Create a New Ham Kit for Your Club to Distribute Page 64

QST

DIGITAL EDITION

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Getting in Gear

QST Reviews

Icom IC-705
HF/VHF/UHF Multimode Portable Transceiver

Three High-Power Dry Dummy Loads

Choosing the Best of the Best

A Superb All-around Wide-Coverage Transceiver

HF/50/144/430MHz TRANSCEIVER

FT-991 A 100W

- Includes HF through UHF with one Radio
- Supports SSB/CW/AM/FM and C4FM digital
- IF Roofing Filters produce Excellent Shape Factor
- IF DSP enables Superb Interference Rejection
- Built in Real-Time Spectrum Scope Display
- 3.5-inch TFT Color Touch Panel Display
- 100 Watts (2 Meter & 70 Centimeter: 50 Watts) of Solid Performance

* External Speaker SP-10: Optional

* External Speaker SP-30: Optional

The New Standard High Performance SDR Transceiver

HF/50MHz TRANSCEIVER

FTDX10 100W

- Hybrid SDR Receiver (Narrow Band SDR & Direct Sampling SDR)
- 9MHz Down Conversion Receiver Configuration
- IF Roofing Filters produce Excellent Shape Factor
- IF DSP enables Superb Interference Rejection
- 5-inch TFT Color Touch Panel with 3DSS*1 Visual Display
- Superior Operating Performance by means of the MPVD*3

The World Leading HF Transceiver with Hybrid SDR

HF/50MHz TRANSCEIVER

FTDX101MP 200W

FTDX101D 100W

- Dual Hybrid SDR Receivers (Narrow Band SDR & Direct Sampling SDR)
- 9MHz Down Conversion Receiver Configuration
- IF Roofing Filters produce Excellent Shape Factor
- VC-Tune (Variable Capacitor Tuning) Signal Peaking
- IF DSP enables Superb Interference Rejection
- 7-inch TFT Color Touch Panel with 3DSS*1 Visual Display
- Superior Operating Performance by means of ABI*2 & MPVD*3

* Microphone M-1: Optional

* Photo shows the FTDX101MP

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

YAESU
The radio

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

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YAESU
The radio

C4FM/FM 144/430MHz Dual Band Mobile

High Visibility and Resolution QVGA Display with Exceptional Operability

Real Dual Band Operation V+V/U+U/V+U/U+V & Simultaneous C4FM Monitoring

FM Friendly Digital : AMS (Automatic Mode Select)

System Fusion II Compatible

WIRES-X Portable Digital Node Function

- **Wide Range RX Coverage : 108 ~ 999.99 MHz**
- **Easy to Operate II (E2O-II) : New User Interface for Easy Operation**
- **New Memory Auto Grouping (MAG) Function**
- **New Multi-Channel Standby (MCS) Function**
- **High-Speed 61 Channel Band Scope**
- **Easy Hands-Free Operation with Built-in Bluetooth® Unit**

C4FM/FM 144/430 MHz DUAL BAND
50 W DIGITAL MOBILE TRANSCEIVER

FTM-300DR

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WIRES-X

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Cushcraft...Keeping You in Touch Around the Globe

MA-6B 6-Band Beam

Small Footprint – Big Signal

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

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

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

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

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

MA-5B, $579.95. Like MA-6B but five bands: 20/17/15/12/10 Meters. 12 and 17 Meters is a single element trapped dipole.
***See cushcraftamateur.com** for gain figures.*

Cushcraft 10, 15 & 20 Meter Tribander Beams

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

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

The 3-element A3S/A3WS and 4-element A4S are world-famous for powerhouse gain and super performance. **A-3WS, $529.95,** 12/17 M. **30/40 Meter** *add-on kits* available.

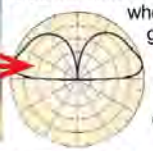
Cushcraft R9...80-6 Meters 80 Meters...No Radials...1500W

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

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

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

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



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

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

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

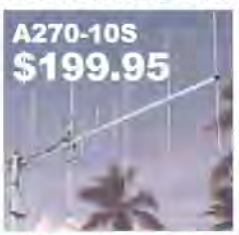
31.5 feet tall, 25 lbs. Mounting mast 1.25 to 2 inches. Wind surface area is 4 square feet.

R8, $569.95. Like R9 antenna but less 75/80 Meters.

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

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

Cushcraft Dual-Band Yagis



One Yagi for Dual-Band FM Radios

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

Cushcraft Famous Ringos Compact FM Verticals

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

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Add shipping. Prices and specifications subject to change. 2016 ©Cushcraft.

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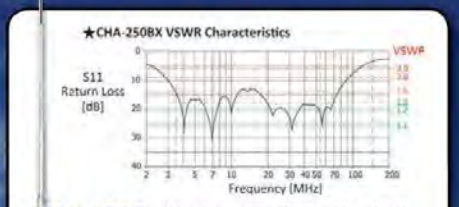

CHA-250B - *No Antenna Tuner Needed!*

❶ ❷ ❸ ❹ ❺ ❻ ❼

Base Antennas

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

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

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

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

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

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

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

NEW
CAA-500MarkII
1.8-500MHz Antenna analyzer

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.

Operates on 8-16VDC external power, 6 AA Alkaline or NiMH rechargeable cells • Trickle charger built in (only when using NiMH batteries) • Typical battery life: 9 hours of continuous operation • Battery level indicator • Selectable auto power-off time limit preserves battery capacity • SO-239 connector for 1.8-300MHz range • N-female connector for 300-500MHz range

The perfect combination of analog and graphic information, designed in particular for antenna diagnostics and adjustments while on the roof, tower or in the field!

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Protect your CAA-500MarkII from moisture, shock, dents and dings!
Shoulder strap included.

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www.arrl.org/qst-author-guide
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Our Cover

Frankford Radio Club members John Crovelli, W2GD (on the mast), and Dave Hawes, N3RD (on the work platform), put the finishing touches on the antenna installation for fellow club member Ed Post's, W2MKM, new 90-foot motorized crank-up tower in Washington, New Jersey. Antennas include a tribander on the bottom of the stack, a seven-element Yagi for 6 meters in the middle, and a three-element Yagi for 40 meters at the top. Ed is thrilled with his new setup, which has been on the air since November 10. In this issue, you'll find more gear to thrill you, from coax choke baluns that you can wind yourself, to details about a mesh networking go-kit, to the in-depth information in *QST* Product Reviews. [Ed Post, W2MKM, photo]

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NEW

Z-100Plus/IC-705
Zero Power Antenna Tuner

Designed to provide 125 watt power handling in SSB, CW and digital modes, the Z100Plus/IC-705 features 2000 memories that store both frequency and tuning parameters. Operating frequencies are stored with tuning parameters to make memory tunes in a fast 0.1 seconds. Full tunes take an average of only 6 seconds. Now includes 8 AA heavy duty batteries, Stereo interface cable, and BNC to PL-259 coax cable.

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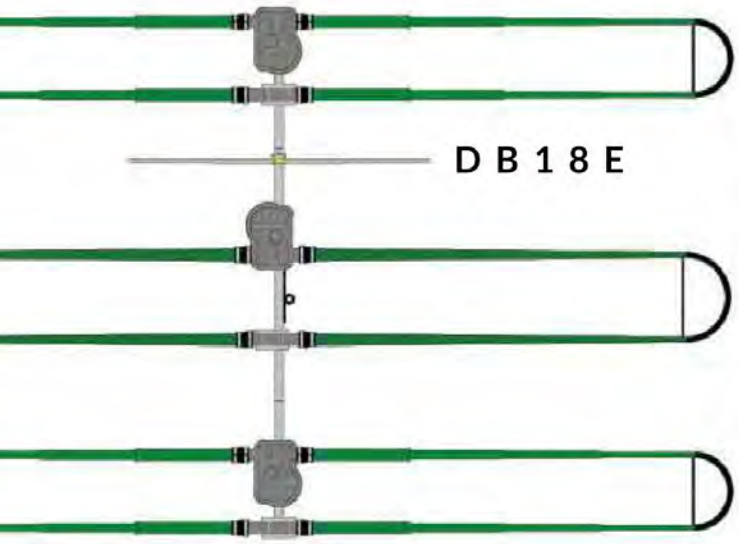

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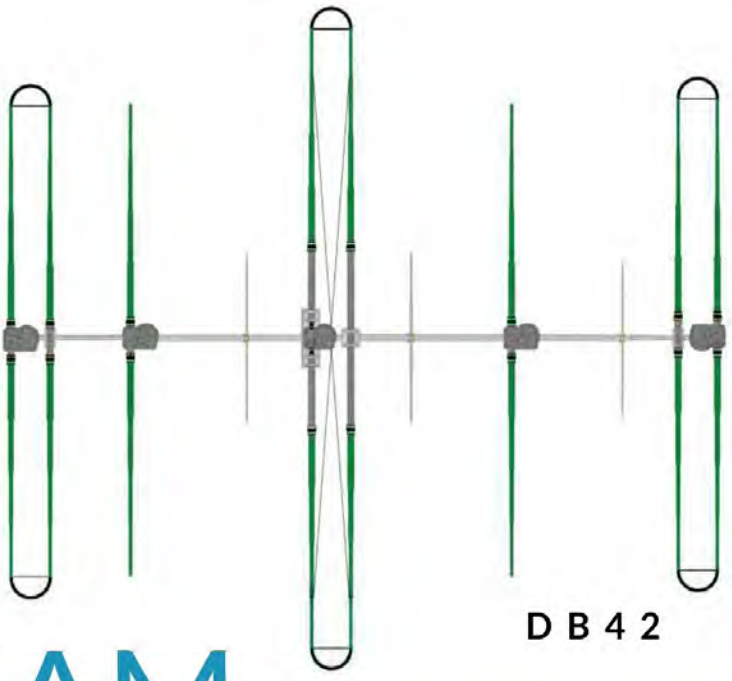

DB42

DREAM BEAM

The DB Series (DreamBeam) Yagi antennas are ideal for those looking for broadband, high-performance gain and exceptional front-to-rear. Each DreamBeam, with the exception of the ultra-stealth DB-11 (13.8-54 MHz), is an optimized Yagi antenna 6.8-54 MHz. The DB36 and DB42 Yagis have 3.5 -6.8 MHz dipole options available, which utilize the end elements as top-hats for excellent band coverage. All of the DB Series antennas employ our patented loop technology, resulting in a physical footprint that is 40% shorter than a full-size Yagi – with only 0.3 dB reduction in performance gain!

DB

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

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

X700HNA Special Features:

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

Here is a small sample of our wide variety of antennas

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

The Standard By Which All Others Are Judged

RF PARTS™ COMPANY

Diamond Antenna is a division of RF Parts Company

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

Second Century

No One Left Behind

The part of amateur radio that has always been the most important to me has been our community. Over the years, as I have traveled domestically and internationally, I have had the opportunity to meet many hams and count them as my friends. The amateur radio community is a diverse one. People from all walks of life, all backgrounds, all demographics — there doesn't seem to be a single area the hobby doesn't touch. So why do new hams feel left out, lost, and even not welcomed into our community?

When I think about my ham friends, I look to someone like Bennett Norell, KO2OK, and see a *connector*. He's someone who shows a real passion not just for being in the community, but for bringing people together to strengthen and expand our community. He has long held leadership positions in local amateur radio clubs, has been a "first responder" to radio amateurs who need help solving a problem with their station, and even takes the lead in organizing field operations like VHF contests and ARRL Field Day. Maybe you know Bennett, or a ham like him, who, time and time again makes sure that everyone, regardless of age or interest, gets the opportunity to be involved and get on the air.

Now ask yourself: After your club held its last VE exam session, what happened to those new Techs? If they came to the club meeting later that day or at the next session, were they asked to stand and introduce themselves? Was there a round of applause for joining our ranks? Did you exchange phone numbers and offer to mentor them on what to do with their new license? Maybe the unwelcome feeling didn't come from a club experience at all. It could have come when that new Tech, with a budget handheld, broke into a conversation on the local repeater to try to introduce a shiny new call sign. Was that new ham met with a message of welcome? Or rather, with sharp criticism for using an inferior piece of equipment to interrupt two longtime repeater buddies?

The feeling of being included — *inclusion* — is a powerful tool for our community. Our strength is in our numbers, our shared passion for the hobby, our breadth of deeply experienced people, and our ability to communicate as friends and mentors! I can't be there at your next meeting, on your next repeater QSO, or at your next hamfest. It's just not possible. So, I need to count on *you* to be a connector, like Bennett. Go out of your way. Meet these new hams. Or even the longtime hams that have drifted away for whatever reason. We are members of a national association, coming together to share the common interest and passion of our hobby. Be that connector who strengthens our bonds!

