during the previous year, must provide three letters of recommendation and three years of transcripts, and must submit a written rationale as to why they should be awarded one of the scholarships.

The Fritz Nitsch, W4NTO, Memorial Scholarship

Endowed through the generosity of Fritz Nitsch, W4NTO, a $5,000 scholarship will be awarded to an applicant pursuing studies in engineering or other 4-year technical degrees. Preference will be given to applicants from South Carolina or the Roanoke Division. Applicants must hold a General-class amateur radio license or higher for at least 1 year prior to applying.

The Potomac Valley Radio Club (PVRC) Scholarship

The Potomac Valley Radio Club (PVRC) has established a $1,500 scholarship for students pursuing full-time studies at an accredited undergraduate degree-granting institution. Preference will be given to applicants who are residents of, or attending a post-secondary institution, located in the District of Columbia or any of the states comprising main territory of PVRC: Pennsylvania, Maryland, Delaware, West Virginia, and North Carolina.

Full scholarship eligibility requirements for all scholarships can be found at **www.arrl.org/scholarship-descriptions**. The 2021 Scholarship Program will be accepting applications online from October 1, 2020 until December 31, 2020. If you are a high school senior or attending college next year and are an FCC-licensed, active amateur radio operator, you are encouraged to apply. Awards will be announced in May 2021. Awards are sent directly to recipients' colleges.

To learn more about the ARRL Foundation Scholarship Program, please go to **www.arrl.org/scholarship-program**.

The ARRL February School Club Roundup

The event begins on Monday, February 8 at 1300 UTC and runs through Friday, February 12 at 2359 UTC.

Anna Matson, KN4IVD, along with her brother, Winston, as logger, operated as part of the N4SMS School Club Roundup team from Schofield Middle School in Georgia. [James Matson, KN4OQD, photo]

- Stations may operate for up to 24 hours during the entire contest and may only operate for 6 hours during any single 24-hour period. Any mode — SSB, CW, or digital — is allowed.
- There are five participation categories: Elementary/Primary; Middle/Intermediate/Junior High School; Senior High School; College/University Club, and Non-School Club. There is also a category for Individuals.
- School Club Roundup is co-sponsored by ARRL and the Long Island Mobile Amateur Radio Club (LIMARC). Results will be available in *QST* and online at **contests.arrl.org**, where you can also download award certificates.

Don't forget to share your team's photos and stories! One of the best parts of School Club Roundup is showing off your team members and station. You can upload your photos and stories when you submit your score at **contests.arrl.org/arrlscrscoresubmission.php**.

For complete rules, logging sheets, and other resources, visit www.arrl.org/school-club-roundup

Bernie McClenny, W3UR, w3ur@arrl.org

How's DX?

Lakshadweep Islands Update

As a follow-up to the August 2020 *How's DX* column, which gave "Updated Top Ten Lists," we'll be taking a closer look at the Lakshadweep Islands (VU7), formerly known as the Laccadive Islands, and its only licensed radio operator, Aboobacker Kunhi Badayi, VU3EBX.

Lakshadweep Islands (VU7)

The VU7 prefix is reserved for special operations or DXpeditions for the Lakshadweep Islands, which means "100,000 islands," but in reality, there are 10 inhabited islands and 17 uninhabited islands. One of two island groups, the Lakshadweep Islands are located some 200 – 400 kilometers (120 – 270 miles) off the southwestern end of India (VU). The other is the Andaman and Nicobar Islands (VU4). These island groups count as separate DXCC entities. Indian nationals who live in either the Andaman, Nicobar, or Lakshadweep Islands are issued regular VU2 or VU3 callsigns.

Currently VU7 ranks 55 on Club Log's DXCC Most-Wanted List. In 2016, 2017, 2018, and 2019, there were four activations from VU7.

To Lakshadweep, With Love

After reading the August 2020 column, Alan Kline, KB1DJ, wanted to know if any DX foundations were working on getting Aboobacker an HF rig, because the lone ham in VU7 only had a VHF rig. Alan has been a ham for over 40 years and has "always looked for ways to give back to our hobby." Over the years, he has taught classes, worked with Scouts, and been active with the Courage Kenny Handiham Program.

Upon finding out that no DX foundations were in the process of getting a station to Aboobacker, Alan said he wanted to get an HF radio to EBX. Thanks to the support of Jose Jacob, VU2JOS, coordination was completed in just 2 months after the initial realization of what needed to be done. Jose was working closely with Sajeev Sukumar, VU2MSA, from Kochi, along with VU2NL and VU2PEY, who helped get the VHF station and antenna installed 2 years ago.

Aboobacker Kunhi Badayi, VU3EBX, operating his VHF rig. He was making a contact with mainland India, some 400 kilometers away. [Aboobacker Kunhi Badayi, VU3EBX, photo]

Before Aboobacker received the HF rig, he was running a Yaesu 2900 into a 10-element, 2-meter Yagi some 40 meters above the ground. He was making contacts through the VU2GCC repeater 470 kilometers away in Kerala. Obviously Aboobacker has been a DXer from the beginning.

Aboobacker was very thankful "from the bottom of [his] heart for [the] kind offer of amateur radio HF equipment." In addition to the radio, Alan sent some coax and a power supply, plus all the needed paperwork. Aboobacker said the equipment was sent "via USPS, as there is no private international courier service" in Kavaratti, the capital city in the Lakshadweep Islands.

In order to get his amateur radio license, Aboobacker had to go to mainland India, which involved some logistics. His license class is only allowed to run 50 W, and he noted that, at his age, "it is difficult to upgrade." His current license is good through April 19, 2038. As a tribute to Alan, KB1DJ, and Aboobacker, Jose, VU2JOS, published an article, "From USA to Lakshadweep, with Love," which appeared in the October 2020 issue of *Telangana Today*, an English daily publication in Hyderabad. You can see the full copy at **https://telanganatoday.com/from-usa-to-lakshadweep-with-love**. DXers around the globe certainly appreciate the kindness of Alan, Jose, and the other VU operators who helped a fellow ham, who by all indications is going to be a DXer.

KH9 — Wake Island

The Wake Island or Atoll (KH9) is made up of three Islets — Wake, Wilkes, and Peale, which are some 3,204 kilometers (1,991 miles) west of Honolulu. The island is an unorganized, unincorporated territory of the United States and is also claimed by the Republic of the Marshall Islands.

Tom, NL7RR, operated from Wake Island in October 2020. He set up with an Icom IC-7300 and a 10-meter vertical. He plans to be back for 6 weeks in early 2021. [Thomas Hitzner, NL7RR, photo]

Under an agreement by the United States Department of Interior that is administrated by the United States Air Force and at any given time has a population of about 100 people.

KH9 ranks number 34 on Club Log's DXCC Most-Wanted List. Over the past 2 decades, there has been some kind of Wake Island amateur radio activity all but 2 years (2006 and 2019). Most of those operations were by individual contractors who had a rig and got on in their spare time. The last major DXpedition there was in 2013 by the K9W team, who made just over an amazing 100,000 contacts.

In October 2020, Thomas Mayhan, NL7RR, was working on Wake Island and was active over 3 days. He was on the air for a total of about 2.5 hours and had about 75 contacts, mostly from Japan, but also including stations in Alaska, the US west coast, and his furthest contact was in New York. NL7RR/KH9 was reported on both 20 (14.292 MHz) and 40 (97.146 MHz) meters SSB. Thomas is planning to go back this year, probably sometime around the New Year's to mid-February. He expects to be there this time for up to 6 weeks. In the meantime, you may also hear him from Shemya Island (IOTA NA-037). Watch your favorite DX outlet for any updates.

3D2/R — Rotuma Island

Antoine (aka Tony), 3D2AG, who lives just outside of the capital Suva, Fiji (3D2), is planning to visit his family on Rotuma Island (3D2/R), a separate DXCC entity, starting around Christmas 2020 and staying through mid-January 2021. The emphasis of this trip will be putting up a tombstone for his son, who drowned in January 2020. Tony is calling this next visit the "Rehanisi Memorial DXpedition." When operating from home, Tony signs 3D2AG, and when on Rotuma, his signs 3D2AG/p. Listen for him mainly on CW and FT8. Those FT8 contacts will be uploaded to Club Log, and all other mode QSLs should be sent direct, abiding by instructions on his **qrz.com** page. You can also use PayPal for direct QSLs.

JD1/M — Minami Torishima

As of October 14, 2020, Take, JG8NQJ, is back at the weather station on Minami Torishima and is expected to be there through mid-January. He has a 50 W Yaesu FT-450D and plans to be active in his spare time on CW. As the time of this writing, JD1/M ranks number 22 on Club Log's DXCC Most-Wanted List. He'll be using a TD-3040 dual-band dipole for activity as JD1/JG8NQJ on 40 and 30 meters. QSL via JA8CJY or via Logbook of The World (LoTW).

9G — Ghana

Tom Hitzner, DL2RMC (aka HZ1FI, SU9TH, V31FI, etc.), is now in the capital city of Accra working with the Ghana Skills Development Initiative until September 2022. In less than 2 days, he received his 9G5FI license, and he is now ready to operate with an Icom IC-7300 and a 10-meter vertical, on top of a five-story building, with a tuner. He plans to be active on all bands, including the QO-100 satellite. Listen for him on CW, FT8, and SSB. QSL direct or via the bureau to DL1RTL and LoTW.

Wrap-Up

That's it for this month with thanks to 9G5FI, KB1DJ, NL7RR, and VU2JOS for helping to make this month's column possible. You can follow *The Daily DX* on Twitter **@dailydx**. Please forward any DX, IOTA, or contest expedition news, photos, and newsletters to your editor at **Bernie@dailydx.com**. Until next month, see you in the pileups! — *Bernie, W3UR*

Jon Jones, NØJK, n0jk@arrl.org

The World Above 50 MHz

Letters from the VHFers

VHF Expedition to CN98

I operated portable from Fox Peak in Oregon in rare grid CN98 during the July CQ World Wide VHF Contest. On Saturday, July 18, through Monday, July 20, I operated with Ed, N7PHY, and Brian, KJ4ZTP, at a 6,200-foot altitude on the eastern slopes of the Cascade Mountain Range, where the horizon is a little below 0 degrees facing most of the US (see Figure 1). Our operating location from Fox Peak (CN98vc) had excellent propagation.

Figure 1 — Barry Hansen's, K7BWH, location at Fox Peak (CN98vc), some 6,200 feet on the eastern slopes of the Cascade Mountain Range in Oregon. [Barry Hansen, K7BWH, photo]

I made 254 contacts in 124 grid squares, using mostly 250 W. My favorite contact was with Edfel, KP4AJ, in Puerto Rico at 5,793 kilometers. The 6-meter band had openings most of the time, and generally small regions came in strongly. We worked FN01 to FN43 with a double-hop sporadic E from Pennsylvania to New Hampshire.

There were 6-meter gaps between single- and double-hop sporadic E at distances around 700 miles; 2,100 miles, and 2,800 miles. I made very few contacts at these distances, but I'm extremely pleased about providing over 200 stations with rare CN98. — *73, Barry Hansen, K7BWH*, **barry@k7bwh.com**

An Impressive 6-Meter EME Array

I finished installation of a 6-meter EME array in August 2020 (see Figure 2). The array has full azimuth and elevation rotation. It has four LFA-10 Yagis on homebrew round 17.7-meter booms, which KJ9I designed with K7NV *YagiStress* software. The tower is a custom repurposed self-supporting US Coast Guard tower. A new 3-inch chromoly steel mast is used in conjunction with K7NV-designed pro-

Figure 2 — The impressive 6-meter array that Dave, KJ9I, put up in August 2020. [Dave Schmocker, KJ9I, photo]

fessional thrust bearings at the mid-rotor plate and tower top plate (plus rain covers to weather-protect the bearings).

The array spacing was determined by Lionel Edwards, VE7BQH. The power-splitter at the array center is a W7GJ design, and phasing lines are LDF5-50 A, ⅞-inch Heliax cables. Transmit and receive feed lines to the tower are 1⅝-inch Heliax cables. Rotators are K7NVextra large propeller pitch units for azimuth rotation. The elevation rotor is a custom design by K7NV (system) and K7PN (rings), which incorporates a small propeller pitch unit as the motor and allows full 0- to 180-degree rotation (with the 55 G cross-boom truss removed). Green Heron Engineering deluxe controllers run each propeller pitch rotor. A hearty thank you to W7GJ, KB8RQ (SK), N5DG, VE7BQH, G0KSC, K7NV, K7PN, W2FU, N0TB, N9DL, N9BDR, N1DG, and Randy Piskula,. — *73, Dave Schmocker, KJ9I,* **kj9idave@charter.net**

On the Bands

50 MHz. Sporadic E made a number of surprise appearances in October. On October 6, WA2GFN (FN20) worked KD4ESV (EL87) in Florida on SSB. WA1EAZ (FN42) logged HC2FG (FI07) in Ecuador on FT8. Ken, WB2AMU (FN30), said there was a surprise E_s opening on 6 meters on October 17 at 2300Z. He worked WA3GWK in EM60 at 2335Z and heard several beacons. More sporadic E appeared later that evening from Florida and the Gulf Coast to the northeast. KC4AAW (EM85) worked stations in W1, W2, and W3.

Larry, N0LL, operated portable in rare grid EM07 for the Orionid meteor shower on October 21 – 22. He made over 70 MSK144 contacts, including one with XE2AT.

On October 23, E_s occurred across eastern North America to the Caribbean and South America. Some E_s links to TEP occurred as well.

Figure 3 — Gene Shea's, KB7Q, portable 222 MHz Yagi that he used from Nevada. [Gene Shea, KB7Q, photo]

Nelson, KD2CYU (FN20), worked PJ2MAN in Curacao "for a new one" on FT8, along with 9Z4CP, CM2ANA, HI8PLE, KP4EIT, YV1DIG, and PV8DX in Brazil, starting at 1900z.

On October 24 UTC, KF0M (EM17), N0LL (EM09), and N0JK (EM28) worked E_s to the southeast states. N0LL and KF0M worked N4MF (FM03), and N0JK logged N4MF (FM03), W4CHA (EL88), WB4EVH (EM81), KQ4KX (EL98), XE1KK (EK09), and XE1RK (EK09).

On October 25, there was a very rare opening between the northeast US states and Europe. KD2CYU worked F4VPC and G0GGG. WA1EAZ was spotted by GW7SMV. Tim Havens, WW1L (FN54), worked deep into Europe. He logged MM0AMW, HA2NP, DK2EA, and others. E_s is very rare in October — the only month with less sporadic-E is March. This is the first multi-hop E_s opening I am aware of from North America to Europe in the month of October.

144 MHz. I, N0JK (EM28), worked Larry, W5LDA (EM15), on FT8 tropo on October 3. On October 6, Mike, K7ULS (DN41), worked W5LDA (EM15) on MSK144. Tropo was reported by WZ1V on October 19 to W4. His best DX was WA4CQG (EM72) at 1,506 kilometers.

222 MHz. Gene, KB7Q, went on a road trip to Nevada. He operated 222 MHz portable on October 13 and 14 from DN21qx in Jackpot, Nevada. He operated JT65 on EME and FSK441 on meteor scatter. He used an Icom IC-7300 with a Q5 transverter to an 800 W SSPA amplifier and a long Yagi with full elevation and polarity adjustment (see Figure 3).

His trip was a great success, and helped several stations add to their WAS count on 222 MHz. He said, "Conditions were quite good and being able to twist my Yagi to change polarity really helped at times."

1296 MHz. John, KF0M (EM17), logged Pete, NO0Y (EM18), for a new grid on October 13. Pete set many VHF contest records from his station back in the 1990s.

Here and There

The Quadrantid meteor shower is predicted to peak on January 3, 2021 at 1430 UTC. The ZHR is predicted to be from 120 – 200 with a meteor velocity of 42 kilometers per second. This shower is useful for 144 and 222 MHz. It has a short-lived peak of only a few hours. The best path based on the meteor shower radiant location is NE – SW from 0500 – 0700 local time, which is close to the 2021 predicted peak.

Bob, K6QXY, lost his world-class 6-meter EME station in the California forest fires.

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!

Dec. 10 – Dec. 20, 1700Z – 1700Z, K9Z, Rochester, IL. Sangamon Valley Radio Club. **Commemoration of the Birth of PSK31**. 14.070 7.070; all bands, all modes. QSL. J. Mitch Hopper, K9ZXO, 536 E. Mill St., Rochester, IL 62563. *All conversational modes will be used.* **www.qrz.com/db/k9z**

Jan. 2 – Jan. 31, 0000Z – 2359Z, K3Y, Ellicott City, MD. Straight Key Century Club. **15th Annual Straight Key Month**. 21.050 14.050 7.055 3.550. Certificate & QSL. Jeremy Downard, KD8VSQ, 511 W. Pottawatamie St., Tecumseh, MI 49286. *K3Y/Ø through 9 plus KH6, KL7, KP4 and DX member stations in six WAC areas operating straight key, bug, and cootie keys. QSL card confirms one QSO per area, up to 19 for all-area sweep. See URL for schedule, map, stats, etc.* **www.skccgroup.com/k3y**

Jan. 8 – Jan. 9, 1800Z – 0000Z, W5IR, Metairie, LA. The Mystic Knights of the Louisiana Roundtable. **206th Anniversary of the Battle of New Orleans**. 18.145 14.275 7.270 7.045. QSL. Dale F. Budenski, 4713 Neyrey Dr., Metairie, LA 70002. *FT8 on the usual frequencies. See website for more details.* **www.qrz.com/db/w5ir** or **harry504@outlook.com**

Jan. 15 – Feb. 15, 0000Z – 2359Z, KL7RST, various, AK. North Country DX Association. **Alaska "RST" QSO Party**. 28.450 21.350 14.250 7.250. QSL. John F. Reisenauer, Jr., 2573 Old Georgetown Rd. W., Kershaw, SC 29067. *KL7RST, KL7RST/KL7, VY1RST/KL7, VE8RST/KL7, and VYØRST/KL7. Certificate by email for working any three stations when you QSL.* **www.qrz.com/db/k7ice**

Jan. 16, 1300Z – 1900Z, W1M, Russell, MA. Western Mass. Council BSA. **Woronoco Heights Outdoor Adventure/ SCOTA**. 14.290 14.060 10.115 7.190. QSL. Tom Barker, 329 Faraway Rd., Whitefield, NH 03598. *All logging is done on paper, then uploaded to LoTW and eQSL.*

Jan. 23 – Jan. 25, 1700Z-0000Z, AG6AU, Placerville, CA. El Dorado County Amateur Radio Club. **California Discovery of Gold**. 21.348 14.248 7.248. QSL. El Dorado County ARC, P.O. Box 451, Placerville, CA 95667. **www.edcarc.net**

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 **April** *QST* would have to be received by **February 1**. In addition to being listed in *QST*, your event will be listed on the ARRL Web Special 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

QST Congratulates...

■Dr. Ulrich L. Rohde, N1UL, the recipient of the 2020 IEEE Region 1 Technological Innovation (Industry or Government) Award. The selection was made by the IEEE Region 1 Awards and Recognition Committee and approved by the Region 1 Board of Governors. The award states "Technological Innovation Award — For pioneering research and leadership in signal processing." The Technological Innovation (Industry or Government) award is given for significant patents, discovery of new devices, development of applications, or exemplary contributions to industry or government fitting Dr. Rohde's accomplishments in our industry.

Dr. Rohde holds an Amateur Extra-class license. He has been an amateur radio operator since 1956, and also holds the call sign DJ2LR. He has also published extensively in *QEX* and *QST*.

■Author and filmmaker Don Keith, N4KC, whose new film, *Colors of Character*, debuted in selected theaters nationwide in November 2020. The film follows young African-American artist Steve Skipper. Keith also wrote a biography of Skipper, titled *Dream On: A Journey to Deliverance*.

Certificate of Code Proficiency

Recipients

Sponsored by VIBROPLEX
www.vibroplex.com

This month, ARRL and Vibroplex recognize 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.

June 2020
Vern Davison, KL3IB 30

August 2020
Gary G. Gimmestad, K9KOE 10
John D. LeJeune, KR4CC 10
John D. LeJeune, KR4CC 15
Brian E. Lewis, KO4AXD 15
Gary G. Swenson, KA2HAN 15
Christopher H. Tenev, K2QFA 15
Nancy K. Wigginton, N1GFV 20
Philip L. Graitcer, K3UT 25
Larry A. Miller, NR3R 25
Michael E. Snook, W7LG 25

September 2020
William A. Freeman, KE1G 10
Roger Hillson, KM4LHZ 10
Aaron S. Huber, KO4GBD 10
Lloyd L. Lank, KDØI 10
Vaden A. McDonald, NN4K 10
Joseph S. Kennedy, WQ6Q 15
Vaden A. McDonald, NN4K 15
Robert E. Rightmire, WA7YNU 15
Robert L. Heider, WØEJO 20
Vaden A. McDonald, NN4K 20
J. Michael Shaw, Sr., K2LRE 20
Larry A. Miller, NR3R 30
John T. Pescatore, K3TN 30

October 2020
Marc Beaupre, VE7TBP 10
Jeffrey K. Bowman, WY4G 10
Keith E. Brandt, WD9GET 10
Alfred M. Holt, WD4AH 10
Stephen J. Kellam, N4SJK 10
Edward W. E. Nijst, AJ6ET 10
Stewart W. Taylor, K7RPN 10
William A. Freeman, KE1G 15
Kirk S. Goddard, AG7YM 15
David Loveridge, AC9TA 15
Louis K. Yadevia, WA3EBS 20
David J. O'Farrell, WB0IXV 25
Albert H. Ziegler, KD2ST 25
William R. Gardner, KØUG 40

November 2020
Stephen F. Hersey, K7OFG 10
David D. Herzberg, K7MTD 10
Bernd Peters, KB7AK 10
George R. Anderson, W4GRA 15
Bernd Peters, KB7AK 15
Joseph M. Rinella, KGØHG 20

Congratulations to all the recipients.

January 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.

January 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 K9JM on Wednesday, January 27 at 9 PM PST (0500 UTC on January 28) on 3590 and 7047.5 kHz. Unless indicated otherwise, sending speeds are from 40 to 10 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.

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 — January 2021
(All times are in Eastern Standard Time)

Monday	Tuesday	Wednesday	Thursday	Friday
1/4 4 PM – 2100Z 10 – 35 WPM	**1/5** 7 PM – 0000Z **(1/6 – UTC)** 35 – 10 WPM		**1/7** 10 PM – 0300Z **(1/8 – UTC)** 10 – 40 WPM	**1/8** 9 AM – 1400Z 10 – 35 WPM
	1/12 4 PM – 2100Z 10 – 35 WPM	**1/13** 7 PM – 0000Z **(1/14 – UTC)** 10 – 40 WPM	**1/14** 9 AM – 1400Z 35 – 10 WPM	**1/15** 10 PM – 0300Z **(1/16 – UTC)** 10 – 35 WPM
	1/19 9 AM – 1400Z 10 – 35 WPM	**1/20** 10 PM – 0300Z **(1/21 – UTC)** 35 – 10 WPM	**1/21** 7 PM – 0000Z **(1/22 – UTC)** 10 – 35 WPM	**1/22** 4 PM – 2100Z 10 – 40 WPM
1/25 10 PM – 0300Z **(1/26 – UTC)** 10 – 40 WPM		**1/27** 9 AM – 1400Z 35 – 10 WPM	**1/28** 4 PM – 2100Z 35 – 10 WPM	**1/29** 7 PM – 0000Z **(1/30 – UTC)** 10 – 35 WPM