What I can do, and what I am personally committed to, is work to be more inclusive of hams who are visually impaired and blind. I recently saw some posts from Paul Ladd, KN4CHK, a visually impaired radio amateur only recently licensed. Paul is navigating through amateur radio using ARRL discussion groups on everything from seeking advice about his BTECH handheld, to learning CW, to making contacts on his Kenwood TS-120S and G5RV. What tenacity! It strengthens our resolve to be more inclusive of this community, knowing that ARRL will be paving the way for Paul, and many other amateurs and wannabe amateurs with disabilities, to enjoy traveling the world and meeting new people through the comfort and convenience of their home stations, or leveraging remote stations! We will be making ARRL's newsletters and magazines more readily available to this community by supporting formats for text-to-speech and refreshable Braille displays. We will also be exploring new interfaces for SDR receivers and transceivers so anyone, regardless of ability, can tune in the world.

Additionally, we at ARRL are working on programming and tools to make our Section Managers, Field Organization, and Affiliated Clubs more successful in building the community. We'll provide structure and standards for locally produced newsletters and websites, the content needed to make them relevant, and other forms of instructional and informational content to drive meetings. We're also working to support youth and STEM initiatives to expand broad interest in radio technology and radio communications, and we'll help make that happen by enhancing our Learning Center with someone who has extensive video content production and youth educational programming experience. Along with all of these efforts, we will strive to expand an active and engaged ARRL membership as well.

As always, I encourage you to be radio active. Be a connector! Have a friend who isn't a member? Get them to join ARRL! And reach out — we'd love to hear from you at **ceo@arrl.org**.

David A. Minster, NA2AA
Chief Executive Officer

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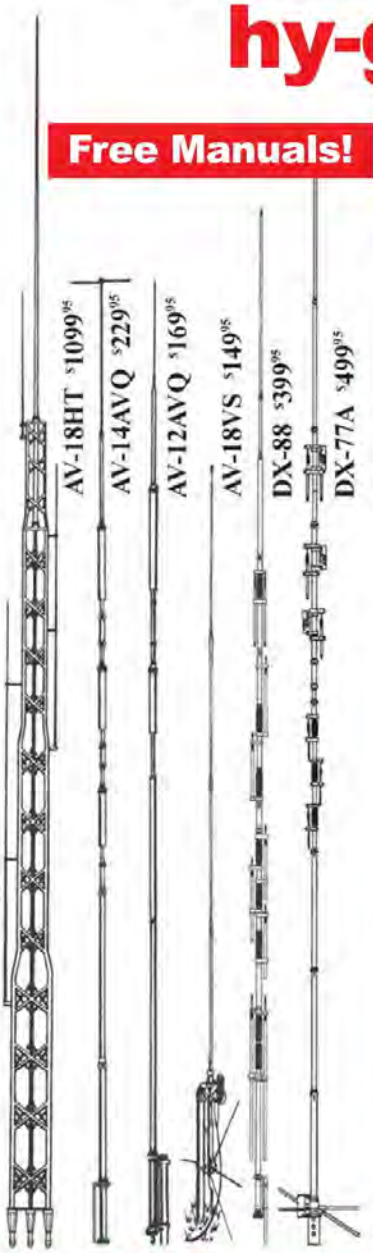

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The Hy-Gain AV-14AVQ uses the same trap design as the famous Hy-Gain Thunderbird beams. Three separate air dielectric Hy-Q traps with oversize coils give superb stability and 1/4 wave resonance on all bands. Roof mount with Hy-Gain **AV-14RMQ kit, $119.95**.

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High quality construction and low cost make the AV-18VS an exceptional value. Easily tuned to any band by adjusting feed point at the base loading coil. Roof mount with Hy-Gain **AV-14RMQ kit, $119.95**.

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AV-14AVQ	**$229.95**	**10, 15, 20, 40**	**1500 W PEP**	**18 feet**	**9 pounds**	**80 MPH**	**1.5-1.625"**
AV-12AVQ	$169.95	10, 15, 20 M	1500 W PEP	13 feet	9 pounds	80 MPH	1.5-1.625"
AV-18VS	**$149.95**	**10 - 80 M**	**1500 W PEP**	**18 feet**	**4 pounds**	**80 MPH**	**1.5-1.625"**
DX-88	$399.95	10 - 40 M	1500 W PEP	25 feet	18 pounds	75 MPH no guy	1.5-1.625"
DX-77A	**$499.95**	**10 - 80 M**	**1500 W PEP**	**29 feet**	**25 pounds**	**60 MPH no guy**	**1.5-1.625"**

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The DPM6000 SWR 2 channel power meter measures forward and reflected power over a 70dB range. A 0dBm 50MHz reference ensures high repeatability and accuracy. Range is .01uW to 2kW with a frequency response of 50KHz - 6 GHz depending on sensor. It displays SWR, Watt/dBm, peak power, return loss RL, RC (c), frequency and a bar graph.

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PG50PS Pulse Generator

The PG50PS delivers ultra high (8,000V/uS) slew rate 35ps tr steps. Use it for mm TDR and oscilloscope/amplifier frequency response tests. Apply the step to a scope and the rise-time is measured using the BW=.35/rise-time formula (printed on the case) allowing bandwidth checks to 6GHz.

SALE $775

TDR-Cable Radar®

This time domain reflectometer (TDR) features a fast pulse generator to check transmission lines & cables by analyzing reflections on an oscilloscope. It computes distance to fault (DTF) 2.5 cm - 15km, return loss (RL), velocity factor (Vf) & line loss dB @ 100'. It covers 50 - 600 Ω with 25 ps resolution using isolated samplers and separate (DUT) outputs.

T150 Step Attenuator

Attenuation covers 41dB in 1 dB steps, using Pi-Pad attenuators from DC to 1 GHz. It features a 50 Ω 2W strip line design with UHF switches. Great for ham radio tests of receivers and general signal conditioning.

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SMT Station Monitor

The monitor provides all connections, plus the demodulator, to drive an oscilloscope in XY (drive v. output) mode, resulting in a trapezoid waveform, revealing non-linear operation of a transmitter in real time.

$259

TTG1 Two Tone Generator

The generator has two low distortion (700Hz and 1900Hz) sources to analyze SSB & AM transmitter linearity and overdrive for IMD distortion and harmonic splatter.

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DDS-1 Dual Directional Coupler

The coupler measures forward and reflected power with an oscilloscope. The transmitter connects to RF IN, the load connects to RF OUT. When the load absorbs all the energy, virtually no power is reflected, resulting in very little REFL power (SWR 1:1). The FWD port shows power (– 30 dB) to the load!

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HFS-1.5 HF Sampler -30dB

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RLB-E 500MHz Return Loss Bridge

The bridge compares an unknown Z to a reference Z. A test oscillator connects to the RF IN. An oscilloscope connects to the DET OUT. The tested device such as an antenna or coax, connects to the DUT. Equal Z result in essentially zero output and very high RL.

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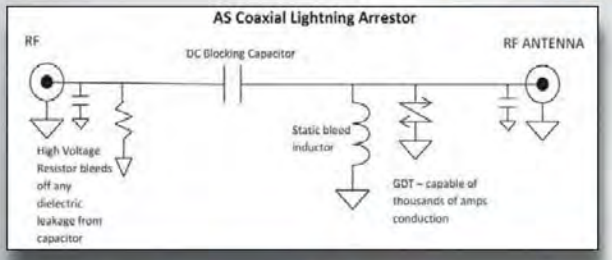

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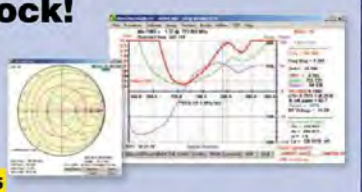

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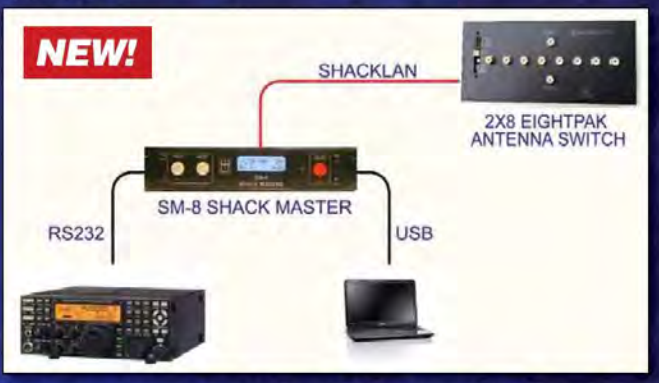
Hamation remote and Local Station Control products allow you to automatically or manually select antennas, bandpass filters, and control accessories. Accessories can be StackMatches, Antenna switches, antenna phasing systems, SteppIR controller, turning radios on and off, etc. All of this can be done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

Wiring are simple phone cables that daisy chain to all the devices. Wireless control is also available to your tower-located switches. Call us to learn how to set up simple or complex systems. Below is a simple basic system that can switch antennas as you change bands. We can interface to any radio CAT port, not just RS232.



A more complex system could be a SO2R contest station as shone.

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Caroline Kenney, ckenney@arrl.org

Member Spotlight

Francis Hildwine, KC3QGE

Francis "Fran" Hildwine, KC3QGE, is an EMT, paramedic, simulation educator, and an American Heart Association Instructor with CPR, Advanced Cardiovascular Life Support (ACLS), and Pediatric Advanced Life Support certifications. A career as a first responder led him to write as a columnist for the Journal of Emergency Medical Services and later reinvigorated his interest in amateur radio.

Becoming a First Responder

Fran has been an EMT since 1986, a paramedic since 1989, and an instructor since 1992. Over the course of 24 years, Fran rose through the ranks of a hospital-based EMS system, becoming the assistant chief for training. He called it an "odd career path," explaining that he started in electronics and video production, and later became a volunteer firefighter, EMT, and paramedic.

Additionally, after helping coordinate local responders as logistics support for a Journal of Emergency Medical Services (JEMS) annual conference in the 1990s, Fran was offered the opportunity to write a monthly product review column. He called it the best and busiest job he'd ever held, and said, "I had all the newest EMS products and gadgets coming across my desk monthly."

Fran said one of the pivotal moments in his career was working on disaster drills with a Philadelphia airport. The drill involved a complicated scenario, with patients being transported to dozens of area hospitals. The drill coordinator used area ARES-RACES members to provide communications support and transport coordination. He said, "The support from the amateur radio team was irreplaceable."

Work and Interests Overlap

Amateur radio has always been an aspect of Fran's career as a first responder, saying, "Using the public safety bands is a daily occurrence." Getting his radio licence has given him deeper insight into the public safety aspects of amateur radio.

He explained that many operators have a background in STEM fields, are involved in public safety, and are knowledgeable about electrical safety, especially because it's part of the Technician- and General-class exams. Fran wants to merge the two fields even further, stating, "I would encourage everyone to add a First Aid and CPR class to your list of things to learn. While there is a potential for our hobby to be dangerous, the best thing I've seen about it is everyone's willingness to learn and help."

Future Goals

Though ham radio has always been present in one way or another throughout Fran's life, he only recently earned his Technician-class license in October 2020 and quickly upgraded to General in December 2020.

His father was an avid Heathkit builder, and growing up in the 1970s, he watched his brother, who was a Novice-class licensee, collect QSL cards. Though he was interested in the vocation, he was intimidated by the Morse code requirement, and considered the amateur radio license to be "unobtainable." After learning from a licensed EMT colleague that the Morse code requirement had been dropped, his desire to get licensed was reinvigorated.

Now that he's earned his license, nothing about amateur radio seems unobtainable. For instance, Morse code was once something that had dissuaded him from pursuing his license, but he's not letting that hold him back any longer. "Now on to Amateur Extra and CW," he said. He's looking forward to always learning new things about the hobby. "The number of things there are to learn in ham radio has kept, and will keep, me interested for a long time."

Keeping Busy

Currently, Fran works as a life support training coordinator and simulation educator for a local children's hospital. He explained, "The things I've learned in ham radio classes have helped me better understand the internal workings of the high-fidelity simulators we use in healthcare education."

As if work and amateur radio don't keep him busy enough, he has a house full of animals, including two dogs, Sookie and Aries; a rabbit named Dexter, and a guinea pig named Buttons. He has been married for 25 years to his wife, Jeanette, who is a high school special education teacher. He may have his hands full, but he's always looking for new projects.

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ARRL supports legislation and regulatory measures that preserve and protect meaningful access to the radio spectrum. Our **ARRL Regulatory Information Branch** answers member questions concerning FCC rules and operating practices. **ARRL's Volunteer Counsel** and **Volunteer Consulting Engineer** programs open the door to assistance with antenna regulation and zoning issues.

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

ARRL is an incorporated, noncommercial association without capital stock chartered under the laws of the State of Connecticut, and is an exempt organization under Section 501(c)(3) of the Internal Revenue Code of 1986. Its affairs are governed by a Board of Directors, whose voting members are elected every 3 years by the general membership. The officers are elected or appointed by the Directors.