Life Members

Elected October 22, 2020

James K. Aderholt, KI4DH
James T. Allen, K6JAX
Marc Allen, WM7RA
Fred Amis, KK4BD
Jason R. Amos, KD4BJW
Melissa Amos, KD4BJX
Zac Amsler, K6ZWA
Claudius Anderson, KC8RMR
Herbert E. Anderson, KØHEA
John F. Appuhn, K4JFA
William J. Arban, WØOFO
Jeremy Arthur, KG5SWK
Daren Bachmeier, VE3NMD
Franklin E. Baker, WØQC
Richard Baker, KG5SRM
Richard F. Ballieu, WBØTML
Richard M. Bateman, KD7BBC
David M. Baughn, KX4I
Coke E. Bean, W4TSN
Marc Becker, KI4ZXX
Matthew Beckwell, KØMWB
Jack Belew, KI4SP
Javier Beltran, K6TNT
William G. Benn, KB1QWO
James Bird, KM6WCA
Nathan J. Bloch, W6NJB
Joshua Boyd, KN4LJL
Peter W. Bradley, KA6SGT
David Brain, WW5Y
Barbara Brainerd, KF7LGL
Thomas C. Breslin, K6TCB
Timothy R. Brode, KEØMVT
Bryan M. Brown, NO8M
Jeremy S. Brown, W2JSB
Martha E. Brown, KF4TRG
Chad M. Buchanan, N6NWZ
Bill Carpenter, AA8EY
Mitch K. Carroll, NØISU
Timothy Cassibry, KØTPC
David E. Catlett, K5YR
Kulandaivelu Chandrasekaran, KD2KWH
Steven V. Christ, K9AOG
John W. Clark, NØURE
Kevin Clarke, KD2TGE
Kenneth R. Class, KA2BLG
Paul W. Colberg, KI7BKL
Joseph B. Connors, W4ELT
Thomas E. Coombs, KN4GPT
Richard Crow, N2SPI
Richard Crowley, N1ATM
James R. Custer, WØHJ
Clifford J. d'Autremont, K6LH
Donald D'Egidio, WJ3U
Robert E. Dalbec, WB6NNC
Mark L. Dallner, AC9DE
Thomas H. Daniel, AH6KW
Calvin P. Darula, KØDXC
Marc S. Davidson, W1LN
Jason Day, KB5WQK
Richard L. Demoske, KC2EFA
Victor A. Desoto, KK4ZUP
Francis K. Dill, WA3GYW
Wade Dillard
Franklyn D. Dimino, K5FDD
Brian K. Done, K4BBB
Donald J. DuBon, N6JRL
Shawn Dumas, KC6SCD
Richard S. Dunn, KD8XB
Al Dynarski, W7SYK
Andrew Ebert, KD9LDL
Robert A. Eisenstein, KK5QM
Jeff Engelhardt, KF6D
Cliff Ensley
David Erlach, W7VSX
John Evans, N5QI
Erin Farmer, KM4WSK
Dale A. Ferrier, WU9I
Jason D. Findlay, W2PX
Julie Firos, K7JSF
Alan M. Foskett, K1NTR
Justin D. Fountain, KN4PRV
Doug Foxworth, KE5KGD
Kevin Francart, N8KLF
Gerard Fridmann, K2ZE
Julie Friedrichsen
Buzz Geist, KA6NJX
Patricia A. Gennaitte, KM6HHC
Dwight B. Gibson, KQØRS
Troy Giffin, KB1ZHP
Matthew Gilbertson, KØOMI
Stuart C. Gilman, W4PR
James W. Glidden, KD7BYF
Marc Goldberg, W4PSO
Joseph M. Grace, W1SK
Chris Gray, W5AFK
Nevell L. Greenough, N2GX
Michael Grubbs, WH6ERS
Michael P. Gurski, KØGUR
Kevin D. Hall, W6KN
Sean D. Hallinan, KB1IXG
Wayne Harris, NC8F
Robert F. Harshman, WØKEE
Jarod B. Hazlett, KI5AUV
Bruce A. Hegrenes, KØOE
William W. Heid, W6WWH
Tyler B. Heinemann, AF7BO
Wayne W. Heinen, NØPOH
Christopher D. Heiser, N6CDH
Casey O. Henderson, W1COH
Paul L. Henry, KI7YKO
Ruben A. Hernandez, WP4H
Thomas E. Hoegerman, K6FYU
Paul R. Holm, KC2BHQ
John F. Horton, KC1LSO
Michael L. Hubsky, KJ7GLG
Bradley S. Hufnagel, WØBSH
Ryan R. Hutton, KI6EXO
Asil J. Ingram, KB7FHK
Peter M. Iverson, KH6GK
Kathleen Jakubowski, N2AGQ
Ronald J. Jakubowski, K2RJ
Dennis M. Jaworski, N8NF
Andrew L. Johnson, KZ6R
Cory Johnson, NQ1E
Richard W. Johnson, KBØBDN
Allen M. Jones, KBØVGG
David L. Jones, WD5J
Donald P. Jordan, W8UZ
Clyde Joyce, KE8JVW
Ralph A. Juliano, N3RJ
Kris Kallaway, K4RIS
Sean J. Kedney, N9EBJ
Steve Keller, AE8AT
David J. Kershaw, KQ6T
Gary Kirsch, KN4RMG
Daniel G. Kitchens, W5DGK
Timothy B. Kleinow, KD9EHS
Timothy K. Knechtly, N8TK
Wayne A. Koehler, KE4PMS
Robert Koepke, KB5BK
Ken Kontor, W8KEN
John C. Kroener, W3KRO
Daniel K. Kutch, K6RRJ
Clayton L. Lamm, AI6XL
Thomas A. Lauzon, KI4AFE
James J. Lavin, K5VZ
Sharon L. Lawson, KJ7ATY
Andrew R. Lear, WØARL
Rick LeFevers, KJ7R
Victor A. Lepouce, AA9CN
Michael P. Lewallen, KD8Q
James E. Lewis, KEØNNH
John D. Lewis, AI3I
Gregg Lind, KCØSKM
John F. Lindberg, AA9JL
Dean W. Livingston, N1VKJ
Stephen N. Livingston, KM6JON
Kim Longo, K3JAR
John P. Lowrey, AL3W
Louis M. Lucier, KJ6VHZ
Jonathan Macias, W7ZTM
Peter H. Mahowald, K6TJ
Joshua M. Markell, KG7FOQ
Sid Markowitz, K2GG
Thomas E. Mattoon, KE6TM
Kienan H. Maxfield, AI7CC
James F. McGinnis, AB2QJ
Andrew J. McQuade, KC5HHR
Fred A. McCurdy, WAØIVV
Don McDade, N5VIH
Rachel D. McGraw, KF7AWC
Kenneth N. McGrew, KG5TGA
Sean F. McMahon, KK9U
Michael McNevin, NY6G
Thomas Messer, KC1KVE
David E. Mevis, W5FRR
Jim Miles, KF4FWF
Steven A. Miller, AE6L
Andrew J. Milluzzi, KK4LWR
Anthony J. Milluzzi, KD8RTT
C L Mitchell, K9PNP
Frank Mitchell, N5EVE
Jerald H. Moller, N4JHM
Victor A. Morgan, KG9GE
John Morris, KW4LT
Shane Morton, KC8TBA
Daniel J. Mouer, WA4GSD
John H. Mouw, WA4JM
Steven F. Mrkvicka, KC9FSW
Peter S. Murphy, WA9ZTF
Timothy A. Murphy, KCØWBP
Christopher M. Myers, AF6RF
Robert E. Neff, N6EFF
Kenneth B. Newman, KB4BJM
Reed B. Nightingale, KR7EED
Joseph M. O'Brien, WI2E
Larry A. Olson, W9INE
Remigius J. Onyshczak, AC8J
Arthur D. Osborne, KI5ERE
Mike Padron, N1CC
David A. Pais, N1VSI
Bryon R. Palitto, KB8JTH
Luke Parobek, W4LSP
Edward A. Pennington, K3YTR
Mark A. Perez, WL7N
Mark A. Peters, KA6FFM
Noel J. Petit, WBØVGI
Patricia G. Phillips, N4IGI
Julian D. Pile Spellman, K9TE
R Pineda, KD8FVV
Jon Plyler, AB8RD
Jeffrey B. Potter, W9CE
Robert R. Provost, N1OVU
Rigoberto Ramos Gonzalez, WP4PRT
Giancarlo Rampino, KC3LOJ
Kristin Ramsay, KD2SIE
Ralph M. Ray, KC9EGP
Robert B. Reilly, K3EMT
Ronald E. Richard, N1IEX
Kristin R. Ridste, KJ6OFO
Ruth A. Ring, KJ1V
Terry T. Ringer, W1EHQ
James W. Robinson, W5ZYX
Timothy R. Robnett, WØTRR
Richard Robyn, AI6AI
Paul W. Rogers, KC2RP
Joseph L. Ronzio, KN4LSB
Chris Roose, KE2A
Bill Rupp, N9CQQ
Evan M. Russo, KI4CRP
Neil Sablatzky, K8IT
Franklin D. Salas, KBØMMR
Audie Sanchez, W6ZDR
Timothy S. Saponas, W5GNR
Robert L. Schick, KX4XO
Steven E. Schopp, KD2BS
Douglas J. Schultz, N9EZF
John P. Seibels, K4AXV
Adam Selsley, KD2EMW
Shep Shepardson, NØNMZ
Richard J. Silva, WA6ES
Andrew Silvester, K6OP
Lloyd Simms, KJ6MLG
Michael K. Skrocki, K1UX
David J. Slotter, W3DJS
C Chris Smith, AE4CC
Jeff A. Smith, N6SGC
Lori Smith, KG5AYL
Arthur Snyder, KO4DGY
Scott L. Snyder, KG6ERY
Gary A. Sobek, WB3KOR
Matthew Sofley, KI4HFL
Philip R. Specht, K4PQC
Richard E. Spencer, KJ7PAN
Michael T. Sprenger, W4UOO
William K. Stegemueller, K5KB
Michael A. Stern, KB7THL
Robert H. Sterrett, W8PKP

Carolyn L. Stinemates, W6CLS
Donna Streeter, W9DJS
Robert D. Streeter, W8ST
Michael J. Stump, AC7MS
Daniel Suh, KJ6SVQ
Michael G. Sullivan, KS1O
Eugene M. Swiech, WB9COY
Alan M. Taylor, W9JZH
Blair F. Thompson, AL0G
Joseph G. Thompson, KR7Y
Robert C. Thompson, W7CO
Lixian Tian, BG9GXM
Ray E. Tillman, K4RDE
James B. Tinkler, N9JBT
David I. Titelbaum, KB1MSR
Bernard J. Trentmann, N0JVW

Charlie Troxell, KH2OP
Kenneth D. Trudel, N1RGK
Duane S. Tucker, AF7K
David T. Turner, N8DT
Edward E. Valasek, K3HTK
Tony Van Der Wal, K9UDS
Dean Varni, KN6DMK
Brent Venis, K0SPN
Frank M. Ventura, N1FMV
David A. Vine, WA1EAW
Ed Vivian, KJ7OEG
Lawrence E. Vosper, KB7VT
Thomas L. Voss, W7TLV
Jennifer E. Wagner, KE8FNB
Patrick Wagner, WA9AAV

Eryn Wagoner, KE0WEY
Michael Warren, W6MEW
Herb W. Watchinski, KE0ZYL
Joshua M. Webb, W0JOS
Timothy W. Weikert, KC7DCW
Matthew C. Werner, K7MCW
Howard Wexler, W2SAH
Melvyn Whitten, K0PFX
Christopher J. Wilbur, WG0JRA
Jennifer L. Williams, N5LKG
Peter F. Williams, W4PFW
Thomas D. Williams, WA1MBA
Paul L. Winter, KW4GI
Jeffrey S. Wolfe, KX4DU
Scott D. Yonally, N8SY

Bryan Zayas, KP4M
Reno J. Zenere, KD9LAU
Fred H. Zumwalt, NC0U
Kyle D. Zylstra, W0KDZ
Michael Zyskowski, KD9MZ

Congratulations

October 2020
QST Cover Plaque Award Winner

Fred Kemmerer
AB1OC

Fred's article, "Ham Bootcamp: Getting Hams On the Air," describes a beginner-friendly program to mentor new and upgraded hams, developed by the Nashua Area Radio Society.

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

www.arrl.org/cover-plaque-poll

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

Ham Bootcamp

A beginner-friendly program to mentor new and upgraded hams, developed by the Nashua Area Radio Society.

Getting Hams On the Air

Fred Kemmerer, AB1OC

For the last 5 years, the Nashua Area Radio Society (NARS) in Nashua, New Hampshire, has been actively providing licensing classes and training to help new amateur radio operators develop their skills. Our club has helped over 420 people earn or upgrade their licenses.

The Nashua Area Radio Society has spent quite a bit of time trying to understand why so many of the people who earn a license or an upgrade don't get on the air. The number one reason we discovered is that the amateur radio community isn't providing the mentoring that many hams need to get active. Some examples of the necessary mentoring include:

- Help getting a handheld transceiver or base radio programmed for repeater use
- Guided practice making contacts on the air
- Help to overcome "mic fright"
- Help choosing equipment for their first VHF/UHF or HF station
- Help setting up an effective first HF station

Beyond these basic items, the club has also found that mentoring in the following areas helps boost interest in getting on the air among new and upgraded hams:

- An introduction to foxhunting
- An introduction to low-Earth orbit (LEO) satellite operations
- An introduction to operating on the 6-meter band
- Getting set up and learning how to use *WSJT-X* and FT8/FT4 modes
- A basic introduction to contest participation
- A guide to working DX and confirming receipt of transmissions
- Help with basic physical station-building issues such as grounding, getting cables into a building, and putting up simple antennas and feed lines

Above: Mackenzie Pooler, KE1NZY, and her father, Dan Pooler, AC1EN, mentor hams by explaining how to get started with satellites at Ham Bootcamp.

W1AW Schedule

PAC	MTN	CENT	EAST	UTC	MON	TUE	WED	THU	FRI
6 AM	7 AM	8 AM	9 AM	1400		FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
7 AM-1 PM	8 AM-2 PM	9 AM-3 PM	10 AM-4 PM	1500-1700 1800-2045	VISITING OPERATOR TIME (12 PM-1 PM CLOSED FOR LUNCH)				
1 PM	2 PM	3 PM	4 PM	2100	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
2 PM	3 PM	4 PM	5 PM	2200	CODE BULLETIN				
3 PM	4 PM	5 PM	6 PM	2300	DIGITAL BULLETIN				
4 PM	5 PM	6 PM	7 PM	0000	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
5 PM	6 PM	7 PM	8 PM	0100	CODE BULLETIN				
6 PM	7 PM	8 PM	9 PM	0200	DIGITAL BULLETIN				
6^{45} PM	7^{45} PM	8^{45} PM	9^{45} PM	0245	VOICE BULLETIN				
7 PM	8 PM	9 PM	10 PM	0300	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
8 PM	9 PM	10 PM	11 PM	0400	CODE BULLETIN				

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.

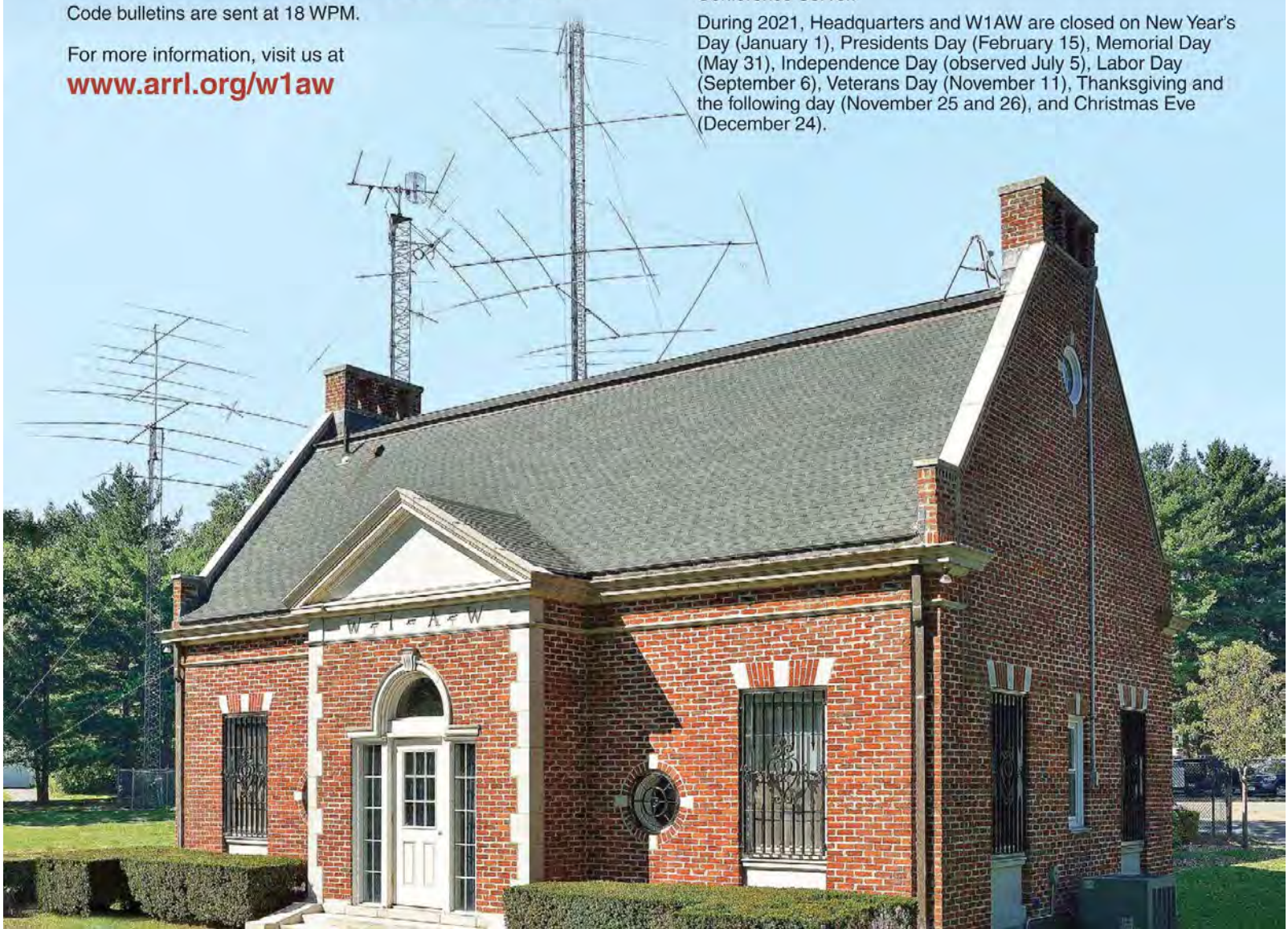
Keplerian elements for many amateur satellites will be sent on the regular digital frequencies on Tuesdays and Fridays at 6:30 PM Eastern time using Baudot and PSK31.