ARRL is noncommercial, and no one with a pervasive and continuing conflict of interest is eligible for membership on its Board.

"Of, by, and for the radio amateur," ARRL numbers within its ranks the vast majority of active amateurs in the nation and has a proud history of achievement as the standard-bearer in amateur affairs.

A *bona fide* interest in amateur radio is the only essential qualification of membership; an amateur radio license is not a prerequisite, although full voting membership is granted only to licensed amateurs in the US.

Membership inquiries and general correspondence should be addressed to the administrative headquarters: ARRL, 225 Main St., Newington, Connecticut 06111-1400 USA.

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

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Up Front

Morse Clinic

Rick Markey, KN3C, and his wife were in Erwin, North Carolina, and came across this healthcare clinic. He was surprised to find that the dots and dashes were not just a design, but real CW.

Morse Code Sheep

Thomas Wayne King, WF9I, and his wife, Debra, have a flock of Icelandic sheep. Of the six, two of them, named Torgeir and Ari, have learned to recognize several Morse code letters. Tom and Debra now use Morse code letters G and T to alert the sheep when there is grain and treats. Torgeir and Ari lead the charge whenever they hear the familiar combinations of dits and dahs.

Teaching Morse Code Early

Barb Caskey, KD7REU, and her husband, Kevin, K7KHC, from Aberdeen, Washington, have been doing some educational crafts with their 4-year-old grandson, Barrett. Every week, they teach him an uppercase, lowercase, and Morse code letter using banners. The B and H banners were among his favorites so far.

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Correspondence

Letters from Our Members

A Worthy Investment

I thought about the 1968 song, "Those Were the Days," by Mary Hopkin when I read the Rules for Life Membership in "A Look Back — 1971" from the December 2020 issue. With ARRL Life Membership costing $130 back then, it was less than I made in a month of flight pay as a US Air Force captain, and becoming a Life Member was a no brainer for me. I have many investments that have turned out well for me in my life, but my ARRL Life Membership is by far the best!

W. David Herbert, N6LW
Billings, Montana
Life Member

Kindness Goes A Long Way

I've been a ham for over 50 years, and I think if we want the hobby to continue, and potentially flourish, we need to be more understanding, inclusive, and patient.

On the low-power frequencies (often used by those with limited funds or who live in antenna-restricted communities) we should take the time to not only make rare DX contacts, but also contact others who are closer, or with lower signal levels or slower CW speeds. You could be someone's first contact as a newly licensed ham, the first CW contact by someone learning Morse code, or a contact for someone with limited resources looking to enjoy the occasional contact. If the contact is dismissive or unfriendly, it could be off-putting to the hobby.

Positive contacts not only help create a bond among fellow ham radio operators, they also help invite others to join the hobby with the promise of interesting contacts, new experiences, and friendly people.

Populating the bands with low-power operation of SSB/FM/CW contacts and friendly nets might help increase our enjoyment of a historic and interesting hobby and entice others looking to become hams, helping the hobby grow.

Jim Kennedy, K2PHD
Ledgewood, New Jersey

Remembering USS *Pueblo*

Thank you for re-publishing the story of the USS *Pueblo* in "A Look Back — 1971" from the December 2020 issue. Although I was not a ham at the time, I was on the USS *Banner* AGER-1. The *Banner* had been operating from Yokosuka, Japan, for about 2 years when North Korea captured the *Pueblo*. I worked in the engineering department of the *Banner* as an Interior Communications Electrician (IC man). The *Banner* and the *Pueblo* were both hold freighters converted for their assignments in intelligence-gathering. They were small, slow, and unarmed. To this day, even though it's on display as a national monument in North Korea, the *Pueblo* remains commissioned as an active US Navy ship.

When the *Pueblo* was captured, the *Banner* was on its way to relieve it. The *Banner* had operated for 2 years at that point, only experiencing the occasional shadowing of Russian and other ships that came out to observe us. The closest thing to aggressive behavior came when one of the Russian ships came too close during a pass-by and scraped some paint.

For those interested in more information about the *Pueblo*, I suggest reading "Bucher: My Story," written by Lloyd M. Bucher, the *Pueblo*'s commanding officer.

Larry Fravel, K8YYY
Shinnston, West Virginia
Life Member

In-Dash Mobile Mount Limitations

Glen Popiel, KW5GP, wrote about an ingenious solution for operating mobile in his article, "Installing an In-Dash Mount for Your Mobile Rig," in the December issue. However, this approach has its disadvantages.

In the last decade, car radios have continued to add features to small dashboards. The large radio screen is becoming an "information window" in cars. The radio often has a control head of two or more electronic modules connected by cables.

Depending on your car, removing the factory-installed radio could mean losing access to voice recognition, hands-free phone, GPS navigation, backup camera display, and telematic services like OnStar. It may mean losing warning beeps, the climate system display, and some information items on the driver's dashboard display. It's unfortunate to have to choose between these features and an in-dash mobile mount, but at least the mobile mount can easily be installed in older cars.

Wes Plouff, AC8JF
Royal Oak, Michigan

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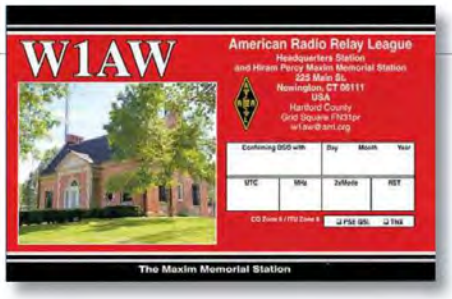

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Create Your Own 1:1 Coax Choke Baluns

Basic rules and examples for home builders that are easy to remember without having to use complex math.

John Portune, W6NBC

In developing new ham antennas, I have painfully learned the importance of testing an antenna prototype through a 1:1 choke balun. On paper, promising concepts often gave unpredictable results when they became an actual antenna, until I included the balun. Using a 1:1 choke balun for all my design work is now standard operating procedure.

There are other types of baluns, but I've found the 1:1 choke balun to be the most universally useful balun type (see Figure 1). Even most of my commercially built antennas have one. They're effective, inexpensive, and simple to make. One merely winds a few turns of the coax directly in the feed line. A well-known example for the HF bands, found widely on the internet, is the HF "ugly balun" (see Figure 2).

Many hams naturally think to wind a balun neatly on a PVC form, as in Figure 1A. Figure 1B is another neatly wound coax balun, but on a handy 3D-printed quick form. Don't hesitate to scramble-wind a coax balun as a random bundle secured with zip ties, as seen in Figure 1C. My favorite way to make a scramble-wound choke balun, shown in Figure 1D, is to loop the windings back through each other to form what is called a torus knot. In this example, no zip ties are needed. All the baluns in Figure 1 are for VHF and higher. When using any of these methods, be careful that the coax is not bent too much around any sharp edges. That could damage the coax, especially if it has a foam dielectric.

HF coax baluns can be large. Some may consider them ugly, but they are effective for a very wide range of balun applications. Most important to many is that they are easy to make and inexpensive. One practical advantage of a coax balun, over other types, is that it can be live out in the weather without a sealed box, connectors, messy tape, or sealants.

Let's now see how to build one. First, you need to choose one of the build-it-yourself methods mentioned earlier. Next, you need to determine the number of turns and the diameter of the coil for a given band. Some may consider this difficult; it isn't. Fortunately, three easy-to-remember math-free rules will get you there.

The Starting Point

The method derives from the primary responsibility of all baluns, which is to keep transmitter RF inside

Figure 1 — Methods of winding a 1:1 choke balun.

(A) Neatly wound on a PVC form.

(B) Handy quick-form winding.

(C) Scramble-wound balun, using zip ties.

(D) Scramble-wound balun as a torus knot.

the feed coax. RF being carried by coax should exist only between the outside surface of the center conductor and the inside surface of the shield or braid. It should not be allowed to find its way onto the outside surface of the coax, where it is technically known as common-mode current. Failure to realize the importance of this fundamental reason for a balun ultimately forced me to begin using a 1:1 choke balun during antenna development. Before that, common-mode current (RF on the shield) kept me from seeing the performance I knew should be there.

Stopping Common-Mode Current

A choke balun stops RF on the shield by introducing an impedance (technically a reactance) in series with the outside of the shield. Any common-mode current will then be choked off when it encounters the coil's reactance. The amount of reactance must be relatively high in comparison to the working (characteristic) impedance of the antenna system — 50 Ω in most ham situations. Standard engineering practice suggests that a reactance of at least four times the system impedance, or 200 Ω, is enough.

Coax Choke Balun Rule 1: **The coax choke coil must have a reactance of at least 200 Ω in a 50 Ω antenna system, at the lowest frequency of operation.**

You can make it larger, but 200 Ω is a satisfactory starting point. Many published designs suggest more, and that is fine. Just remember that using a longer coax to get a higher reactance will cost more and introduce a bit more loss.

Translating Coil Reactance into Windings

Coax Choke Balun Rule 2: **(1) convert ohms to microhenries and then (2) convert microhenries to turns and coil diameter.**

Most RF handbooks have the math formulas to do both. I find online calculators much easier. I use the reactance-to-inductance calculator at **https://www.electronics2000.co.uk/calc/reactance-calculator.php**, and the coil inductance calculator at **https://www.allaboutcircuits.com/tools/coil-inductance-calculator** to determine the turns and coax coil diameter.

Let's now look at two practical examples. Try the two steps with the calculators for yourself; the process is straightforward.

Example 1

For a 2-meter 1:1 coax choke balun, use the reactance calculator to translate the 200 Ω of reactance at 146 MHz to 0.22 µH of inductance. Next, use the inductance calculator to translate 0.22 µH of inductance into three turns of 0.2-inch-diameter coax (RG-58 or LMR-200) on a 1-inch-diameter form.

This balun, seen in Figure 1B, is wound on a handy 3D-printed quick form. The 3D printer file (.stl) for this coil form is available for free download at **w6nbc.com/3d** and **arrl.org/qst-in-depth**.

Example 2

For a 160-meter and higher 1:1 coax choke balun, use the reactance calculator to compute that a reactance of 200 Ω at 1.8 MHz needs a coil of 18 µH. Next, use the inductance calculator to compute that an 18 µH coil requires a minimum of 12 turns of 0.4-inch-diameter coax (RG-8 or LMR-400) coil wound on a 5-inch-diameter Schedule 40 PVC form (see Figure 2).

Shown is a typical "ugly balun" widely described on the internet in a variety of lengths, diameters, and coax types. Many references indicate that you may use more inductance if you wish, or more turns and a larger diameter. This is fine, because a lower-frequency balun also works on higher bands.

Figure 2 — An "ugly balun" for 160 meters and higher.

Scramble Winding

It is quite okay to randomly wind a coax balun (see Figures 1C and 1D). A neat coil on a form, seen in Figure 1A, is not essential.

> ***Coax Choke Balun Rule 3:*** **A scramble-wound coil has a bit more inductance than a neatly wound coil with the same coax length. Use the same total length of coax that you would have used in the coil calculated by Rule 2.**

As a fan of homebrew ham antennas, my design mantra is to now use a balun on all antennas, even commercially built antennas. One might use a 4:1 balun, for example, for the needed impedance transformations in an OCF HF dipole, but for most other balun applications, a simple coiled-coax 1:1 choke balun works very well.

I have a good example at my home station. The SO-239 "unbalanced output" jack of an automatic antenna tuner feeds a multi-band 20-foot HF flagpole antenna with 450 Ω or open-wire window line. I use a short length of coax from the tuner, through a coiled coax choke balun, to the balanced line. That takes care of both the balance issue and keeping common-mode RF off the coax run from my rig to the tuner.

A 1:1 choke balun — whether in coax or as ferrite cores/beads — is the most useful form of the balun. For most applications, it works well to eliminate unwanted RF on the shield without interfering with what is going on inside the coax. For antenna development or modification, I now consider one an essential for consistent performance with any antenna. These few rules I provided have become a basic component of my antenna design toolkit.

All photos by the author.

John Portune, W6NBC, is an ARRL member and frequent contributor to *QST*. He has been licensed for 54 years and has held an Amateur Extra-class license since 1972. John has a BS in physics and also holds an FCC Commercial General Radiotelephone Operator license and an FCC Radiotelegraph license. He retired as a broadcast television engineer and technical instructor at KNBC in Burbank and then from Sony Electronics in San Jose, California. You can reach John at **jportune@aol.com** or through his website at **www.w6nbc.com**.