♦ 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 your current FCC amateur license or a photocopy. In a communication emergency, monitor W1AW for special bulletins as follows: voice on the hour, teleprinter at 15 minutes past the hour, and CW on the half hour.

W1AW code practice and CW/digital/phone bulletin transmission audio is also available real-time via the *EchoLink Conference Server* W1AWBDCT. The conference server runs concurrently with the regularly scheduled station transmissions. The W1AW Qualifying Run texts can also be copied via the EchoLink Conference Server.

During 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).



US Amateur Radio Bands

Operator license classes: **E** = Amateur Extra **A** = Advanced **G** = General **T** = Technician **N** = Novice
CW operation is permitted throughout all amateur bands. Except as noted, all frequencies are in megahertz (MHz).

= RTTY, data, phone, image = USB phone, RTTY, data and CW = RTTY and data = phone and image
= SSB phone = CW only

LF – Low Frequency band

2200 Meters (135 kHz) E,A,G

1 W EIRP maximum

135.7 kHz – 137.8 kHz

Amateurs wishing to operate on **2200 or 630 meters** must first register with the Utilities Technology Council online at **https://utc.org/plc-database-amateur-notification-process/.** You need only register once for each band.

MF – Medium Frequency bands

630 Meters (472 kHz) E,A,G

5 W EIRP max, except in Alaska within 496 miles of Russia where the limit is **1 W EIRP**

472 kHz – 479 kHz

160 Meters (1.8 MHz) E,A,G

1.800 – 1.900 – 2.000 MHz

HF – High Frequency bands

80 Meters (3.5 MHz) E,A,G,T,N

3.500 – 3.600 – 3.700 – 4.000

E
A
G

N,T (*200 W*)

3.525 – 3.600 – 3.800 – 4.000

60 Meters (5.3 MHz) E, A, G (100 W)

CW, Digital

5.332 – 5.348 – 5.3585 – 5.373 – 5.405

2.8 kHz

5.3305 – 5.3465 – 5.3570 – 5.3715 – 5.4035

USB

Gen, Adv, and Extra licensees may operate on a secondary basis with a maximum ERP of 100 W maximum.

40 Meters (7 MHz) E,A,G,T,N

7.000 – 7.075 – 7.100 – 7.300

ITU 1,3 & FCC Region 2 west of 130° west or below 20° north

E
A
G

N,T 200 W

7.025 – 7.125 – 7.175 – 7.300

N,T *outside Region 2*

30 Meters (10.1 MHz) E,A,G

10.100 – 10.150

200 Watts Maximum

20 Meters (14 MHz) E,A,G

14.000 – 14.150 – 14.350

E
A
G

14.025 – 14.150 – 14.175 – 14.225

17 Meters (18 MHz) E,A,G

18.068 – 18.110 – 18.168

15 Meters (21 MHz) E,A,G,T,N

21.000 – 21.200 – 21.450

E
A
G

N,T (*200 W*)

21.025 – 21.200 – 21.225 – 21.275

12 Meters (24 MHz) E,A,G

24.890 – 24.930 – 24.990

10 Meters (28 MHz) E,A,G,T,N

28.000 – 28.300 – 29.700

E, A, G

N,T (*200 W*)

28.000 – 28.500

VHF – Very High Frequency bands

6 Meters (50 MHz) E,A,G,T

50.1

50.0 – 54.0

2 Meters (144 MHz) E,A,G,T

144.1

144.0 – 148.0

1.25 Meters (222 MHz) E,A,G,T,N

E, A, G, T

N (25 W)

222.0 – 225.0

UHF – Ultra High Frequency bands

70 cm (420 MHz) E,A,G,T

420.0 – 450.0

33 cm (902 MHz) E,A,G,T

902.0 – 928.0

23 cm (1240 MHz) E,A,G,T,N

1240 – 1300

E, A, G, T

N (5 W)

1270 – 1295

SHF&EHF – Super and Extremely High Frequency bands

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

2300-2310 MHz	3300-3500 MHz	10.0-10.5 GHz	47.0-47.2 GHz	122.25-123.0 GHz	241-250 GHz
2390-2450 MHz	5650-5925 MHz	24.0-24.25 GHz	76.0-81.0 GHz	134-141 GHz	All above 275 GHz

See www.arrl.org/band-plan for detailed band plans.

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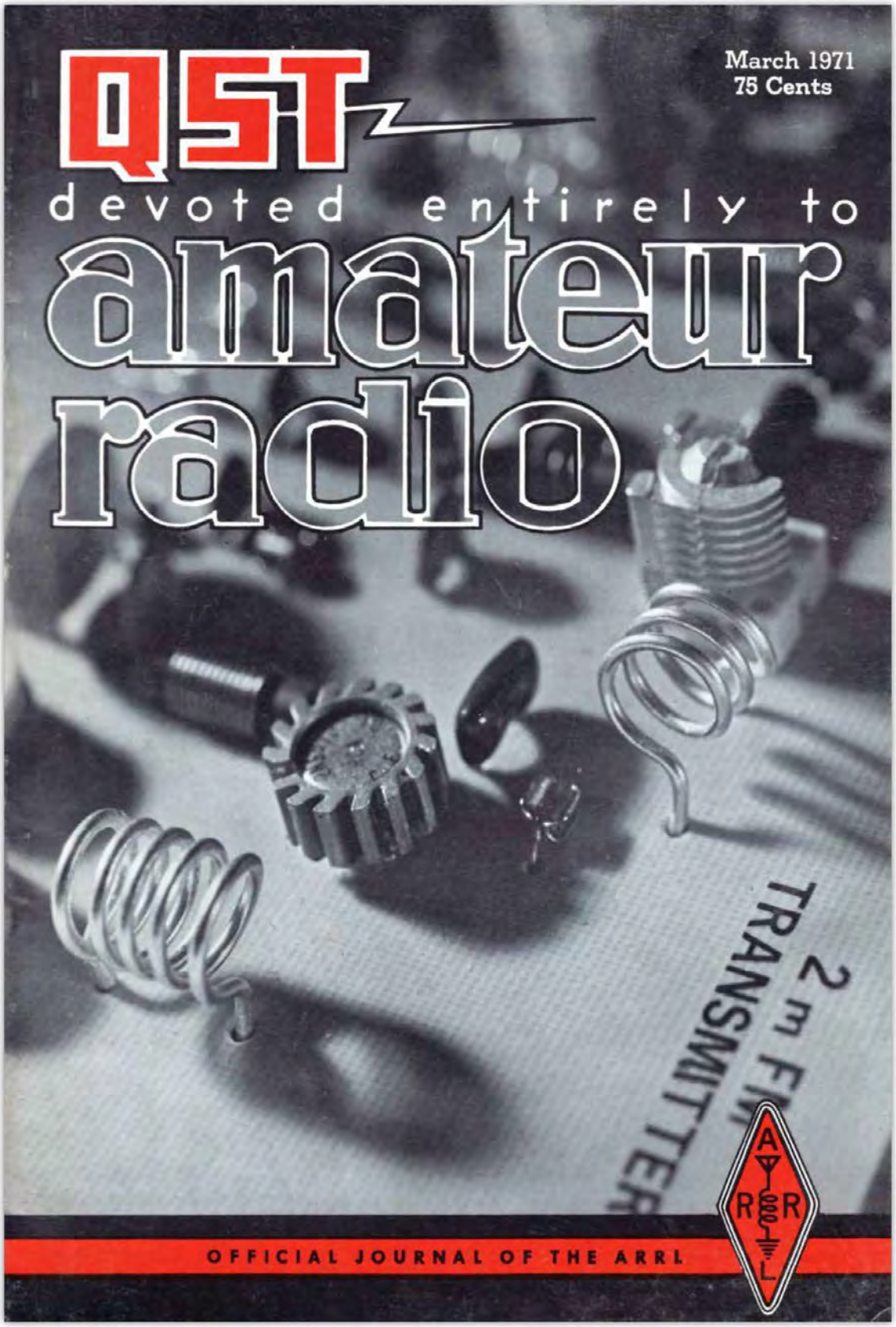
OTAbands **rev. 1-22-20**

A Look Back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March 1971
75 Cents
devoted entirely to
amateur radio
2 m FM TRANSMITTER
OFFICIAL JOURNAL OF THE ARRL

A 75/80-Meter Vertical Antenna Square Array

BY JAMES L. LAWSON,* W2PV

BECAUSE OF the low-angle radiation properties of vertical antennas, which make them especially useful in the reception of high-frequency (75-80 meter wavelength) signals, it seemed appropriate to investigate the possibility and practicability of providing a suitably phased array of vertical elements to improve horizontal-plane directivity. There have been many examples in the past where two vertical elements have been used either in a broadside mode or in an end-fire mode.[1] There is also a good example of the use of four verticals[2] in a switched system providing not only (normally) good end-fire directivity along the line of verticals, but also with appropriate excitation a bilateral "beam" broadside to the array.

However, some years ago the author investigated the possibility of using an array of four vertical elements arranged in a *square* configuration for producing four electrically-switchable separate "beams" along either the diagonals of the square or in the direction of the sides of the square. Through a computer program produced by H. Hurwitz, WA2VBW, the square array was simulated,[3] and it was soon found that such an array could indeed produce a very fine pattern along its diagonal (substantially better than along its edge). The side dimension of the square is not especially critical, but should be in the neighborhood of a quarter of a wavelength, $\lambda/4$; however, the *phases* of the currents in the four radiators must be adjusted for the particular dimensions of the square. At the time of construction of the square array (1963) the author wished to use the array for both 75 and 80 meters, and also on 40 meters, so that the actual size of the square was set to 42 feet (about $\lambda/6$ on 75/80 meters, and $\lambda/3$ on 40 meters). For such an array, and numbering the elements consecutively around the square, the currents in all four elements are made equal and the phases are set to the following computer-determined values.

It is interesting that a somewhat similar suggestion has been made recently.[4] However, the arrangement suggested in this reference would not give quite as good a pattern nor as much gain as it would if the size of the square were *reduced* and optimum phase lags used.[3]

The beam produced by the currents given in the above chart is maximum along the diagonal toward element 3, and for the two situations, $\lambda/6$ and $\lambda/3$ excitation wavelengths, the computer-produced power gain patterns are shown in Figs. 1 and 2.

Corner el. No.	$\lambda/6$ phase (deg.)	$\lambda/3$ phase (deg.)
1	0	0
2	-130	-80
3	-260	-160
4	-130	-80

*2532 Troy Road, Schenectady, NY 12309.

[1]See, for example, Cousins, "80-Meter Vertical Beam Antenna," *Ham Radio*, May 1970, pp. 26-27. Hy-Gain Electronics Corp. Engineering Report, "Amateur Phasing" (undated); available from Hy-Gain Electronics Corp., N. E. Highway 6, Lincoln, Nebraska, U. S. A.

[2]Atchley, "A Switchable Four-Element 80-Meter Phased Array," *QST*, March 1965, pp. 48-52.

[3]Lawson, "Simple Arrays of Vertical Antenna Elements," report in preparation. Will appear in a later issue of *QST*.

[4]Bibby, "Unidirectional Antenna for the Low-Frequency Bands," *Ham Radio*, Jan. 1970, pp. 61-65.

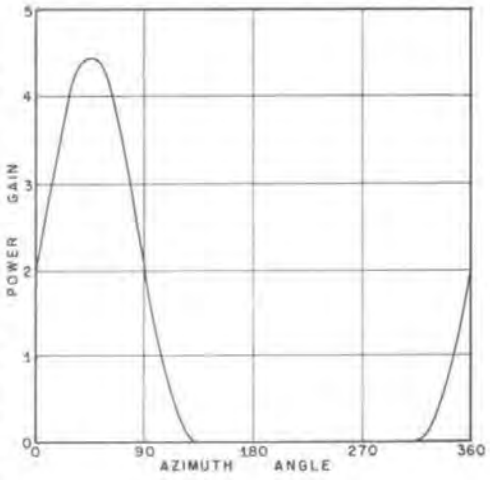

Fig. 1

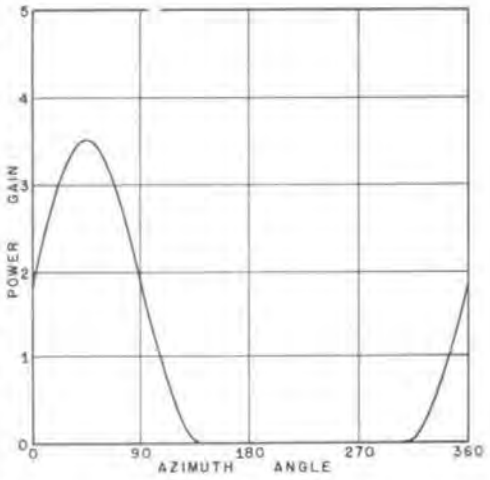

Fig. 2

These patterns are particularly noteworthy for the substantial power gain on the "nose" of the beam (at 45 degrees or along the diagonal) and for the rejection over the entire back hemisphere of the pattern. These patterns were not found especially sensitive to either the exact current balance in the elements nor their exact phases, and therefore were used as the basis for constructing an actual square array for trial.

Array Construction

It was decided to construct the array from commercial antennas, and Hy-Gain Hy-Towers were chosen. Four of these were mounted in a square 42 feet on a side and quarter wave (at 75/80 meters) coaxial cables were run from each antenna element to a central control and switching box containing delay coaxial cables and two 4-pole-double-throw (antenna) switching relays, K1A and K2A. Only the 75/80-meter switching and measurement scheme will be described here; the 40-meter arrangements are quite similar. At the central switch box the relay circuit controlling the drive to each antenna is shown in Fig. 3.