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

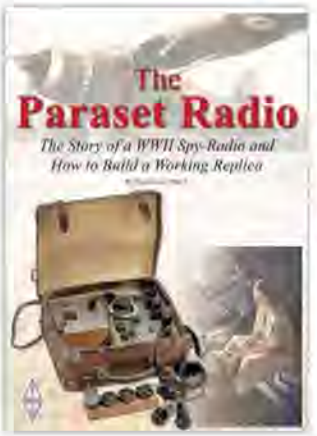
New Books

The Paraset Radio: The Story of a WWII Spy-Radio

Hiroki Kato, AH6CY

Reviewed by Rick Lindquist, WW1ME

This delightful e-book, published by the Radio Society of Great Britain (RSGB), opens a window into the world of wartime radio spycraft. Before the era of miniaturized solid-state electronics, the brave and sturdy souls of the Special Operations Executive (SOE) — a super-secret paramilitary organization (dubbed "Churchill's secret weapon") that provided the Allies with critical information from behind enemy lines — lugged compact radio sets that, while creatively crammed into containers the size of a small suitcase, might weigh more than 30 pounds.



By and large, these "parasets," which often were dropped by parachute into enemy territory, employed bulky vacuum-tube technology and a high-voltage power supply that required power from the ac mains, although some could be powered from batteries or even by hand-crank or bicycle generator. The transmitters were definitely in the QRP category. Fortunately, World War II coincided with a period of relatively high sunspot activity. These sets were not transceivers, but separate receiver-transmitter units.

SOE operatives had to avoid detection at all costs; the Nazis routinely and carefully monitored the HF bands for any unusual signals, and had mobile tracking vehicles.

Kato not only describes the radio equipment and the tactics operators used, but how to construct a replica paraset. His book includes numerous photos of several operatives and of replicas that were fabricated with considerable skill and ingenuity.

But, some of the most gripping reading had to do with the experiences of SOE volunteers while behind enemy lines. Many such clandestine operatives were detected, captured, tortured, and executed. It was a grim period in world history, perhaps made a bit shorter by those who volunteered as part of the paraset brigade.

The Paraset Radio: The Story of a WWII Spy-Radio and How to Build a Working Replica, Radio Society of Great Britain: Bedford, UK, 2020. Available from **Amazon.com**, Kindle edition, $9.99.

Using Your 160-Meter Vertical on 80 Meters

Implementing a dual-band solution for your 160-meter radiator.

Bill Conwell, K2PO

My 160-meter radiator is an 85-foot vertical wire with a T-top of similar length, and a decent radial system. When I lost my shortened rotatable 80-meter dipole in a winter storm, I decided to try to adapt my 160-meter vertical for use on 80 meters. A decent radial system on 160 meters is an excellent radial system on 80 meters. An 80-meter vertical over such a ground plane has a low angle of radiation, which gets lower with increased radiator length — up to ⅝-wavelengths or so. This makes it an exceptional antenna for DX and contests. For comparison, an 80-meter dipole needs to be above 100 feet to have a comparable pattern at 5 degrees elevation.

Adapting a 160-meter vertical for use on 80 meters is a challenge, because its feed point impedance can exceed 2,000 Ω on 80 meters. Even if an antenna tuner in the shack succeeds in matching the 40:1 SWR, the SWR-related feed line losses will be high for any significant feed line lengths. I considered five approaches:

1 Add an 80-meter trap. This would entail placing an 80-meter resonant parallel L-C circuit at about 65 feet above the ground. While this works fine for single-frequency 80-meter use, it doesn't easily permit retuning between the 80-meter phone and CW band segments. And it can be bulky if built for high power.

2 Add a second wire radiator from the feed-point, cut to a quarter wave on 80 meters. This is the vertical analog to a horizontal multi-band fan dipole. However, it can be a construction challenge to ensure the wires don't wrap each other in wind events. And retuning between 80-meter phone and CW band segments is again a problem.

3 Place a manual antenna tuner at the base of the 160-meter vertical, and switch it in when 80-meter operation is desired. This would allow manual retuning between 80-meter phone and CW frequencies. However, this requires powering a relay at the antenna base for in/out switching. And, some commercial tuners don't have the tuning range necessary to match the high 80-meter SWR.

4 Place an automatic tuner at the base of the 160-meter vertical. However, high-power automatic tuners are expensive, power must be run to the base of the antenna, and most automatic tuners do not have the needed 80-meter matching range.

5 Implement a ground-mounted inline passive matching network that permits operation on both bands. This is the solution I selected.

My antenna is naturally resonant at about 1650 kHz, so its impedance is a bit higher on 160 meters than the typical 35 Ω impedance at resonance. My 160/80-meter matching network, shown in Figures 1 and 2, is specific to this particular antenna. The matching network consists of just three series components: a capacitor, a short section of coax, and an inductor. This simple network provides a 2:1 SWR or better on both 160 and 80 meters. An in-shack tuner can be used to bring the SWR to 1:1 if needed. Also, if running legal-limit power, the current on 160 meters

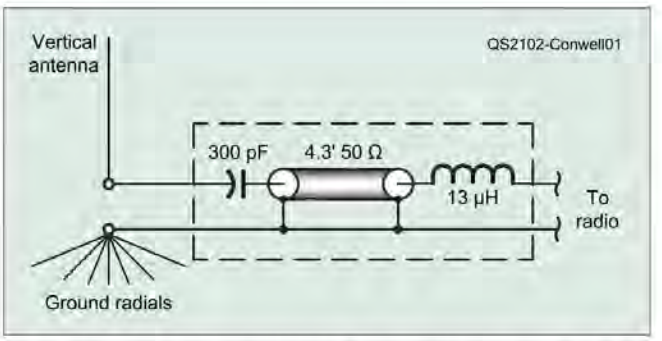


Figure 1 — A dual-band matching network that enables use of a 160-meter vertical on both 160 meters and 80 meters.

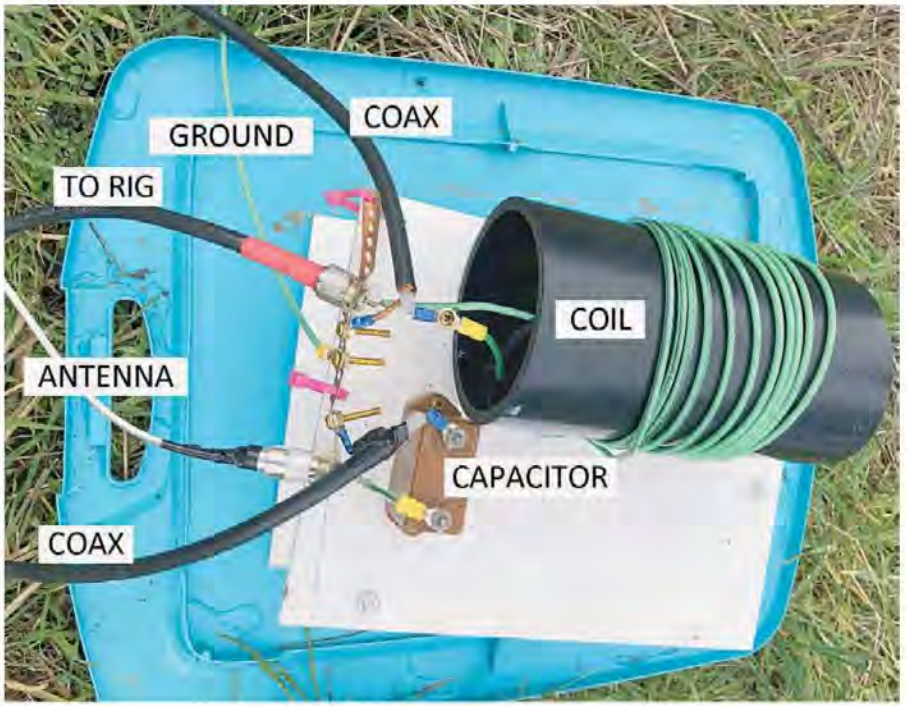


Figure 2 — The author's matching network.

is high due to the low antenna impedance — about 5 to 6 amps RMS. On 80 meters, the voltage is high due to the high impedance — about 1,700 V RMS. So, the components must be able to handle these current and voltage extremes.

My unit uses a fixed 300 pF surplus silver mica transmitting capacitor from a friend's junk box. Similar high-current mica and doorknob capacitors can be found on online auction sites. Or you can use a variable capacitor if you can find one with a sufficient voltage rating. The coax is 4.3 feet in length. The coil is 13 µH, and consists of 14 turns of #10 stranded, insulated wire on a 7-inch length of 4-inch-diameter PVC pipe. The windings can be compressed or expanded to tune the antenna between the CW and phone sections of 80 meters. With the coil compressed, this circuit yields an SWR below 2:1 from 1810 – 1865 kHz and 3500 – 3680 kHz.

On 160 meters, the capacitive and inductive reactances largely cancel each other out. Because my 160-meter antenna resonates below the band, the circuit produces a net capacitive reactance to cancel the inductive reactance of the antenna. The coax is short enough, and close enough in impedance to the antenna, that it has no effect. On 80 meters, however, the large disparity between the coax impedance and the antenna impedance causes the coax to affect a substantial impedance transformation. The inductor and capacitor cancel out most of the remaining reactance.

Because your 160-meter antenna is probably different than mine, you will need to adjust the component values to suit your antenna. The free *SimSmith* software by Ward Harriman, AE6TY, is well suited for determining the needed components. You can download *SimSmith* from **www.ae6ty.com/Smith_Charts.html**.

The *SimSmith* user interface is shown in Figure 3. I dragged components from the lower left to virtually construct the network in the upper left. I imported a .csv file of my antenna impedance values from my AIM4170 antenna analyzer, specifying resistance and reactance values every 10 kHz from 1.5 to 4 MHz, by clicking at location A in the user interface. The antenna impedance is shown by trace B on the Smith chart. The program virtually sweeps an analysis frequency between start and stop frequencies (specified at location C) within the input .csv data, and plots the network-transformed output impedance as a second trace D on the Smith chart.

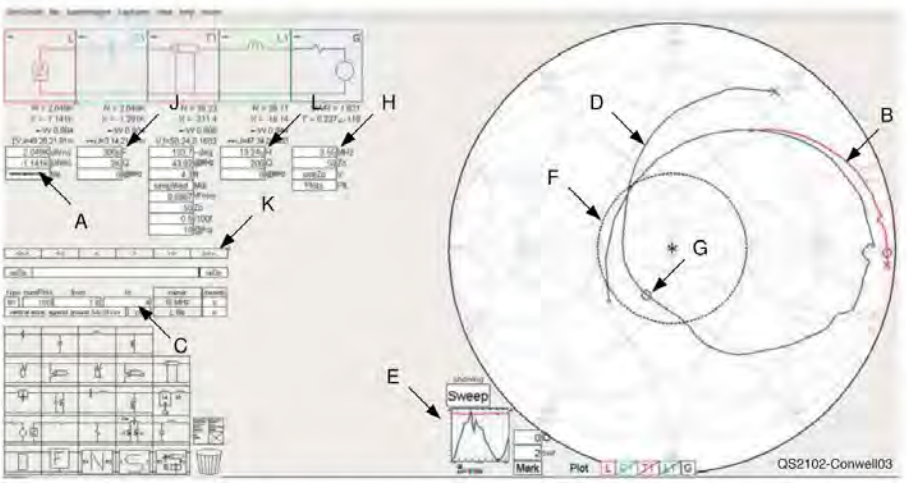


Figure 3 — The *SimSmith* program, which can be used to experimentally determine values of matching network components.

Corresponding SWR curves are presented at E; clicking there swaps the Smith chart and SWR curve presentations, minimizing the former and enlarging the latter.

I started with values of 250 pF, 10 µH, and 5 feet of 50 Ω coax (velocity factor is 0.66). Be sure to enter the "p" in the capacitance value box for picofarads, and "u" for microhenries. I then iterated values, so that a desired range of frequencies in the 80-meter band, and a desired range of frequencies in the 160-meter band, fell within the dashed circle (location F) of the Smith chart, which represents an SWR of 2:1. A marker (G) can be placed anywhere on the Smith chart trace, e.g., at 3.55 MHz, by entering that frequency at location H in the *SimSmith* user interface.

To iterate the components, I first placed the cursor in the capacitor value field (location J). Then I increased or decreased the value in small, medium, or large steps (location K), while watching movement of the desired 160-meter frequencies' impedance. You will see the impedance move up and down along one of the Smith chart circles. Next, I placed the cursor in the inductor value field (location L) and varied the inductor value, while watching movement of the desired 80-meter frequencies' impedance. I then varied the length of the coax. Several cycles of these adjustments were required to bring the SWR in both bands down to an acceptable level. A 15-minute video, showing this design process, can be viewed at **https://www.youtube.com/watch?v=3b99ZUVAVr0**.

While my solution may not be applicable to every situation, I hope it provides some ideas about repurposing a 160-meter antenna for dual-band 160/80-meter operation. And perhaps it will also serve as an enticement to try the *SimSmith* software to design matching networks.

Bill Conwell, K2PO, has been a ham for 50 years. He has an electrical engineering degree from Georgia Tech, and worked briefly on broadcast and radar antennas for RCA and Radio Free Europe before getting a law degree from Emory University. Bill now resides in Portland, Oregon, where he works as a patent attorney for Digimarc Corp, dealing with data-hiding technologies. You can contact Bill at **bill@conwellpdx.com**.

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November 2020
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Roy Gross
KM6EOO

Roy's article, "Science Fair Adventures in Ham Radio," explains his inspiration for, and journey through, troubleshooting and improving his radio-related project.

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Science Fair Adventures in Ham Radio

A teenage ham's journey in troubleshooting and improving his radio-related project.

Roy Gross, KM6EOO

With just 15 minutes until the Terman Middle School Science Fair in Palo Alto, California, I decided to test my project once more — but something went wrong. After the first transmission, my push-to-talk (PTT) circuit failed and the radio was stuck transmitting noise. I desperately tried replacing the metal-oxide-semiconductor field-effect transistor (MOSFET) with a new one, and, thankfully, the problem was fixed.

After setting up my poster and laying out my prototype, I began my speech: "Imagine the aftermath of a natural disaster: power lines down, cell towers destroyed, no phone, no internet, no communications. What would you do? How could you contact your loved ones? How could you call for help? My invention lets you use your own smartphone to send and receive emergency messages when normal communications are down."

I opened the app on my Android phone to send a message: "Testing 1, 2, 3." It didn't go through. I tried again. Finally, on my third try, the message made it through, but things went downhill from there.

Most of my demonstrations failed, and my Bluetooth connection disappeared. The Android phone and my Bluetooth module wouldn't talk to each other. When the day was over, all that could have gone wrong did, and at the worst possible time. I trudged home, disappointed but determined to improve my project.

Inspiration to Help

My science fair journey began 5 months earlier while watching a news story about Hurricane Maria's devastating effects to Puerto Rico. Mobile phones, land lines, radio towers, and the Internet were all rendered useless. Lack of communication meant that food, water, medicine, and generators couldn't get to where they were desperately needed. I listened to the *Amateur Radio Newsline* report and heard how ham radio operators were able to relay messages around the island and to the mainland. However, with communication in high demand, only a limited number of civilians could be helped.

I was determined to find a way to help. My idea was to prototype a decentralized communication system — a network that would let people communicate using their own phones, even when all other systems had failed.

Roy troubleshot his project to prepare for the Silicon Valley Science and Technology Championship.

Identifying Common Feed Line Miscreants

In-line instruments and switches can increase the mismatch and losses in your feed line.

Ralph Gable, WA2PUX

I set up an antenna-switching system for my radios that included the 2-meter and 70-centimeter bands. Changing or disconnecting antennas was as simple as flipping a switch. Then I noticed something strange going on with my 2-meter radio, so I started to investigate, wondering why the SWR was quite high for my dual-band Yagi antenna.

I was using an MFJ-864 SWR meter to measure the SWR, and its readings varied significantly from the readings on my Bird 43 directional wattmeter. I already knew that anything you insert in your feed line can change things for better or worse. My first task was to determine the effects of the SWR meter. It could be that inserting an impedance mismatch can cause it to have its own SWR, like having a damaged piece of coax in the line.

Self-SWR

I set up my vector network analyzer (VNA) to measure the "self-SWR" of the SWR instruments I had, namely, an MFJ-864 (144 and 440 MHz), an ancient Heathkit HM-2102 (50 to 160 MHz), and a Bird 43 wattmeter (450 kHz to 2.7 GHz).

First, I properly calibrated my VNA over the range from 140 MHz to 500 MHz. To measure the "self-SWR" I terminated the antenna port with a calibrated 50 Ω load that had an SWR of less than 1.01:1. I connected the VNA Port 1 to the transmitter port of the SWR bridge under test.

I then measured the return loss (*S*11, a positive value in decibels) of the SWR bridge under test, and then calculated the SWR using:

$$SWR = \frac{10^{(\text{return loss, dB})/20} + 1}{10^{(\text{return loss, dB})/20} - 1} \qquad (1)$$

Figure 1 shows the measured SWR of the three SWR instruments across the 2-meter band (A), and the 70-centimeter band (B). Right off, I discovered that my MFJ SWR bridge had a problem in both the 2-meter and 70-centimeter bands. The old Heathkit was much better, while the Bird 43 wattmeter was the best.

Measuring an Antenna Switch

I next measured the self-SWR, insertion loss (transmission), and isolation of my MFJ-1702C (DC to 600 MHz) and a Diamond CX-210 (DC to 1 GHz) antenna switch. The reference switch is shown in Figure 2. I first calibrated the VNA from 100 kHz to

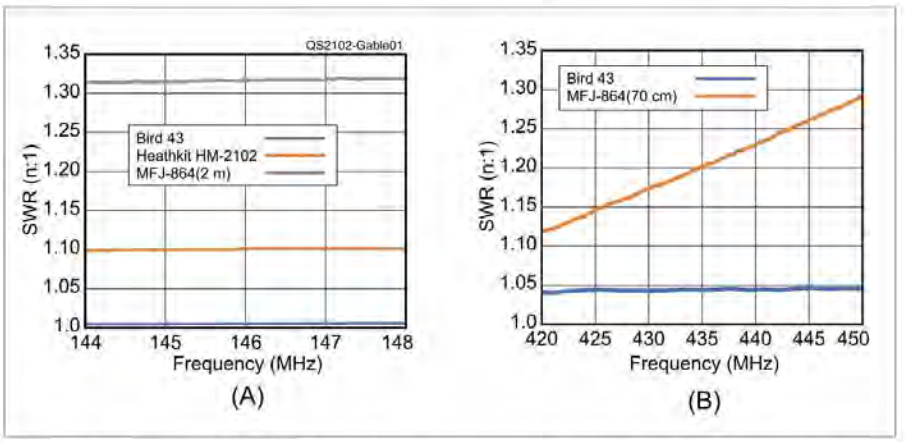

Figure 1 — The Self-SWR for several measurement instruments in the 2-meter (A) and 70-centimeter (B) bands.

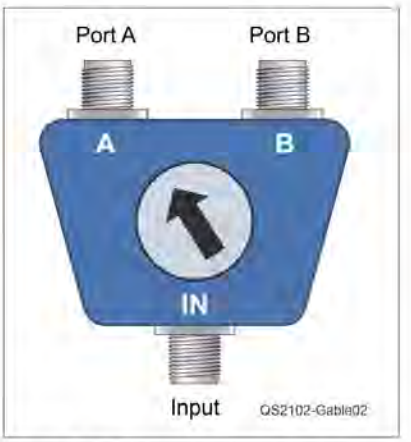

Figure 2 — A two-position coaxial switch.

600 MHz for the MFJ switch, and from 100 kHz to 1 GHz for the Diamond switch.

Self-SWR

This is a measurement of the impedance match of the switch itself across its advertised frequency range. Connect the switch Input Port to Port 1 of the VNA, then terminate switch Ports A and B in calibrated 50 Ω loads that have SWR lower than 1.01:1.

Select switch Port A and measure return loss, *S*11 in decibels. Calculate SWR from the measured return loss using Equation (1). Next, select switch Port B and measure return loss, *S*11 in decibels. Calculate SWR from the measured return loss using Equation (1).

Insertion Loss

This is a measurement of signal loss between the Input Port and the selected Output Port. Insertion loss is *S*21 in decibels between VNA Port 1 and Port 2, as follows.

Connect the Input to Port 1 of the VNA. When measuring insertion loss to Port A, connect switch Port A to Port 2 of the VNA with Port B terminated in a calibrated 50 Ω load. Set the switch to position A.

When measuring insertion loss to Port B, connect switch Port B to Port 2 of the VNA with Port A terminated in a calibrated 50 Ω load. Set the switch to position B.

Switch Port Isolation

This is a measurement of signal leakage from the selected channel to the unselected channel. When measuring the isolation of switch Port A, connect VNA Port 1 switch Port B, and terminate Port A in a calibrated 50 Ω load. Set the switch to position A.

When measuring the isolation of switch Port B, connect VNA Port 1 switch Port A, and terminate Port B in a calibrated 50 Ω load. Set the switch to position B.

Results

The measurement results are shown in Figure 3 for Self-SWR, Figure 4 for insertion loss, and Figure 5 for isolation (signal leakage).

Self-SWR

Below 10 MHz, there was very little difference (see Figure 3). The SWR curves begin to diverge above 10 MHz. At 200 MHz, the MFJ switch is at 1.2:1, while the Diamond switch is 1.1:1. Surprisingly, on

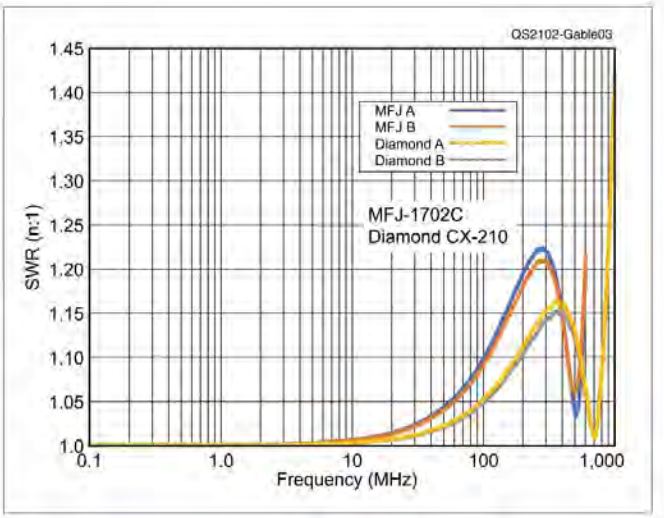

Figure 3 — The Self-SWR of Port A and B in two coaxial switches.

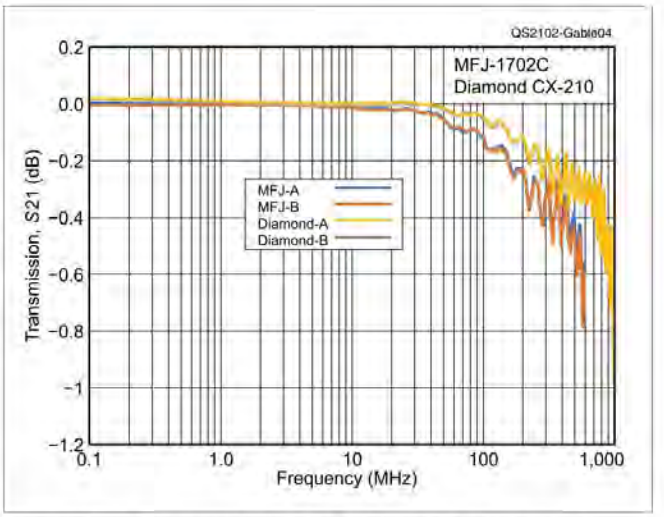

Figure 4 — The transmission of Port A and B in two coaxial switches.

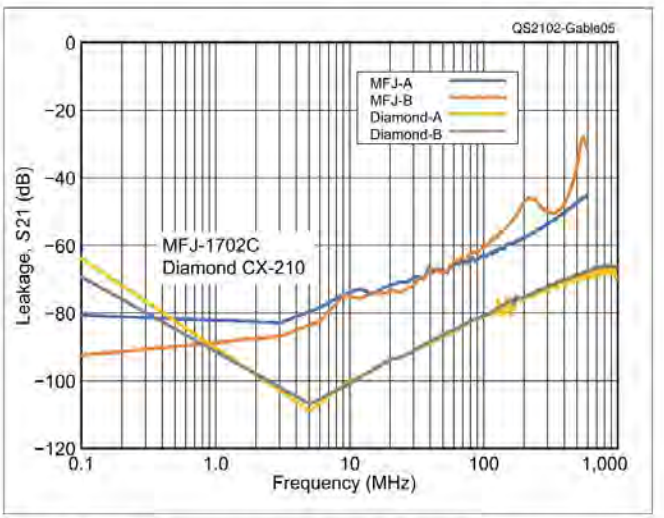

Figure 5 — The signal leakage of Port A and B in two coaxial switches.

When measuring insertion loss to Port B, connect switch Port B to Port 2 of the VNA with Port A terminated in a calibrated 50 Ω load.

the 70-centimeter band, the MFJ had better performance than in the 2-meter band.

Insertion Loss

Below 10 MHz, there was very little difference (see Figure 4). Even in the 70-centimeter band, the difference is still a mere 0.2 dB. However, the absolute loss was 0.3 dB for the Diamond and 0.5 dB for the MFJ switches.