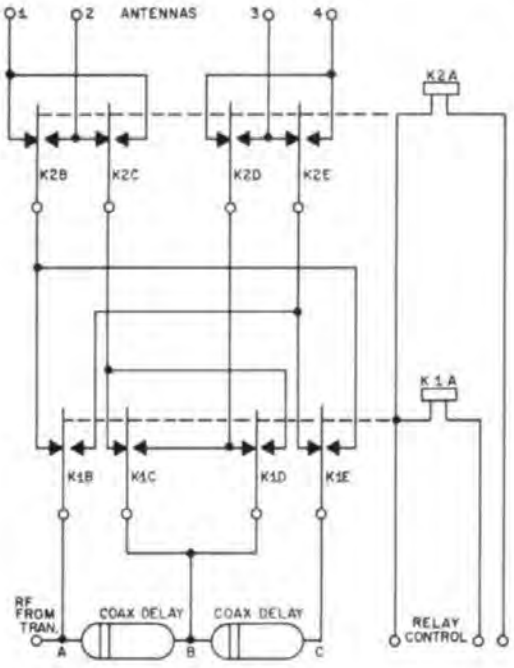

Fig. 3

Note that the incoming drive from the station transmitter, in undelayed form, A, is applied through the two 4pdt relays, K1A and K2A, to one antenna element (say, No. 1), a singly-delayed part B (about -130 degrees) is applied to elements 2 and 4, and a double-delayed part, C (about -260 degrees), is applied to element 3. Through proper excitation of the two relays this same excitation pattern can be moved around the square array, producing any one of four (diagonal) beams. The following chart explains how this is done.

Ry 1	*Ry 2*	*Drive A*	*Dr. B*	*Dr. C*	*Beam Direction*
off	off	No. 1	No. 2,4	No. 3	Toward No. 3
off	on	No. 2	No. 3,1	No. 4	No. 4
on	off	No. 3	No.4,2	No. 1	No. 1
on	on	No. 4	No. 1,3	No. 2	No. 2

The delay lines are made of series combinations of RG-8 (50 ohm) and RG-11 (70 ohm) cable to arrive at the correct delays, and also the correct impedances. It was found quite easy, although somewhat tedious, to arrive at the proper combination of cables. The big problem is to have a simple way of determining the currents and their phases, with relatively simple equipment. This task was solved by the use of a VTVM able to read 4-MHz rf voltages with reasonable (relative) accuracy, and the switch system of Fig. 4.

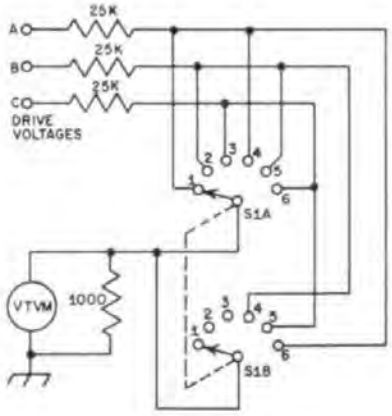

Fig. 4

There are six switch-selected positions connecting the VTVM to read a small sample of each of six selected voltages. All of these voltages are simple combinations of the drive voltages: the undelayed transmitter voltage, A; the singly-delayed voltage, B; and the doubly-delayed voltage, C. Remember that these voltages all appear (through the switch system of Fig. 3) at the inputs to the $\lambda/4$ connecting coaxial cables to the antenna elements, and can be directly related to the corresponding currents at the antenna elements themselves by the simple transmission line equation:

$$E = jIZ_O$$

where E is the input voltage,
I is the output current (antenna drive current)
Z_O is the characteristic impedance of the cable link.

Therefore the system can be adjusted simply to the case where the *voltages* A, B, and C bear the same desired relationship as the *currents* specified earlier, namely:

A = reference voltage
B = amplitude A, phase -130 degrees
C = amplitude A, phase -260 degrees

Referring to Fig. 4, it can be seen that the six

switch positions provide voltage readings as follows:

Position	Voltage
1	A
2	B
3	C
4	A + B
5	B + C
6	C + A

From these six readings it is quite easy to construct graphically the vector diagram of the three drive voltages A, B, and C. To do this, mark off graphically (at 0 degrees phase) vector A (magnitude = meter reading, switch-position 1) as shown in Fig. 5.

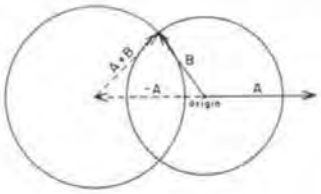

Fig. 5

From the origin draw a circle of radius B (locus of end of vector B), and from the end of vector -A (the image of vector A through the origin) draw a circle of radius A + B (also a locus of the end of vector B). The intersection of these two circles defines the vector B. Note that there are two possible intersections; choose the one consistent with the known (approximate) phase delay of B over A. In a similar fashion vector C can be located relative to B, and to check for consistency it can also be determined relative to A. The author has found this procedure to be quite rapid, self-consistent, and accurate, usually defining the vectors to within 5 percent in amplitude and to a very few degrees in phase.

Using this procedure the drive voltages and phases were brought approximately to their desired values at a frequency of 3.8 MHz, and the array immediately demonstrated what the computer simulation had predicted, i.e., a pronounced diagonally-oriented beam with low side and back readings (typically down in practice 15 or more dB). The relatively good properties of the array, however, persist over only about ±100 kHz due to (frequency-dependent) phase and impedance changes of the antenna elements. Some of the beam effect still persists down to 3.5 MHz, but for best performance at that frequency tuning readjustments really should be made.

Performance

The array has been in use for several years and has proved to be quite helpful especially in the reception of DX signals where the combination of low vertical angle radiation and horizontal directivity is particularly desirable. The transmitting effectiveness is also quite pronounced compared to a single vertical radiator, but is not generally quite as good as that from a single high inverted-V antenna recently erected. It is believed that this is entirely due to the relatively poor efficiency of the vertical array probably owing to insufficient grounding and lack of enough radials. For those who are either fortunate enough to be situated on high-conductivity ground, or who make the effort to provide exceptionally good grounding arrangements, this type of square array should prove to be a very effective performer. QST

Strays

For the second straight year W4LHV has won a *ham* as a Christmas office party door prize.

— . . . —

What's the elevation of the highest "home station" in the U.S.? WBØDBK's shack is at 11,200 ft. Any challengers?

— . . . —

After 40 years of operating with not more than 2-watts input, W4ZRJ has finally gone high power. He now has a new solid state transceiver running 5 watts input!

— . . . —

"CQ Kansas," a 5-minute program devoted to amateur radio and short wave listening, is broadcast each Saturday evening on radio station KFH (1330 kHz), Wichita, Kansas. The program host is KFH News Editor Mike McGee, WAØJPX.

Is W3SDX the oldest active amateur? Raymond received his Novice license at the age of 72 and became General class 10 months later. Now, at the age of 92, he is active on 6- and 2-meter phone and 15-meter cw.

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• **Linear permeability tuned VFO** with 1 kc dial divisions. VFO and crystal frequencies pre-mixed for all-band stability • **Covers ham bands** 80, 40, 20, 15 meters completely and 28.5 to 29.0 Mc of 10 meters with crystals furnished • **Any ten 500 kc ranges between 1.5 and 30 Mc** can be covered with accessory crystals for 160 meters, MARS, etc. (5.0-6.0 Mc not recommended) • **Four bandwidths of selectivity,** 0.4 kc, 1.2 kc, 2.4 kc and 4.8 kc • **Passband tuning** gives sideband selection, without retuning • **Noise blanker that works on CW, SSB, and AM** is built-in • **Notch filter and 25 Kc crystal calibrator** are built-in • **Product detector** for SSB/CW, **diode detector** for AM • **Crystal Lattice Filter** gives superior cross modulation and overload characteristics • **Solid State Permeability Tuned VFO** • 10 tubes, 10 transistors, 17 diodes and 2 integrated circuits • **AVC** for SSB or high-speed break-in CW • **Excellent Overload and Cross Modulation characteristics** • **Dimensions:** 5½"H, 10¾"W, 12¼"D. **Wt.:** 16 lbs. **$475.00** Amateur Net.

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In 1964, I joined the Salem (Oregon) High School Radio Club. Their station license was W7BPN, and they had a Hallicrafters S-20R receiver and code practice records. After school, I would practice and study for my license test. Testing required me to take a bus to Portland (the Greyhound bus station was near the FCC's Office of Inspector General). On my first attempt, I passed the written test, but it took me two tries to pass the code test. I received my license in 1947, when I was 15.

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Date of issuance 4-11-47

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Charles Austin's, W7LVB, ham radio license, issued in 1947.

I built a CW transmitter using a 6L6 crystal oscillator and enjoyed CW, including handling traffic on the Oregon Emergency Net. I mostly used crystal-control transmitters during my early ham radio days. Later, I built a 6V6/6F6 transmitter and acquired a National NC-98 receiver. My best DX contact was ZL3OP, running a crystal-controlled transceiver with 12 W input on 80 meters CW. In 1948, I received a code certificate from ARRL for 25 words per minute.

When I was 16 years old, my shop teacher called me out of class to assist with the Vanport flood. After checking with my parents, I went to Portland to the most beautiful radio shack I had ever seen. My job was to keep a clear frequency at night for stations using low-powered radios on dike patrol (at night, signals from the east would wipe them out). I returned home after 3 or 4 days.

I currently live in a retirement community, and other than VHF/UHF use, I stick to remote operation. Ham radio has always been an important part of who I am. It's a wonderful hobby.

Charles E. Austin, W7LBV
Salem, Oregon
Life Member

My Family Mentor

I was 10 years old when my father (WD8AND, SK) introduced me to ham radio, with a Hallicrafters S-77A receiver and an old World War II Jeep antenna with tank headphones. It was exciting turning knobs and switches. Soon after hearing all sorts of strange noises, I stumbled across a few foreign languages before hearing English. I was hooked!

I joined the North American Shortwave Association and was soon a regular contributor of my logs. I enjoyed getting up in the middle of the night in the Upper Peninsula of Michigan to log local stations around 60 meters.

The next year, my father signed me up for a ham radio license class and I earned my Novice-class license. With the money I earned from my paper route, I bought an old Heathkit DX-35 transmitter with one crystal, paired it with my Hallicrafters receiver, and hung a dipole between the trees with wire I found on the side of the road.

I went on to earn my Master's degree in electrical engineering and had a career in radio communications. To this day, it's hard to put into words the excitement of hunting for signals on HF. I'm grateful my father introduced me to the hobby in 1972.

David H. Heimke, AL7LO
Anchorage, Alaska
Life Member

Generations of Ham Radio

I first learned about amateur radio as a Cub Scout in 1943. My Den Chief was a ham who was studying electrical engineering at the University of Vermont. I enjoyed tinkering, but eventually progressed from a crystal set to a one-tube regenerative detector.

I learned Morse code at my local ham radio club, subscribed to *QST* in 1947, and earned my license in 1949. I was one of the few undergraduates involved in my college's radio station, W1AF.

My wife eventually earned her license, as did our two daughters when they were young. My wife helped me erect a triband beam antenna on a 30-foot telephone pole in our backyard. With the antenna, it became fairly easy to attain WAS and DXCC.

Although I was an attorney, my love of ham radio always had a strong presence in my life.

Joseph E. Frank, W1SOV
South Burlington, Vermont
Life Member

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 Misic, KE8RN, ke8rn@comcast.net

Classic Radio

Advancements in Receiver Technology

Frequency Stability and Accuracy

Collins made the first big step forward for better communications receivers, improving frequency stability, especially at higher frequencies. It also aided in improving frequency readout accuracy, especially at higher frequencies. The Collins 75A or 75A-1, which premiered in 1946, was the first receiver to use a crystal-controlled first conversion and a tunable first IF, along with double conversion.

Collins also introduced their outstandingly stable permeability tuned oscillator (PTO). The PTO in the 75A or 75A-1 covered 1.0 MHz, which covered the 160-, 80/75-, 40-, 20-, and 15-meter bands. For the 11- and 10-meter bands, the PTO output was doubled, so it tuned 2.0 MHz, and the receiver covered 26.0 – 28.0 and 28.0 – 30.0 MHz to cover all of 11 and 10 meters. The tunable first IF was also changed to work with the PTO. This same scheme was used on the 75A-2 and 75A-3 receivers. The 75A-4 did not double the PTO and tuned in three segments to cover 11 meters (26.5 – 27.5 kHz) and 10 meters in two ranges (28.0 – 29.0 and 29.0 – 30.0 MHz). In 1958, 11 meters ceased to be a ham radio band, and in the US, it became the citizens band.

Selectivity and Dual-Conversion

Hallicrafters made a big step toward better selectivity with the S-76 receiver in 1951. The receiver used double conversion, which was very rare at the time and had a last IF of 50.0 kHz. The first IF of 1650 kHz helped improve image rejection on higher frequencies. This benefit was already achieved by Collins, because of their tunable first IF, which had a significantly higher frequency than the common IF of 455 kHz. During the 1950s and 1960s, Hallicrafters, Hammarlund, National, and RME all used low-frequency IFs to improve selectivity. This was a significant improvement in receiver performance and was popular until crystal lattice filters became commonplace.

Collins Develops Mechanical Filters

By 1953, the Collins mechanical filter was a small sealed unit with two transducers and circular mechanical resonant disks. The mechanical filters were usually made for the final IF operating at a frequency of 250 to 500 kHz. They had excellent shape factor and ultimate attenuation, making them excellent devices for getting very good selectivity. The mechanical filters were manufactured in bandwidths of 1 kHz to about 16 kHz for various purposes.

Crystal Lattice Filters

Starting in 1960, crystal lattice filters began to appear in bandwidths of 200 Hz to 10 kHz. They were made for IF frequencies of 455 kHz to 10.7 MHz. The crystal lattice filters had similar performance to the Collins mechanical filter, but the crystal lattice filters could be built at much higher frequencies than the Collins mechanical filters. Additionally, crystal lattice filters were not patented by Collins, which limited the spread of mechanical filter technology.

Product Detectors

The next major step forward in receiver performance was the use of product detectors. In 1955, Collins offered a product detector for very good SSB and CW reception on their 75A-4 receiver. The product detector appeared on the Drake 1A receiver aimed at excellent SSB and CW performance in a smaller package, at 6.75 inches wide and weighing 18 pounds. National picked up on the product detector almost immediately, calling it a heterodyne detector and including it on their NC-300 receiver in 1955 (see Figure 1). National added a

Figure 1 — The National NC-300 Receiver and accessories specifications sheet from 1955. [Photo courtesy of **www.virhistory.com/ham/nc300/nc300.html**]

product detector to the general coverage NC-109 in 1957. In 1957, Heathkit included it on their ham band-only RX-1 Mohawk receiver.

By 1960, product detectors were everywhere. Receivers that used product detectors included automatic gain control (AGC) that worked with the product detector. Most diode detectors did not work with AGC if the BFO was turned on for SSB or CW reception.

The product detector and AGC that worked with the BFO made receivers work well with both SSB and CW, vastly improving receiver operation on the SSB mode. By the end of World War II, essentially all communications receivers were single-conversion superheterodyne types that worked well on AM signals and were satisfactory on CW. SSB had not gained any popularity yet, and an effort to popularize narrow-band FM operation on the 160-meter to 10-meter bands went nowhere. A few receivers, like the Hallicrafters SX-71, had a mode for narrow-band FM as did a few transmitters, but the narrow-band FM concept went nowhere.

Heathkit Makes Technology Affordable

More modern receivers started to become smaller, weighing around 20 pounds or less, such as the Drake 1A receiver from 1957, the Collins 75S-1 from 1958 (see Figure 2), and the Heathkit SB-300 from 1963 (see Figure 3).

Heathkit sought to duplicate the major units in the Collins S-Line introduced in 1958. Heathkit developed crystal lattice filters for SSB (2.1 KHz wide), CW (400 Hz wide), and AM (3.5 to 5.0 kHz wide) to mimic the function of the Collins mechanical filters. Heathkit also developed an assembled tuning oscillator that they called the Linear Master Oscillator (LMO), manufactured by several subcontractors to duplicate the function of the Collins PTO. Ultimately, TRW (as Thompson, Ramo, Woolridge was known) was the largest volume producer of the LMO units for Heathkit.

Figure 3 — The Heathkit SB-300 appeared on the market in 1963, making Collins technology more widely available. [Photo courtesy of *73* Magazine]

The first Collins imitator from Heathkit was their SB-300 receiver, which appeared on the market in 1963, 5 years after the Collins 75S-1. The SB-300 resembled the Collins 75S-1, had an attractive cabinet and an opening top (which was outsourced by Heathkit to make it more affordable), a stale VFO with 1.0 kHz readout, and good selectivity from up to three crystal lattice filters. The SB-300 covered the whole 10-meter band, while the Collins S-Line only covered 200 kHz of 10 meters from 28.5 to 28.7 MHz. Additionally, Heathkit's kit form, priced at $250, made the Collins technology affordable to the average radio amateur.

Collins as the Technology Leader

Equipment on the market today owes its excellent performance to Collins, who no longer builds and sells amateur radio equipment. Collins set the stage for solid-state ham radio equipment with their last ham radio product, the KWM-380, which shared technology with their commercial and government radio products. The all-solid-state radio had a general coverage receiver that covered 5 kHz to 30.0 MHz. It had a built-in power supply, speaker, and digital frequency readout to 10 Hz. It was an impressive piece of equipment.

Figure 2 — The Collins 75S-1 from 1958, along with most of the Collins S-Line, inspired several imitations by Heathkit. [Photo courtesy of **www.universal-radio.com**]

100, 50, and 25 Years Ago

January 1921

- The cover art shows a ham wearing a tie at his workbench.
- The editorial, "This A.R.R.L. of Ours," reports on the growth of ARRL.
- "Some Thoughts on Spark Operation" notes that the growth of CW is hampered by the lack of power tube availability.
- The Editor asks readers to write articles for *QST* and announces, "A Contest for Practical Articles," explaining that there are cash prizes offered for the top three articles.
- "The Fading Tests" provides the newest information of the results of our fading reports.
- John H. Miller reports on building "Some Interesting Receiving Equipment," with arrangements for easily changing components and circuitry while doing experimental work.
- Charles W. Eliason, Jr., discusses some methods of "QRM and QRN Reduction."

January 1971

- The cover photo shows Doug D. DeMaw's, W1CER, solid-state receiver and some of the sub-assemblies used in it.
- The editorial, "This Was 1970!", discusses the work of amateurs in natural disasters.
- Doug D. DeMaw, W1CER, shares "More Thoughts on Solid-State Receiver Design" in a comprehensive 10-page article.
- Douglas A. Blakeslee, W1KLK, presents Part 1 of "Receiving FM," discussing basic principles and new circuits.
- In "The Morse-A-Verter," Raymond C. Petit, W7GHM/4, tutors readers on copying Morse code by machine.
- "Five for Five," by J.E. Kear, K4MI, explains how he built a two-band beam to get 5 dB gain for $5.
- Janice Robidoux, WØQXA, shares how "Ham Radio Broadens Horizons for Handicapped" at Camp Courage in central Minnesota.
- Bill Reichert, WA1NFS/WA9HHH, offers a report on the valuable communication work done by hams in the wake of "Hurricane Celia."
- Lew McCoy, W1ICP, explains the importance of reducing our spurious radiations, as required by "U.S. Regulations. Part 97, Section 97.73."

January 1996

- The cover photo shows the VHF/UHF antenna farm of VE3BFM.
- The editorial, "Making Sense of 40 Meters," explains how that band's usage has evolved over the years.
- Garry Shapiro, NI6T, reports on the many problems involved in operating from Conway Reef, in "Awash in the Pacific."
- In "More EWEs for You," Floyd A. Koontz, WA2WVL, describes how to modify the basic EWE antenna to have switchable directivity.
- Dean F. Poeth II, K8TM, discusses "How to Measure Large Direct Currents with Common Meters."
- In "DXing enroute to the Red Planet," Michael R. Owen, W9IP, and John L. Callas explain how NASA will allow radio amateurs to participate in monitoring signals from the Mars Global Surveyor when it's launched.
- Patty Winter, N6BIS, details how today's computers and sophisticated HF transceivers can easily be used for remote station operation, in "Remote Operation Comes Home."
- In "Ham Radio — An Ancestral Link," Robert L. Turek, K8AAI, tells the tale of how a chance on-the-air contact led him to find long-lost European relatives, and eventually being able to visit them.
- In "Radical Radiators and Weird Wires," Curtis R. Holsopple, K9CH, shows how less-than-optimum antennas can provide plenty of ham fun, and offers some examples of what he has done.

Silent Keys

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

♦K1AF **Garner**, Owen S., Copley, OH
•W1AX **Corey**, Roger E., Westwood, MA
N1IN **Sexton**, William C., Sarasota, FL
♦W1LI **Wetzel**, Lewis D., Bridgton, ME
♦KA1NH **Thomas**, Harry D., Vernon, CT
N1POP **Ploski**, Gregory, Prospect, CT
N1RA **Avrutik**, Robert F., Sarasota, FL
K1TLP **Gibson**, Joseph A., Meriden, CT
•KB1YP **Kleber**, John A.C., Bedford, MA
N1YYB **Roy**, Deborah J., Somers, CT
K2ASM **Wolff**, William R. "Dick," Morris Plains, NJ
WA2AUI **Beckley**, Stewart D. "Bud," Keaau, HI
NG2C **Ledger**, Leonard L., North Bangor, NY
WA2DFL **Eick**, John R., Hampton, NJ
♦AB2DW **Deegan**, Thomas E., Inwood, WV
W2EKR **Edelstein**, Allen S. "Al," Miramar, FL
K2ENC **Kahan**, Lester I., Woodinville, WA
WB2MAC **Cronce-Coons**, Mary Agnes, Slingerlands, NY
KD2NAE **D'Agostino**, Christopher "Fish," Edmeston, NY
WF2Q **Krimko**, Howard, Kings Point, NY
K2RDB **Armstrong**, Michael F., Hansville, WA
♦K2SO **Ostrove**, Steven A., Elizabeth, NJ
W3AEH **Lipkin**, Alan B., Philadelphia, PA
N3BMT **Link**, Donald G., Knoxville, TN
K3DMA **Taylor**, John D., Glenside, PA
W3FIK **Bain**, Thomas R., Bethlehem, PA
AA3GN **Landis**, Joseph F., Hatfield, PA
♦W3IIT **Brown**, Harry H., Norristown, PA
K3IPM **Smith**, Stanley, Boca Raton, FL
♦W3VSD **Ciampaglia**, Albert W., Westminster, MD
W3WM **Kunst**, Arthur F., DuBois, PA
KA3ZOF **Montalvo**, Daniel J., York, PA
AK4AN **Moss**, William A., Kannapolis, NC
WA4AXA **Wheeler**, Mary H., Huntsville, AL
KD4CWB **Wyrick**, Daniel S. "Scott," Seymour, TN
KF4CWR **Pitsenbarger**, Joan B., Staunton, VA
KW4DW **Wyman**, Dennis E., Highland Springs, VA
AG4DZ **Brown**, Ray A., Margate, FL
KD4KAW **Martin**, Thomas G., Gadsden, AL
W4KKP **Kayhart**, Charles C., White Rock, SC
NN4KW **Wood**, Kenneth A., Marion, NC
KD4NKN **Sisk**, Mary L., Madisonville, KY
•KE4NXF **Cummings**, Betty M., Opelika, AL
K4PIC **Phillips**, Larry A., Commerce, GA
•W4QCF **Travis**, John H., Asheville, NC
•KE4SXQ **Reeves**, Charles R., Williamsburg, VA
WB4UD **Outland**, Howard B., Lincolnton, NC
K4VJO **Adkins**, Clyde C., Jr., Climax, NC
W4WAM **Penny**, Thomas L., Newport News, VA
W4WFS **Snyder**, William F., Sr., "Bill," Williamsburg, VA
•KG4ZQP **Brackett**, John S. "Steve," Madisonville, KY
KI5CGP **Reed**, Raymond W., Granbury, TX
KK5EW **Chmiel**, Bernard F., Biloxi, MS
WB5FLV **Yearley**, Richard W., Tularosa, NM
N5GJ **Platts**, Fred H., Jr., Saucier, MS
•KF5GXW **Frei**, Robert H., Alva, OK
W5HRF **Gikas**, Gus N., Baton Rouge, LA
♦•K5JMS **Piker**, John F., Baton Rouge, LA
AC5QT **Branam**, Johnny L., Hobart, OK
W5SBF **Jones**, Patsy R., Plano, TX
K5UAW **Tillman**, Daniel R., Tulsa, OK
KC5UNC **Sprain**, Eugene P., Jr., Tonawanda, NY
K5WRB **Brown**, William R. "Ralph," Wylie, TX
K6BMD **Reed**, Michael, Walnut Creek, CA
♦WA6DDL **Matthews**, Wesley P. "Paul," Riverside, CA
W6GAR **Davis**, Mike K., Jr., San Antonio, TX
KF6KUZ **Silva**, Sabra J., Hanford, CA
WA6LDV **Gordon**, Stephen H., Fancy Farm, KY
KI6NXN **Athey**, Michael J., Sacramento, CA
KI6QKD **Brague**, Carl L., Orange, CA
♦N6WLY **Rodke**, Thomas W., Las Cruces, NM
NH6YH **Koch**, James A., Albuquerque, NM
KO6ZW **DeMagri**, Clifford E., Payson, AZ
N7CPE **Grant**, Ronald L., Klamath Falls, OR
WB7CUS **Morrell**, Roger N., Dallas, OR
KR7EK **Karau**, Eric A., Reno, NV
♦W7ENP **Breeding**, Charles R., Sun City West, AZ
N7FG **Wargocki**, Frank E., Tucson, AZ
•W7GJT **Holton**, Carl E. "Gino," Prescott, AZ
N7HMN **Clemans**, Scott B., Tucson, AZ
KD7HTN **Pickering**, Bruce A., Surprise, AZ
N7IZM **Schuknecht**, Walter H., III, Scottsdale, AZ
•WB7NJE **Goss**, John C., Lake Forest Park, WA
W7PEW **Romans**, Robert A., Jr., "Bob," Panaca, NV
•W7QBT **Reynolds**, William F., Eugene, OR
W7QDK **Brown**, Donald P., Richland, WA
W7QLL **Hertlein**, Fred, Jr., Reno, NV
WW7R **Buford**, James M. "JB," Flagstaff, AZ
W7SPD **Cork**, Thomas F., Salt Lake City, UT
•W7STV **Baker**, Robert W., Klamath Falls, OR
KD7TLN **Cowdell**, Parry L., Riverton, UT
♦W7VTR **Randazzo**, Vincent T., Pocatello, ID
♦N7XY **Nielsen**, Robert D., Bainbridge Island, WA
W7YRV **Callison**, Roy W., Bisbee, AZ
W8AEP **Parent**, Arthur E., Livonia, MI
N8DNX **Scott**, Charles P. "Chuck," Petoskey, MI
KB8EAX **Wyland**, Joseph C., Sheffield Lake, OH
WD8JTJ **Davis**, Wesley E., Debary, FL
K8MWY **Kasten**, David R., Toledo, OH
N8NGK **Shannon**, John A., Columbus, OH
KB8RF **Goupie**, Joseph E. "Joe," Westland, MI
♦KB8RIM **Grandstaff**, Danny G., Zanesville, OH
♦K8SIA **Besancon**, James E., East Tawas, MI
WA8TSI **Tenan**, Richard D. "Rick," Kent, OH
AC8VG **Pakulski**, Scott J., Independence, KY
KE8VK **Johnson**, Thomas A. "Tom," Okeechobee, FL
WY9B **McLean**, Robert D., Hartford, WI
KC9BBA **Harper**, Richard W., Rehoboth Beach, DE
•K9BVG **Lawrence**, George W., Sheboygan, WI
N9DJQ **Richmond**, John S., Aurora, IL
KB9GRW **Fessler**, Joseph G., Richmond, IN
KC9HQG **Wesley**, Howard L., Sr., Sheridan, IL
•KA9IYH **Anderson**, James N., Bremen, IN
•N9JCI **McCarty**, Curtis L., Franklin, IN
•N9JHR **Pope**, Dale E., Chillicothe, IL
K9JPQ **Waite**, Daryl L., Carthage, IL
•KC9KA **Barnett**, George W., Poplar Grove, IL
KB9KYS **Peters**, Richard C., Milwaukee, WI
KC9NTD **Barath**, Steve P., Gary, IN
K9NZ **Cummins**, Perry A., Metamora, IN
NU9P **Martin**, L. Fred, Fond Du Lac, WI
KC9PTM **Allie**, Andrew L., Wolcott, IN
K9SFJ **Kessler**, Frank J. "John," Milwaukee, WI
KC9UMS **Stucky**, William C., Goshen, IN
♦WB9UNL **Keiser**, David E., Columbia City, IN
KØFUP **Schroeder**, Donald H., McVille, ND
KTØH **Radomski**, John D. "David," Aurora, CO
NØJP **Spittler**, Kenneth R., Winona, MN
NAØOO **Thompson**, Marvin L., Joplin, MO
KUØRDR **Richardson**, Roy D., Fargo, ND
NØTQQ **Skinner**, Gary E., Des Moines, IA
NØXPO **Brummit**, James E. "Jim," Victor, MT
NØZUQ **Mikkelson**, Clifford F., Jr., Colorado Springs, CO
VE2ZV **Brulotte**, Fernand, Ottawa, ON, Canada
VE3DVR **Hodgson**, Allen R. "Pete," Leamington, ON, Canada
VE7BCE **Porterfield**, Arthur K., Victoria, BC, Canada
JA2TY **Matsugatani**, Takuhei, Tsu City, Mie Prefecture, Japan

♦ Life Member, ARRL
• Former call sign

For information on how to list a Silent Key in *QST*, please visit **www.arrl.org/silent-key-submission-guidelines**.