Effect of Self-SWR and Insertion Loss

Self-SWR reflects some of the transmitter power back to the transmitter from the switch itself. Insertion loss dissipates some of your power as heat in the switch itself. So, assuming a 50 W transmitter, an SWR of 1.2:1 will reflect 0.4 W. A 0.3 dB insertion loss burns up 3.33 W, and 0.5 dB insertion loss burns up 5.44 W as heat. So, between a 1.2:1 SWR reflection loss and a 0.5 dB insertion loss, you are losing 5.8 W, or 11.6%, of your transmitter power in the switch itself.

Isolation

The signal leakage between ports was around –70 dB for the Diamond switch all the way up to the 70-centimeter band. That amounts to about 5 µW leaking into the non-selected channel with a 50 W transmitter in the 70-centimeter band.

The MFJ switch exhibited –42 dB leakage in the 70-centimeter band. This amounts to 3 mW with a 50 W transmitter.

Conclusions and Final Comments

At the lower HF frequencies, there is not enough difference among the switches to choose one over the other. At frequencies above 100 MHz, you can get into trouble. In my own VHF/UHF installation, I have totally eliminated everything, except for a lightning arrester. I am also planning to replace as many PL-259/SO-239 (UHF) connectors as possible with N type, because PL-259/SO-239 connectors can be bad actors, as I verified by VNA experiments.

Ralph Gable, WA2PUX, was licensed as a Novice in 1970. He upgraded to a General-class license in 1997 and to an Amateur Extra-class license shortly into the 21st century. He worked as an electronics engineer in product development for almost 20 years in both the medical and gas and oil industries. Ralph retired in the fall of 2019. He is currently the chairman of the repeater committee for the Great River Amateur Radio Club. He maintains a YouTube channel, "Electronics for the Inquisitive Experimenter," which is aimed at folks who want detailed, but not overwhelmingly technical, explanations about electronics. You can reach Ralph at **wa2pux@gmail.com**.

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

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

- Anthony Le Cren, F4GOH/KF4GOH, shows how to provide a vocal output from an SWR meter.
- Rick Littlefield, K1BQT, describes a 300 W MOSFET HF amplifier.
- Eric Nichols, KL7AJ, in his essay series, discusses dealing with EE math and with Ohm's Law.
- Phil Salas, AD5X, turns a Nano VNA into a more robust instrument.
- John C. Westmoreland, AJ6BC, builds an NMEA-based GPS time display.
- Robert J. Zavrel, W7SX, tabulates losses in plastics that hams often use.

QEX, a forum for the free exchange of ideas among communications experimenters, is edited by Kazimierz "Kai" Siwiak, KE4PT, (**ksiwiak@arrl.org**) and is published bimonthly. All ARRL members can enjoy the digital edition of *QEX* as a member benefit. The printed edition annual subscription rate (six issues per year) for members and non-members in the United States is $29. First-class delivery in the US is available at an annual rate of $40. For international subscribers, including those in Canada and Mexico, *QEX* can be delivered by airmail for $35 annually; see **www.arrl.org/qex**.

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Steve Ford, WB8IMY, wb8imy@arrl.net

Eclectic Technology

WSPR and *WSJT-X* Apps

I discovered two interesting apps for Apple and Android devices. One of them has been around a while (although I recently tried it for first time) and the other is relatively new. Both apps are free and intriguing!

WSJT-X Monitor lets you keep an eye on your *WSJT-X* activity remotely.

WSPR Watch

If you're an iPhone or iPad user and you want to stay on top of activity in the WSPR universe, *WSPR Watch* is a handy tool. It allows you to harvest the latest WSPR beacon spots from WSPRnet, PSKReporter, and other sites. You can look up specific call signs, or just get a snapshot of all activity on a given band or groups of bands. Figure 1 shows a glimpse of 6-meter activity from a few months ago. If you look closely, you'll see a sporadic-E opening between two stations along the east coast. You can gather whatever data you desire, and the app will export it to a comma-delimited file that you can read in *Excel* or another software of your choice.

WSPR Watch will also transmit WSPR beacons, although you'd need to find a way to interface your device to your transceiver. An alternative is to just hold your iPhone up to the microphone.

You'll find *WSPR Watch* in the Apple App Store.

Figure 1 – *WSPR Watch* showing beacon activity on 6 meters.

WSJT-X Monitor

This app is rather different for the Android community. *WSJT-X Monitor* lets you to use your mobile device to monitor your home computer's *WSJT-X* activity, regardless of mode, from any location.

Granted, you could just use Chrome Remote Desktop to spy on your computer's screen, but *WSJT-X Monitor* is more than a viewer. It allows you to set alerts for certain stations, filter the decoding results, and sort the results based on distance, signal strength, frequency, or direction.

This is a convenient app for when you want to keep your finger on the pulse of, say, FT8 activity while doing other things around the house.

You can download *WSJT-X Monitor* from the Google Play Store.

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

Product Review

Icom IC-705 HF/VHF/UHF Multimode Portable Transceiver

Reviewed by Steve Ford, WB8IMY
wb8imy@arrl.net

There's no question that portable operating is on the rise. Award programs, such as Summits on the Air (SOTA), Parks on the Air (POTA), and Worldwide Flora and Fauna (WWFF), have fueled a substantial increase in activity. Even on weekdays, it's common to find mini pileups on the bands as portable operators, or *activators*, set up stations in parks and on mountaintops.

Restrictions imposed by the COVID-19 pandemic haven't dampened enthusiasm. After all, it is relatively easy to take transceivers to parks and summits without running afoul of social distancing rules. You just connect your gear, deploy an antenna, and get on the air. When *chasers* — operators trying to make contacts with you — become aware of your presence, you can suddenly find yourself sorting through a mob of callers. Improving conditions on the HF bands bode well for low-power stations. Solar Cycle 25 is under way. In the coming months and years, conditions will only get better on 15, 12, and 10 meters.

Bottom Line

The Icom IC-705 is an extremely versatile low-power portable transceiver that covers 160 through 6 meters, 2 meters, and 70 centimeters with a wide variety of analog and digital modes. The radio offers a wealth of features typically found on larger desktop transceivers, and receiver and transmitter performance are excellent.

With the debut of the IC-705, Icom seems to be positioning itself to take advantage of the portable operating surge. In a compact 2¼-pound package that you can carry in one hand, Icom has created a transceiver capable of operating on all HF bands, plus VHF and UHF, in any mode you're likely to need — including D-STAR digital voice.

The IC-705 offers 5 W output when powered by its internal battery, and 10 W when using an external 13.8 V dc supply. The battery supplied with the '705 is a 7.4 V/1,880 mAh Lithium-ion pack. An optional 3,150 mAh battery is available as well.

Although the IC-705 is being marketed as a portable transceiver, it's worth noting that this radio is perfectly fine as a home station transceiver, if you're using it with an effective antenna system. Outside of my POTA activity (see the sidebar, "Parks On The Air with the IC-705"), I used the IC-705 at home with an HF dipole antenna and a VHF/UHF ground plane. Neither are gain antennas, yet I enjoyed surprising success, particularly with CW and digital modes.

SDR — With a Twist

At first glance, the IC-705 looks like a miniaturized version of the popular IC-7300 transceiver. The touchscreen is prominent, as it is in the IC-7300, and the front-panel layout is similar in appearance. However, the comparison largely ends there.

While the IC-705 is a software-defined radio (SDR), it implements this technology in a manner that is a departure from the IC-7300. Like the IC-7300, the IC-705 samples incoming signals as close as possible to the antenna input and converts them to digital information for processing. But unlike the IC-7300, the IC-705 is tasked with covering a much greater frequency range. While it is certainly possible to do direct-sampling at UHF and beyond these days, such a high-performance direct-sampling design would add considerable cost to the radio, not to mention the additional power requirements. So, above 25 MHz, the IC-705 operates as a superheterodyne radio, converting the higher-frequency signals to lower frequencies before subjecting them to digital sampling. This approach keeps costs in line while still offering acceptable performance.

Parks on the Air with the IC-705

Steve Ford, WB8IMY

If you've never heard of the Parks on the Air (POTA) program, you're missing one of the most enjoyable — and popular — amateur radio activities available today. See the website at **parksontheair.com**.

The objective of POTA is simple: operate from one of the thousands of eligible state, provincial, or federal/national parks scattered throughout the world, or stay home and become a "chaser," logging contacts with park activators. There are many POTA awards available, and you'll find that activity is surprisingly strong. There is an active POTA Facebook group as well.

The Icom LC-192 backpack was very convenient for carrying the IC-705 and my other station supplies during a quick Parks on the Air activation at Wharton Brook State Park in North Haven, Connecticut.

I'm relatively new to POTA and had never activated a park before — until I got my hands on the Icom IC-705. A quick look at the POTA website revealed that Wharton Brook State Park in North Haven, Connecticut, was just a few miles away.

I made a 20-meter vertical antenna using a telescoping fiberglass mast, a tripod support, and a network of 10 radial wires. For this review, we had also ordered the Icom LC-192 backpack, which is a convenient way to take the IC-705 and accessories on the road.

At the park, it took less than 10 minutes to deploy the antenna and put the IC-705 on the air. It was a chilly November day, so I operated from inside my car, using the IC-705 with its battery. With 5 W to a vertical antenna, it took a few CQs to get some SSB contacts, but I had good reports all around. Things picked up after I saw myself listed on the POTA website spotting page.

At the end of an hour full of calls and exchanges, the IC-705 battery was still going strong. According to the front-panel battery indicator, it had hardly been depleted at all. I estimate the battery could have easily lasted 2 hours, if not longer. This is in keeping with other reports I've heard about the IC-705's battery life. Of course, if I had been using a high-duty-cycle mode, such as FT8, it would likely be less.

My introduction to POTA set the hook. Radios such as the IC-705 make this type of operating a joy. If you've become bored with your amateur radio routine, I encourage you to head outdoors and give portable operation a try.

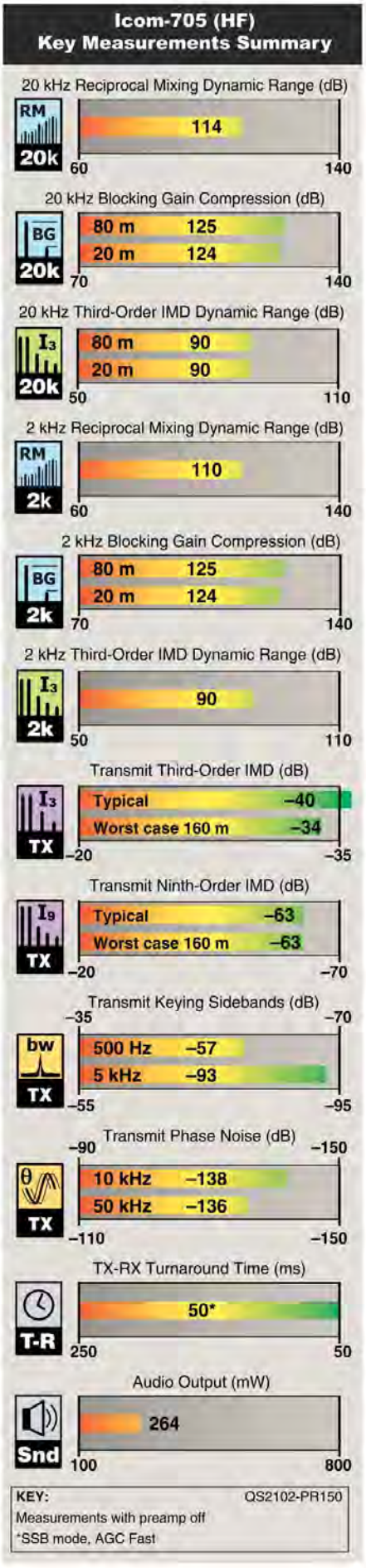


Table 1
Icom IC-705, serial number 12003734, v. 1.11

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: Receive, 0.030 – 200, 400 – 470 MHz. Transmit, 1.8 – 2.0, 3.5 – 4.0, 5.255 – 5.405, 7.0 – 7.3, 10.1 – 10.15, 14.0 – 14.35, 18.068 – 18.168, 21.0 – 21.450, 24.89 – 24.99, 28.0 – 29.7, 50 – 54, 144 – 148, 430 – 450 MHz.	Receive and transmit, as specified.
Power consumption: Receive, 0.5 A (max audio); transmit, 3 A (10 W) at 13.8 V dc. Battery power (using specified battery pack): receive, 0.8 A (max audio); transmit, 2.5 A.	With 13.8 V dc external power: Receive, 512 mA (max. brightness, max. volume, no signal), 446 mA (backlights off). Transmit, 0.6 A at minimum RF output, 2.45 A (typical) at 10 W RF. Battery power: Receive, 431 mA (300 mA with screen saver). Transmit, 2 A at 5 W RF output at 8.3 V dc (full charge).
Modes of operation: SSB, CW, AM, FM, WFM (receive only), RTTY, Data, DV.	As specified.
Receiver	**Receiver Dynamic Testing**
CW sensitivity, 10 dB S+N/N: 0.2 µV (1.8 – 29.995 MHz, preamp 1 on); 0.15 µV (50 – 54 MHz, preamp 2 on); 0.11 µV (144/430 MHz, preamp on).	Noise floor (MDS), 500 Hz bandwidth: *Preamp* *Off* *P1* *P2* 0.137 MHz –128 –135 –137 dBm 0.475 MHz –128 –137 –139 dBm 1.0 MHz –128 –137 –139 dBm 3.5 MHz –129 –138 –140 dBm 14 MHz –129 –139 –141 dBm 50 MHz –128 –138 –140 dBm *Preamp* *Off* *On* 144 MHz –133 –144 dBm 432 MHz –130 –144 dBm
Noise figure: Not specified.	Preamp off/1/2: 14 MHz, 18/9/6 dB; 50 MHz; 19/9/7 dB. Preamp off/on: 144 MHz, 19/3 dB; 432 MHz, 17/3 dB.
AM sensitivity, 10 dB S+N/N: <13 µV (0.5 – 1.8 MHz), <2.0 µV (1.8 – 29.995 MHz), <1.0 µV (50 MHz, 108 – 137 MHz, 144, 430 MHz).	10 dB (S+N)/N, 1 kHz tone, 30% modulation, 9 kHz bandwidth: *Preamp* *Off* *P1* *P2* 1.02 MHz 3.09 1.06 0.97 µV 3.88 MHz 2.75 0.92 0.78 µV 29.0 MHz 4.07 1.24 1.06 µV 50.4 MHz 3.54 1.12 0.89 µV *Preamp* *Off* *On* 120 MHz 2.72 0.55 µV 144.4 MHz 2.04 0.54 µV 432 MHz 3.06 0.63 µV
FM sensitivity, 10 dB S+S/N: <0.5 µV (28 – 29.7 MHz, <0.15 µV (50 MHz), <0.11 µV (144/430 MHz).	For 12 dB SINAD, 3 kHz deviation, 15 kHz bandwidth: *Preamp* *Off* *P1* *P2* 29 MHz 0.99 0.31 0.26 µV 52 MHz 0.85 0.29 0.22 µV *Preamp* *Off* *On* 100 MHz 1.58 0.46 µV (WFM) 146 MHz 0.50 0.13 µV 162 MHz 0.66 0.16 µV 440 MHz 0.76 0.15 µV
Blocking gain compression dynamic range: Not specified.	Blocking gain compression dynamic range, 500 Hz bandwidth: *20 kHz offset* *5/2 kHz offset* *Preamp off/1/2* *Preamp off* 3.5 MHz 125/121/118 125/125 dB 14 MHz 124/121/119 124/124 dB 50 MHz 124/121/119 124/124 dB 144 MHz 122/114 122/122 dB 432 MHz 124/118 124/124 dB
Reciprocal mixing dynamic range: Not specified.	14 MHz, 20/5/2 kHz offset: 114/112/110 dB.
ARRL Lab Two-Tone IMD Testing — See Table 2.	
Second-order intercept point: Not specified.	Preamp off/P1/P2: 14 MHz, +59/+59/+59 dBm; 21 MHz, +51/+51/+51 dBm; 50 MHz, +67/+49/+37 dBm. Preamp off/on: 144 MHz, +27/+16 dBm; 432 MHz, +93/+93 dBm.

Manufacturer's Specifications	Measured in the ARRL Lab
DSP noise reduction: Not specified.	12 dB.
Notch filter depth: Not specified.	Auto notch: 60 dB, single tone; 30 dB, two tones. Attack time: 100 ms single tone; 3 seconds, two tones.
FM adjacent channel rejection: Not specified.	Preamp 2 on: 29 and 52 MHz, 79 dB; Preamp on: 144 MHz, 77 dB; 432 MHz, 69 dB.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset: Preamp 2 on, 29 MHz, 72 dB; 52 MHz, 73 dB. Preamp on, 144 MHz, 72 dB; 432 MHz, 69 dB.* 10 MHz offset: preamp 2 on, 29 MHz, 95 dB; 52 MHz, 87 dB. Preamp on: 144 MHz, 87 dB; 432 MHz, 81 dB.
S-meter sensitivity: Not specified.	S-9 signal, preamp off/P1/P2: 14 MHz, 52.4/15.8/9.3 µV; 50 MHz, 53.7/15.8/9.8 µV; 144 MHz, 14.1/3.4 µV; 432 MHz, 18.4/3.3 µV. Scaling, 3 dB/S-unit.
Squelch sensitivity: Not specified.	At threshold/max level, preamp 2 on: FM, 29 MHz, 0.18 µV/10.6 mV; 52 MHz, 0.18 µV/11.0 mV. SSB,14 MHz, 6.38 µV/105 mV. At threshold/max level, preamp on: FM, 144 MHz, 0.10 µV/3.93 mV; 432 MHz, 0.11 µV/4.31mV.
IF/audio response: Not specified.	Range at –6 dB points:† CW (500 Hz BW): 330 – 882 Hz; Equivalent Rectangular BW: 514 Hz; SSB (2.4 kHz BW): 330 – 2882 Hz; AM (9 kHz BW): 360 – 4575 Hz.
Receiver audio output: 200 mW into 8 Ω.	264 mW into 8 Ω at 10% THD. THD at 1 V_{RMS}, 0.3%.
Receive signal processing delay time: Not specified.	15 ms.
Transmitter	**Transmitter Dynamic Testing**
Power output with external 13.8 V dc supply: 0.1 – 10 W (AM, 0.025 – 2.5 W). With battery: 0.1 – 5 W (AM, 0.025 – 1.25 W).	As specified.
Spurious-signal and harmonic suppression: HF, >50 dB; 50, 144, 430 MHz, >60 dB.	HF, typically >70 dB (55 dB worst case, 30 meters); 50 MHz, 78 dB; 144 MHz, 68 dB; 432 MHz, 65 dB. Meets FCC requirements.
Third-order intermodulation distortion (IMD) products: Not specified.	3rd/5th/7th/9th order, 10 W PEP: –40/–49/–57/–63 dB (HF typical) –34/–53/–56/–63 dB (worst case, 160 m) –37/–47/–57/–66 dB (50 MHz) –33/–44/–57/–64 dB (144 MHz); –37/–45/–56/–63 dB (432 MHz).
CW keyer speed range: Not specified.	6 to 48 WPM. Iambic mode B.
CW keying characteristics: Not specified.	See Figures A and B.
Transmit phase noise: Not specified.	See Figure C.
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	S-9 signal, AGC fast, SSB: 50 ms; CW full break-in, 68 ms.
Receive-transmit turnaround time (TX delay): Not specified.	SSB, 79 ms; FM, 14 ms.

Size (height, width, depth, with protrusions): 3.3 × 8.0 × 4.0 inches.

Weight, 2.55 pounds with battery; 2.3 pounds without battery.

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

*Measurement was noise at the value indicated.
†Default values; bandwidth is adjustable via DSP.

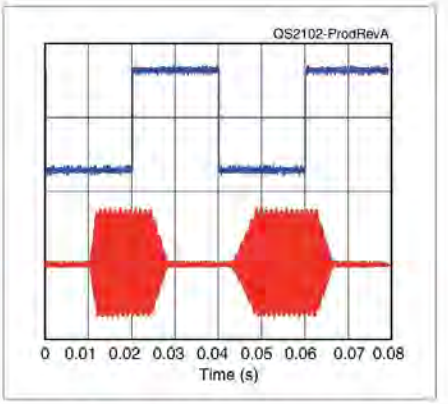


Figure A — The CW keying waveform for the Icom IC-705, showing the first two dits in full-break-in (QSK) mode using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. (Note that the first key closure starts at the left edge of the figure.) Horizontal divisions are 10 milliseconds. The transceiver was being operated at 10 W output on the 14 MHz band.

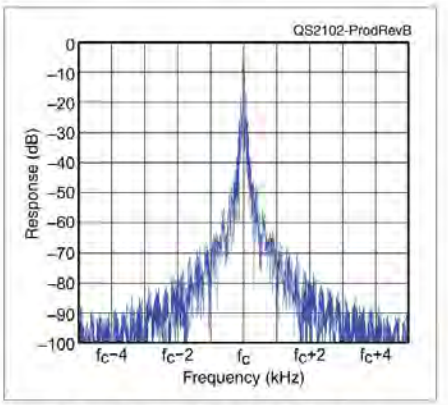


Figure B — A spectral display of the Icom IC-705 transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 10 W PEP output on the 14 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.

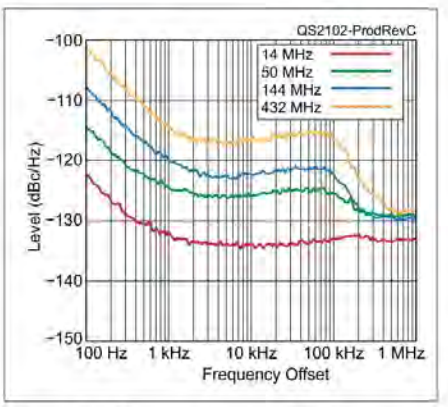
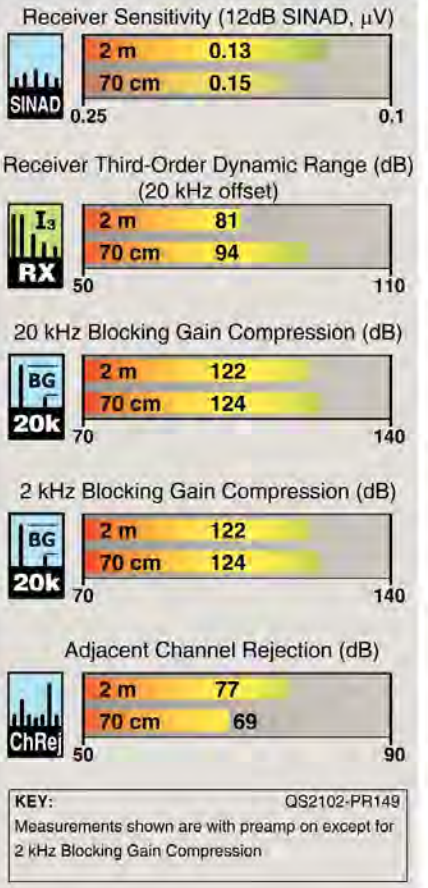


Figure C — A spectral display of the Icom IC-705 transmitter output during phase-noise testing. Power output is 10 W on the 14 MHz band (red trace), 50 MHz band (green trace), 144 MHz band (blue trace), and 432 MHz band (yellow trace). The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 100 Hz to 1 MHz from the car-rier. The reference level is –100 dBc/Hz, and the vertical scale is 10 dB per division.

Table 2
Icom IC-705, ARRL Lab Two-Tone IMD Testing (500 Hz bandwidth)

Band/Preamp	*Spacing*	*Measured IMD Level*	*Measured Input Level*	*IMD DR*
3.5 MHz/Off	20 kHz	–129 dBm –97 dBm	–39 dBm –15 dBm	90 dB
14 MHz/Off	20 kHz	–129 dBm –97 dBm	–39 dBm –15 dB	90 dB
14 MHz/P1	20 kHz	–139 dBm –97 dBm	–51 dBm –26 dBm	88 dB
14 MHz/P2	20 kHz	–141 dBm –97 dBm	–54 dBm –30 dBm	87 dB
14 MHz/Off	5 kHz	–129 dBm –97 dBm	–39 dBm –15 dBm	90 dB
14 MHz/Off	2 kHz	–129 dBm –97 dBm	–39 dBm –15 dBm	90 dB
50 MHz/Off	20 kHz	–128 dBm –97 dBm	–41 dBm –27 dBm	87 dB
50 MHz/P2	20 kHz	–140 dBm –97 dBm	–56 dBm –37 dBm	84 dB
144 MHz/Off	20 kHz	–128 dBm –97 dBm	–45 dBm –31 dBm	83 dB
144 MHz/On	20 kHz	–144 dBm –97 dBm	–63 dBm –43 dBm	81 dB
432 MHz/Off	20 kHz	–130 dBm –97 dBm	–36 dBm –15 dBm	94 dB
432 MHz/On	20 kHz	–144 dBm –97 dBm	–50 dBm –38 dBm	94 dB

Icom IC-705 (VHF/UHF)
Key Measurements Summary



Ins and Outs

If you require more evidence that Icom designed this transceiver with portable operating in mind, notice that the various input and output connections are found on the sides of the enclosure (see Figure 1). This arrangement allows the radio to lie flat, although it can also stand on edge. There is even a threaded hole on the bottom edge that will allow the '705 to be attached to a tripod.