Note: Silent Key reports must confirm the death by one of the following means: a copy of a newspaper obituary notice, a copy of the death certificate, or a letter from the family lawyer or the executor. Please be sure to include the amateur's name, address, and call sign. Allow several months for the listing to appear in this column.

Many hams remember a Silent Key with a memorial contribution to the ARRL Foundation or to ARRL. If you wish to make a contribution in a friend or relative's memory, you can designate it for an existing youth scholarship, the Jesse A. Bieberman Meritorious Membership Fund, the Victor C. Clark Youth Incentive Program Fund, or the General Fund. Contributions to the Foundation are tax deductible to the extent permitted under current tax law. Our address is: The ARRL Foundation Inc., 225 Main St., Newington, CT 06111.

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FTDX10 | *HF/50MHz 100 W SDR Transceiver*

• Narrow Band and Direct Sampling SDR • Down Conversion, 9MHz IF Roofing Filters Produce Excellent Shape Factor • 5" Full-Color Touch Panel w/3D Spectrum Stream • High Speed Auto Antenna Tuner • Microphone Amplifier w/3-Stage Parametric Equalizer • Remote Operation w/optional LAN Unit (SCU-LAN10) • This device has not been approved by the FCC.

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FTDX101D | *HF + 6M Transceiver*

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FT-891 | *HF+50 MHz All Mode Mobile Transceiver*

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FTM-300DR | *C4FM/FM 144/430MHz Dual Band*

• 50W Reliable Output Power • Real Dual Band Operation (V+V, U+U, V+U, U+V) • 2-inch High-Res Full Color TFT Display • Band Scope • Built-in Bluetooth • WiRES-X Portable Digital Node/Fixed Node with HRI-200

FT-2980R | *Heavy-Duty 80W 2M FM Transceiver*

• Massive heatsink guarantees 80 watts of solid RF power • Loud 3 watts of audio output for noisy environments • Large 6 digit backlit LCD display for excellent visibility • 200 memory channels for serious users

FTM-7250DR | *C4FM/FM 144/430MHz Dual Band*

• 50 Watt Mobile • System Fusion-II Compatible • Operates Advanced C4FM Digital & Conventional FM Modes • 3 Watt Powerful & Clear Audio with Front Speaker

FTM-400XD | *2M/440 Mobile*

• Color display-green, blue, orange, purple, gray • GPS/APRS • Packet 1200/9600 bd ready • Spectrum scope • Bluetooth • MicroSD slot • 500 memory per band

FT-70DR *C4FM/FM 144/430MHz Xcvr*

• System Fusion Compatible • Large Front Speaker delivers 700 mW of Loud Audio Output • Automatic Mode Select detects C4FM or Fm Analog and Switches Accordingly • Huge 1,105 Channel Memory Capacity • External DC Jack for DC Supply and Battery Charging

FT-3DR *C4FM/FM 144/430 MHz Xcvr*

• High Res Full-Color Touch Screen TFT LCD Display • Easy Hands-Free Operation w/Built-In Bluetooth Unit • Built-In High Precision GPS Antenna • 1200/9600bps APRS Data Communications • Simultaneous C4FM/C4FM Standby • Micro SD Card Slot

FT-65R | *144/430 MHz Transceiver*

Compact Commercial Grade Rugged Design • Large Front Speaker Delivers 1W of Powerful Clear Audio • 5 Watts of Reliable RF Power Within a compact Body • 3.5-Hour Rapid Charger Included • Large White LED Flashlight, Alarm and Quick Home Channel Access

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Page 48 Product Review Section

«The Dr.Duino Explorer Edition is a well-designed development, prototyping and troubleshooting platform»

Revied by Glen Popiel, KW5GP

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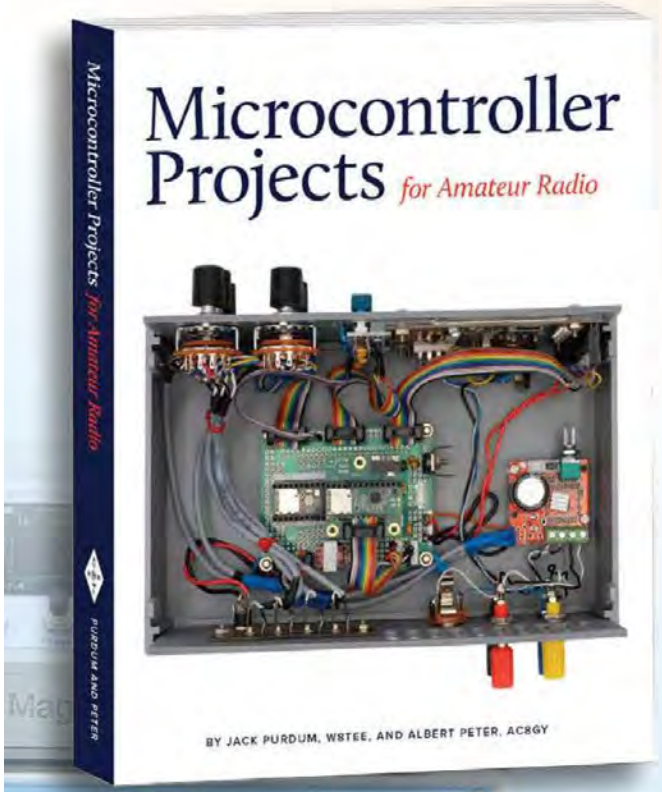
NEW! **Microcontroller Projects for Amateur Radio**

By Jack Purdum, W8TEE, and Albert Peter, AC8GY

All the information you need to build fascinating projects using the Arduino, STM32 ("Blue Pill"), ESP32, and Teensy 4.0 microcontrollers.



Unfamiliar with C or C++ programming? No problem. *Microcontroller Projects for Amateur Radio* provides all the introduction you need to build projects such as a programmable power supply, a signal generator, a DSP mic processor, and more!

Some of the practical hands-on projects featured:

- The Morse Code Tutor - learn and practice sending and receiving methods, with or without Farnworth encoding.
- The CW Messenger allows you to send up to 50 "canned" CW messages, that are completely changeable in the field without a PC.
- The Mini Dummy Load is small enough to fit in a shirt pocket, can handle up to 30W, includes an OLED display that shows RF power, yet can be built for around $20!
- The Double-Double Magnetic Loop antenna sets a new standard for small (3' diameter), multi-band operation and includes remote tuning.

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HAM-VI – $809.95 with DCU-2
HAM-VII – $959.95 with DCU-3

HAM IV and HAM V Rotator Specifications	
Wind Load Capacity (inside tower)	15 square feet
Wind Load (w/mast adapter)	**7.5 square feet**
Turning Power	800 in.-lbs.
Brake Power	**5000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**Dual race/96 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
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TAILTWISTER SERIES II – $869.95

For Large Medium Antenna Arrays up to 20 sq. ft. wind load.

Has 5-second brake delay, Test/Calibrate functions. Low temp grease, tough alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, weatherproof AMP connectors plus 8-pin plug at control box, triple bearing race with 138 ball bearings for large load bearing, electric locking steel wedge brake, North/South center of rotation scale meter, low voltage control, $2^{1}/_{16}$" max mast. **MSHD, $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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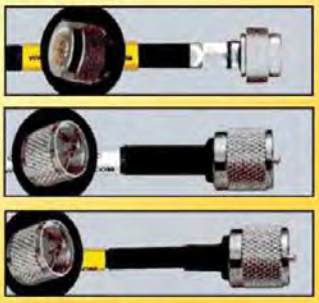
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MFJ G5RV Antennas

Operate all bands 10 through 160 Meters with a single wire antenna!

The famous *G5RV antenna is the most popular ham radio antenna in the world!*

It's an efficient, *all* band 102 foot long antenna – shorter than an 80 Meter dipole. Has 32.5 foot ladder line matching section ending in SO-239 connector for your coax feedline.

MFJ-1778
$69.95

Use horizontally or as Inverted Vee or Sloper with just one support. 1500 Watts.

Operate all bands 80-10 Meters with an antenna tuner and even 160M with ground.

Fully assembled with *ceramic* end and fiberglass center insulators. *Hang and Play™* – add coax, rope to hang and you're on air!

MFJ-1778M, $59.95. *Half-size*, 52 foot *G5RV JUNIOR for limited space*. 40-10 Meters with tuner. Full 1500 Watts.

MFJ All Band Classic Doublet

MFJ 102 foot *all band* doublet covers 160-6 Meters with balanced line tuner. Super strong custom fiberglass center insulator relieves stress on 100 foot ladder line. *Glazed ceramic* end insulators. 1500 Watts.

MFJ-1777
$79.95

RF Isolator

MFJ-915 *RF Isolator* prevents unwanted RF from traveling on the outside of your coax shield into your transceiver. This unwanted RF can cause painful RF "bites" when you touch your microphone or volume control, cause your display or settings to go crazy, lock up your transceiver or turn off your power supply. In mobile installations, stray RF could cause your car to do funny things even blow your car computer. Clear up these problems, plug an MFJ-915 between your antenna and transceiver. 1.8-30 MHz, 1500 Watts. 5 x 2 inches.

MFJ-915
$39.95

MFJ-919, $69.95. 4:1 current balun,1.5 kW.
MFJ-913, $39.95. 4:1 balun, 300 Watts.

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Balun & Center Insulator

True 1:1 *Current Balun/Center Insulator* forces equal radiator currents in dipoles for true dipole radiation pattern. Reduces coax radiation and field pattern distortion – your signal goes where *you* want it. Reduces TVI, RFI and RF hot spots. *Don't build a dipole without one!* 50 hi-permeability ferrite beads on high quality RG-303 *Teflon®* coax and *Teflon®* SO-239. 1.5kW 1.8-30 MHz. Stainless steel hardware. 14 gauge stranded copper wire is *directly* connected to your antenna. 5 x 2 inches. Heavy duty weather housing.

MFJ-918
$39.95

2-Position Antenna Switch

MFJ-1702C, $49.95. 2-position antenna switch, lightning surge protection, center ground. SO-239s.

Lightning surge protectors

MFJ-270, $24.95. 400W. **MFJ-272, $34.95.** 1500 W. Gas discharge tube shunts 5000 amps peak.< 0.1 dB loss. 1 GHz. SO-239s.

MFJ-16C06, $9.45. 6-pack *glazed ceramic* end/center ant. insulators.

MFJ-16B01, $24.95. Molded high strength center insulator. SO-239.

MFJ-16D01, $9.95. 450 Ohm fiberglass end/center insulator with ladder line stress relief and SO-239 mount.

MFJ-18H100, $44.95. 100 feet, 450 Ohm ladder line, 18 gauge copper clad.

80-10 Meter End-Fed Half Wave antenna

Cover all bands with one single wire and no tuner!

MFJ-1982HP
$109.95

No tuner needed!
All band 80-10M EFHW antenna

Get-on-the air on all bands 80-10 Meters with just one wire and one support (pole or tree) and no tuner or long counterpoise.

Installs anywhere in minutes! Rugged *insulated*-wire radiator prevents detuning when contacting limbs/branches. "*No-snag*" end insulator slides over branches, leaves.

Toss over a high limb for inverted-V or sloper or go vertical with an inverted-L.

Dark jacketed wire is virtually invisible – *don't let antenna restrictions keep you off the air!* Great for emergencies.

EFHWs naturally resonate on the 1/2-wave fundamental frequency and odd/even harmonics. Covers 80/40/30/20/17/15/12/10 Meters without traps, stubs or resonators.

Broad-band matching transformer at feed point gives SWR so low you may never need a tuner. Compensating inductor optimizes SWR. 800 Watts SSB/CW. 132 feet jacketed antenna wire.

MFJ-1984HP, $89.95. Like MFJ-1982HP but 40-10M. 66 feet jacketed wire.

See www.mfjenterprises.com for 30 Watt QRP and 300 Watt models.

Dual Band Dipoles

MFJ-17758, $99.95. Operate 80/40 Meters with a short 85 foot dipole. Full-size on 40 Meters with ultra-efficient end-loading on 80 Meters. 1500 Watts. Super-strong custom molded center insulator with SO-239 connector and hang hole. Ceramic end insulators. 7-strand, 14 gauge hard copper wire. No tuner needed!

MFJ-17758
$109.95
80/40 Meters

MFJ-17754, $69.95. Like MFJ-17758 but is only 42 feet. Operate 40/20 Meters. Full-size on 20 Meters, ultra-efficient endloading on 40 Meters. 1500 Watts.

Single Band Dipoles

Ultra high quality center fed dipoles give years of troublefree service. Custom injection-molded UV resistant center insulator has built-in SO-239 and hanging hole. Glazed ceramic end insulators. 7-strand, 14-gauge hard copper antenna wire. 1500 Watts. Use horizontally or as sloper or inverted vee. Simply cut to length with provided cutting chart.

MFJ-1779A
$79.95
160M, 265 ft.

MFJ-1779B
$59.95
80-40M, 135 ft

MFJ-1779C
$39.95
20-6M, 35 ft.

OCFD Dipoles

MFJ-2012
$89.95
1500 Watts

MFJ-2010
$69.95
300 Watts

No tuner needed!
MFJ *Off-Center Fed Dipoles* use MFJ's exclusive *ExactRatio™* RF broadband transformer to give low SWR and maximum bandwidth on 40/20/10/6 Meters. A Guanella current balun kills feedline radiation, pattern distortion, SWR shifts, RFI and noise pickup. Install anywhere and get the same predictable performance regardless of feedline length. You get ground reinforced gain over verticals. Use horizontally, inverted vee, sloper. 98% efficient, 14 gauge, 7-strand copper wire, ceramic end insulators.

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MFJ Portable Antennas!

Cover HF bands with one single EFHW, no tuner needed!

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.

MFJ-1982MP, $79.95. *300 Watts* Restricted space, 80-10M. 132 ft.
MFJ-1984MP, $69.95. *300 Watts* Restricted space, 40-10M. 66 feet.

MFJ-1982HP, $109.95. *800 Watts*, high power, 80-10 Meters. 132 feet.
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.

17' Stainless Steel Telescopic Whip

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

MFJ-2289, $209.95. 7-55 MHz portable, 34' ext., 28" collapsed, 1kW, 30/40M coil, balun.

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.

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 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.

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.

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.**

20W Transceiver Xiegu G-90, $449.95

20-W SDR Xcvr, .5-30 MHz, Auto-tuner, SSB/CW/AM/FM/Digital, detachable front panel, IQ out.

5W 160-6M Transceiver

Xiegu 5105, $599.95. All modes, DSP, ATU, 3800 mAH battery, microphone.

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 4Wx2⅝Hx 1½D 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.

200W Auto Tuner

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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MFJ Magnetic Loop Antennas

MFJ 36-inch magnetic loop antenna lets you operate 7 to 22 MHz or 10 to 30 MHz continuously -- including the WARC and MARS bands! Easily handles a full 150 Watts on SSB/CW/Digital for any transceiver.

Ideal for limited space. Apartments, small lots, motor homes, attics, trailers.

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Super easy-to-use! MFJ remote control auto tunes to your desired band. Fast/slow tune buttons, Cross-Needle SWR/Wattmeter lets you quickly tune to your exact frequency. No control cable needed.

***World's** most efficient small loop antenna has all welded construction, welded butterfly capacitor with no rotating contacts, large 1.050 inch diameter aluminum radiator -- gives you highest possible efficiency.*

Every capacitor plate is welded for extremely low loss and polished to prevent high voltage arcing. Nylon bearing, anti-backlash mechanism, limit switches, continuous no-step DC motor gives smooth precision tuning. Heavy-duty ABS plastic housing has ultraviolet inhibitor protection.

MFJ-1782, $459.95. Like MFJ-1786 but has fast/slow tune manual control.

MFJ-1780, $369.95. 20-10 Meters, 150 Watt *Portable* *24x24x24" box fan loop with carry handle.* Fast/slow tune control. *See QST July 2019.*

MFJ-1780XX, $449.95. Like MFJ-1780, has auto band control.

***New* 40-15M and 30-10M 300W *High Efficiency* Welded Loop Antennas**

Carry it anywhere! Easy carry handle, fold-out feet, tripod mount bracket. Portable, lightweight 36x36x4". Deluxe semi-auto controller with SWR/Wattmeter, no control line needed. Welded Low loss *butterfly* air-variable capacitor. 300W SSB.

MFJ-1784, $699.95. 40-15 Meters.

MFJ-1783, $649.95. 30-10 Meters.

Build your own Mag loop!

Motorized Butterfly Capacitors

Super low loss butterfly capacitors, no rotating contacts, all plates welded with no mechanical electrical contacts. Anti-backlash mechanism. DC motor with gear reduction box. Handles at least 150 Watts SSB/CW/Digital.

1. p/n: 282-1786, $189.95. 11-128 pF.

2. p/n: 282-1788, $249.95. 15-260 pF.

3. p/n: 80-1786-2SM, $249.95. Auto band selecting remote controller with SWR/Wattmeter.

4. p/n: 80-1782-2, $79.95. Manual remote control, fast/slow tune buttons.

Butterfly Capacitors

5. MFJ-19, $79.95. 12-67 pF.

6. MFJ-23, $109.95. 18-136pF.

7. p/n: 729-0142, $19.95. 6:1 vernier gear reduction drive for loop tuning capacitor.

8. 36-inch Aluminum Circular Loop with Integrated welded capacitor and mast mounting brackets

p/n: 10-1786-11, $129.95. 1.05 inch OD heavy duty tubing.

MFJ Magnetic Loop Tuners, 150 Watts

C ***Turns wire or coax into a small, high efficiency multi-band transmitting magnetic loop antenna!***

B **Work** the world 3.5 to 30 MHz with a *full 150 Watts* SSB/CW/Digital. No ground, radials or counterpoises needed.

A ***New*** larger matching capacitor is 313 pF. Increases matching range. Butterfly capacitor has no rotating contacts.

Very quiet receiving antenna -- you'll hardly notice static crashes. High-Q reduces QRM, overloading, harmonics. Perfect for apartments, antenna restricted areas and portable operation.

A 13' wire loop covers 30-20 Meters (4' for 17-10M; 7' for 20-15M; 28' for 60-40M; 50' for 80M). Tune *any* shape loop -- circle, square, rectangle, *etc.*

A wire length gives about 1.5 to 1 frequency range (i.e.7-10, 18-28 MHz).

Easy-Carry handle. Mount for PVC Cross loop support on cabinet top. Included tripod/mast mount.

A. MFJ-936C, $299.95. Antenna current meter, Cross-Needle SWR/Wattmeter. 9¼Wx5½Hx9½D".

B. MFJ-935C, $249.95. Antenna current meter. 6¼Wx5½Hx9½D".

C. MFJ-933C, $209.95. 6¼Wx5½Hx9½D".

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Clearly hear signals 50 KHz to 30 MHz you never knew existed. Power line noise and static disappears. Rotating 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 you high dynamic range, low IMD and 25 dB of low noise gain. Use inside or outside.

QRP Mag Loop Tuner

MFJ-9232 **$69.95**

Turns wire around a bookcase, window, tree, etc. *into a small, high efficiency transmitting loop antenna!* Operate 40-10 Meters with included flexible wire loop (80/60 Meters with your bigger loop). No counterpoises, radials, ground needed. 25 Watts. Very quiet reception. Hi-Q reduces QRM, overload, harmonics. Great for apartments, antenna restrictions, portable ops.

VIDEOS: https://m.youtube.com/results?search_query=MFJ-9232

Antenna Rotator

AR-500 **$169.95**

Perfect for magnetic loops, VHF/UHF, small HF beams, TV, FM antennas. Weather-proof cast aluminum housing with precision all metal gears, steel thrust bearings and automatic braking. Includes rotator, controller, remote control, clamps, hardware. 12 Memories. Digital display. 110/220 VAC.

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

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MFJ Weather-Proof Window Feedthrough Panels mount in your window sill. Lets you bring all your antenna connections into your hamshack without drilling holes through walls.

Simply place in window sill and close window. One cut customizes it for any window up to 48 inches. Use horizontally or vertically. Connectors are mounted on inside/outside stainless steel plates and attached to a 4 foot long, 3 1/2 inch high, 3/4 inch thick pressure-treated wood panel.

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Inside/outside stainless steel plates ground all coax shields. Stainless steel ground post brings ground in.

MFJ-4603 Universal Window Feedthrough Panel

MFJ-4603
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Four 50 Ohm Teflon® SO-239 coax connectors lets you feed HF/VHF/UHF antennas at full legal power limit.

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Best Seller! 3 Teflon® coax connectors for HF/VHF UHF antennas. Separate high voltage ceramic feed-thru insulators for balanced lines and longwire/random wire, Stainless steel ground post.

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6 Coax

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5 Cables, any-size

5 Adaptive Cable Feedthrus™. Pass any cable with connector: 2 cables with large connectors up to 1 1/4 x 1 5/8 inches and 3 cables with UHF/N size coax connectors. Seals out weather.

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MFJ-4616
shown with standard full size vent (not included) it replaces. For 6 Cables
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Add a pair of *PowerPoles*™

MFJ-4230MVP, $119.95. *PowerPoles*™ on back.

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Front-panel rocker switch lets you choose Amp or Volt meter for continuous monitoring. Cool operation with excellent 75% efficiency. Extra low ripple and noise is less than 100 mV.

It's quiet! Continuous air-flow gently cools the power supply and a heat sensor increases the fan speed if the temperature rises above 70 degrees celsius.

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MFJ-4245MV Switching power supply gives 45A surge/40A continuous. 9-15 VDC out. 85-260 VAC in. Low ripple, highly regulated. 5-way posts, cig lighter, quick connects. 5 lbs., 7½W x 4¾H x 9D".

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MFJ-4235MV switching power supply gives 35A surge and 30A continuous. 4-16 VDC with 1% voltage regulation. < 9 mV peak-to-peak ripple. AC input 90-125 or 200-240V. 7W x 4¼H x 8¾D", 4 lbs.

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MFJ-4115 Tiny! 17A surge, 15A cont. 13.8 VDC. 110/ 220 VAC. 3¾W x 2¼H x7 ¾D", 1.5 lb. 5-way posts. Switcher.
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MFJ-4225MV Switching power supply gives 25A surge, 22A continuous. Adjustable 9-15 VDC output, 85-260 AC input. Large 3" dual Amp/Volt meters, Binding posts, Cigarette lighter socket. 3.7 lbs. 5¼W x 4½H x 6D inches.

25-Amps, $99.95

MFJ-4125 gives 25A surge, 22A continuous. 13.8 VDC switching power supply has 5-way binding posts on front panel and quick connects on back. 3.5 lbs. Super compact 5½W x 2½H x 5¾D inches fits anywhere.

25-Amps, $109.95

MFJ-4125P gives 25A surge, 22A continuous. 13.8 VDC switching power supply front has 2 pair of *Anderson PowerPoles*™ and 5-way binding posts on front. Quick connects on back. 3.5 lbs. Super compact 5½W x 2½H x 5¾D".

28-Amps, $99.95

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MFJ-225

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The Alpha Delta TT3G50 Series Coax Surge Protector Design Concept

It was previously thought that lightning discharge energy was in the VLF, Very Low Frequency, spectrum and that a narrow band bandpass DC blocked surge protector in that range provided adequate protection.

However, in a study under the auspices of the U.S. Department of Energy utilizing the satellite FORTE carrying VHF lightning discharge sensors, it was determined that there can be damaging lightning energy emissions throughout the 30-300 MHz VHF spectrum. Therefore the damage threat can be anywhere from VLF through VHF.

Through careful design of the **Alpha Delta Model TT3G50 series broadband** precision constant impedance thru-line and ARC-PLUG™ module, allowing proper firing characteristics, this state of the art surge protector design allows effective protection throughout this entire spectrum.

- **Depending** on the connector style we provide excellent broadband performance through **3 GHz**, compared to narrowband DC blocked designs.
- **The impedance** compensated thru-line cavity design allows control voltages to pass through the device, instead of the "wire around" requirement of DC blocked designs. Our design also allows in circuit cable sweeps.
- **The innovative** field replaceable gas tube ARC PLUG™ module can be removed and replaced in the field with no tools required and without removing the surge protector from the circuit. The knurled knob does the trick. Connectors and knob are O ring sealed for environmental protection.
- **DC blocked** designs require the entire unit to be removed and discarded if hit with a surge beyond its rating. They are not field repairable.
- **As a result** of extensive testing and approvals within the military agencies, the Defense Logistics Agency (DLA) has assigned NSN numbers to our devices. Cage Code 389A5. All of our products are manufactured in the U.S.A. in our ISO-9001 certified facility for highest quality. Various connector styles available.

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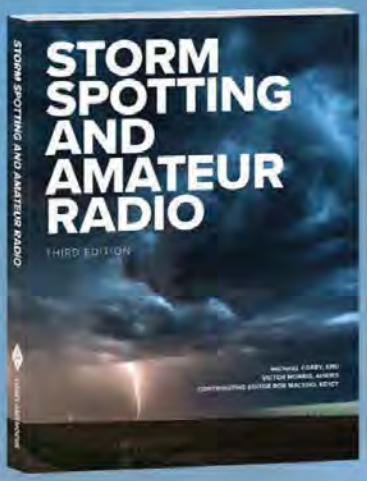

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200 Watt *MightyMite*™

Matches IC-706, FT-857D, TS-50S

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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".

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New, high voltage current balun lets you tune balanced lines at high power with no worries.

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New, larger 2-inch diameter capacitor knobs with easy-to-see dials make tuning much easier.

New, cabinet maintains components' high-Q. Generous air vents keep components cool. $12^{7}/_{8}$W x 6H x $11^{5}/_{8}$D inches.

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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. $10^{7}/_{8}$W x $10^{3}/_{4}$H x $4^{1}/_{2}$D in.

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MFJ-969 $259.95

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Tunes coax, balanced lines, random wire 1.8-30 MHz. Cross-Needle Meter. SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ transceivers. Tiny $6^{1}/_{2}$W x $2^{1}/_{2}$H x 6D in.

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MFJ-902B Tiny Travel Tuner

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80-10 Meters, 25 Watts. 12 position inductor, tune/bypass switch, wide-range T-network, BNCs. 4W x $2^{5}/_{8}$H x $1^{1}/_{2}$D inches. **MFJ-9201, $49.95**

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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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