There is a micro-USB port for computer communication (more about this later). The IC-705 battery can also be charged through this port, if you desire. I connected it to one of my heftier USB power modules and noticed that it took about 3 hours to fully charge an exhausted battery in this fashion. When using the dc power cable and an external 13.8 V dc supply, I had a full charge in about 2 hours. The battery pack simply snaps into the back of the transceiver.

There are two ports for the supplied handheld speaker/microphone. One is a 3.5-millimeter jack for the speaker and the other is 2.5 millimeters for the mic. The 3.5 millimeter jack doubles as the port for connecting headphones or ear buds. There is a jack for your CW key or paddle (with an internal electronic memory keyer available), and a BNC jack for the antenna. While most hams would use the BNC to attach a coaxial cable, you could also connect one of the venerable "rubber duck" antennas to this port for a quick bit of VHF/UHF operating on the fly.

There are two additional ports for attaching external gear. One is intended for an antenna tuner control line and the other is a stereo 3.5-millimeter jack for transmit-receive (TR) relay and an automatic level control (ALC) line for use with an external RF amplifier.

Looking at the front of the radio, the color display is the star attraction, and it can be adjusted to various levels of brightness. At maximum brightness, I had no difficulty reading it in full sunlight. To preserve battery power, the screen is set to switch off after a certain amount of time with no operator activity. The display reappears the instant you touch one of the controls, press the microphone push-to-talk switch, or operate the CW key. The display timer is adjustable, or it can be disabled entirely.

As with the IC-7300 and other modern Icom transceivers, this is a responsive touchscreen through which I ended up controlling most of the radio's functions. In particular, the waterfall panadapter display mode is impressive (see Figure 2). Once you become accustomed to using it, you can choose signals on the panadapter with single taps of your fingers.

Figure 1 — Connectors for the antenna, microphone, CW key, and other accessories are located on the IC-705 side panels. Rubber caps help keep dust and moisture out when the connectors are not in use. The battery snaps into the back of the case.

Figure 2 — The IC-705 spectrum panadapter display, showing activity on 20 meters.

If you prefer mechanical controls, the IC-705 has those on offer as well, and they are arranged to make access as easy as possible. The VFO knob has a pleasant, solid feel — so much so that I often defaulted to it rather than the touchscreen when changing frequencies.

VLF to UHF Reception

The IC-705 offers all-mode reception throughout a range from 30 kHz to 199.99 MHz, and from 400 to 470 MHz. With this extensive range, the IC-705 can provide hours of listening pleasure when you aren't making contacts. The transceiver's front-panel speaker has reasonably good fidelity, despite its small size.

I enjoyed using the IC-705 as a portable shortwave listening receiver and found it to be every bit the match for serious radios, thanks in large part to the '705's flexible filtering options and noise-reduction functions. Sometimes I'd just attach a telescoping whip antenna and put the radio wherever I wanted it at that moment — such as at the side of my desk while working on a kit project. It's worth noting that the IC-705 offers monaural FM broadcast reception from 88 to 108 MHz.

CW and SSB

With portable hamming being the IC-705's most important application, it makes sense to find it well equipped for both CW and SSB operation.

The IC-705 is supplied with a small handheld speaker/microphone that includes programmable buttons for easier control when your hands are otherwise full and you're making contacts at fast clip. According to reports I received, the audio quality was quite good, even when I engaged the speech processor. And when you're operating outdoors, it's nice to have a speaker closer to your face.

There are voice memories at your disposal, and they're invaluable when you are doing a park or summit activation, or a contest. After recording your various voice messages, you can send each one with just a tap on the touchscreen button. You can even set a memory to automatically repeat, such as when calling CQ. This requires a longer push on the screen button to start the auto-repeat mode and the amount of listening time between transmissions is adjustable. If you're out in the field running just 5 W on SSB, having your CQs automatically repeat is very convenient, because it may take several calls before someone finally hears you. When you squeeze the microphone's push-to-talk switch to respond, auto-repeat disengages.

Message memories and repeating functions are available for CW as well (see Figure 3). With many portable operators using CW, these can be a godsend. Manual CW is flawless with the IC-705. I used it with a set of paddles as well as a straight key, and both were as smooth as proverbial silk. The radio features semi break-in as well as full break-in (QSK). The transmit-

Figure 3 — CW memories make park or summit operating much easier.

receive switching uses a relay, and clicking is audible, but not really noticeable if you're sending while listening to the sidetone.

Like the IC-7300, the IC-705 features a versatile audio recorder. With a microSD memory card installed, the '705 will create audio files each time you start recording (you can start recording received audio almost immediately through the front-panel **QUICK** menu). Each audio file is labeled with the date, time, frequency, and operating mode. You can replay the files through the radio or load them into another device.

HF Digital

Another similarity between the IC-705 and the IC-7300 is the functionality available through its USB port for HF digital operating and computer-aided transceiver (CAT) control. If you enjoy digital operating with modes such as FT8, the IC-705 makes this as easy as possible — no external interfaces or sound devices required.

You'll need to provide your own micro-USB cable to connect the transceiver to your computer, but as the manual warns, don't connect the IC-705 straightaway; there are two Windows COM port drivers that must be installed on your computer first. (At the time of this writing, Icom offered only Windows drivers.) You must download the driver installation package from the Icom support site, extract the files, and then run the setup application, choosing either 32 or 64 bit.

I initially tried using an older laptop but discovered the Icom drivers were incompatible with its Windows 8.1 operating system. This may have been due to an issue with the old laptop's configuration. On my Windows 10 desktop PC, there wasn't a problem.

The drivers create two separate COM ports, and you'll need to open the Windows Device Manager to see which numbers Windows has assigned to them. One is for Icom CI-V computer-aided transceiver (CAT) control and the other port is used for other applications, such as streaming GPS information to your computer.

I had a blast using the IC-705 with *WSJT-X* software and the FT8 and FT4 modes. However, when this review was written, the latest version of *WSJT-X* didn't include the '705 in its list of CAT-controllable transceivers. The workaround is to go into the IC-705's CI-V menus and change the CI-V address from the default (A4h) to 94h. Once you've done that, select the IC-7300 configuration from the *WSJT-X* menu, and choose 9600 baud as the signaling rate. (I found that the IC-705 does not allow you to change its CI-V signaling rate; it appears to be fixed at 9600 baud.)

Lab Notes: Icom IC-705

Bob Allison, WB1GCM

The Icom IC-705 has plenty of dynamic range for use in the field or a home station. At 14 MHz, with the preamp off and 2 kHz signal spacing, its lowest dynamic range is 90 dB (two-tone, third-order IMD). This performance is *very good*. Blocking dynamic range (BDR) and reciprocal mixing dynamic range (RMDR) were quite good as well, at 124 and 110 dB, respectively.

The only potential performance issue may surface while operating on the 2-meter band, where second-order products may occur if the offending signals are strong enough. (A second-order product is a "phantom" signal that appears when the sum of the frequencies of the interfering signals equals the tuned frequency. For example, 100 MHz + 44 MHz signals create a phantom signal at 144 MHz.) All transceivers can experience unwanted signals, and that is why amateur radio receiving equipment includes an attenuator function. Use it, if needed, to reduce unwanted effects, though you will rarely need it with the IC-705.

Transmit performance is very good. Even the worst-case transmit intermodulation distortion (IMD) products are better than the typical transmitter IMD products we see in the Lab.

This is an important point to make, because some amateurs will undoubtedly want to use an RF amplifier with the IC-705. It is always best to use a transceiver with lower transmit IMD figures than the IMD figures of the amplifier being driven.

Transmit phase noise is very low on the HF bands and is quite acceptable on 6 and 2 meters. Transmit phase noise is higher on 70 centimeters, but it drops noticeably at 100 kHz, or more, away from the transmitted signal. This may be okay for low power, but perhaps not if used with a high-power RF amplifier when signals are strong. Transmit phase noise is more noticeable on VHF and UHF frequencies, where receiver noise floors are lowest. The CW keying characteristics of the IC-705 are excellent. All in all, the IC-705 is a good neighbor to stations operating nearby on the dial.

I checked FT8 results using PSKReporter while running 5 W to my dipole antenna on 20 meters and saw reception reports from across the US. I was also able to snag a few FT8 contacts on 6 meters with just 5 W to the same antenna.

If your HF digital interests include RTTY, you'll be interested to know that the IC-705 has the ability to send and receive RTTY without the need for an external computer, and it does this quite well with its extremely sharp mark/space "twin peaks" filtering. I used it to copy W1AW RTTY bulletin transmissions, along with the occasional random RTTY signal. I ran the popular *MMTTY* RTTY software simultaneously on my station computer and noticed that the IC-705's RTTY decoder matched it character for character. To send RTTY without an external computer, you'll need to preprogram the RTTY macro memories. Because most RTTY activity these days is confined to contests and DX operating where exchanges are preformatted anyway, this isn't a serious limitation.

Although slow-scan TV (SSTV) isn't the best mode for low-power work, I had to give it a try. I loaded up the *MMSSTV* software, configured it to communicate with the '705, and then sent an SSTV CQ. My 5 W 20-meter signal was rather noisy at KD9DD in Illinois, but my CQ image was viewable (see Figure 4).

The Wireless Connection

This is the era of wireless mobile devices, and the IC-705 is no exception. It includes Wi-Fi functionality as standard equipment. This means the IC-705 can connect to any 2.4 GHz wireless network and instantly become a remotely controllable transceiver.

Figure 4 — You can attach an external computer and operate slow-scan TV (SSTV) with the IC-705. KD9DD was 1,000 miles away in Illinois, but he was still able to view my noisy 5 W CQ image.

You set up the Wi-Fi connection in the IC-705 in the same way you would configure a tablet computer or smartphone. Using the touchscreen, you choose the network SSID, and then enter the password (see Figure 5). I was able to add the transceiver to my home network in less than a minute.

For operation away from home, Icom recommends a travel wireless router to use with the radio, as the IC-705 will not connect to a wireless network requiring secondary connection like you see in many hotels. You would use the travel router to connect to the hotel wireless network with the secondary information, then the radio would connect to the travel router.

With the IC-705 connected to Wi-Fi, it can be used for remote operating in almost any mode. At the time of this writing, the only remote-control software available for the '705 was the Icom *RS-BA1* package. I didn't have an opportunity to test the IC-705 with *RS-BA1*, but I'm aware of a few amateurs who are using it with this transceiver for long-distance remote access. It will be interesting to see what third-party software developers do with this feature in the months and years to come.

Another wireless asset that comes standard on the IC-705 is Bluetooth. This allows you to connect wireless headphones or a complete wireless microphone headset for hands-free operating. I didn't have a wireless headset available, but I was able to connect my Apple AirPods to the IC-705 for hands-free listening. Set-up was simple, and the result was impressive. Within my home, I was able to monitor the radio to a distance of about 30 feet; the range would be likely greater outdoors.

VHF/UHF

With its all-mode capability, the IC-705 does an excellent job as a portable or mobile alternative for exploring the world above 50 MHz. During this review, much of my VHF/UHF operating was analog FM, but I was fortunate to also have a couple of D-STAR digital repeat-

Figure 5 — You can connect the IC-705 to a wireless network for remote control via the internet. It's simply a matter of choosing the desired network and entering the password.

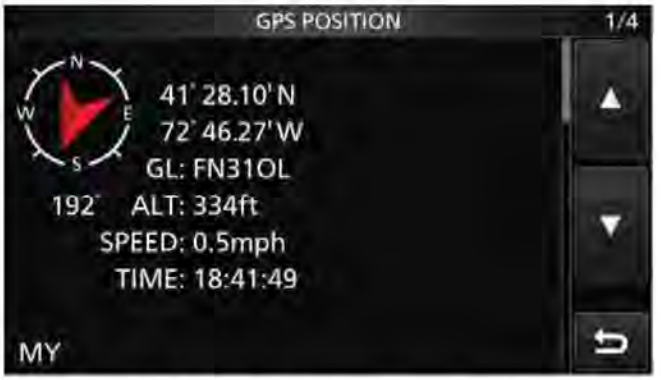


Figure 6 — The IC-705 has a sensitive internal GPS receiver.

ers nearby. If you've never tried D-STAR, you'll need to carefully follow the manual to configure the IC-705. Once I had it properly configured, accessing a D-STAR repeater was straightforward.

I found the audio quality of D-STAR to be quite good. In turn, I received good audio reports as well. In addition to local chats, I was able to enjoy several international conversations through internet-linked D-STAR reflectors.

In addition to swapping voice data during D-STAR transmissions, the IC-705 is capable of sending and receiving digital images via the DV data stream. This separate data channel is one of the cool aspects of D-STAR. It allows you to send other information — such as small images — to accompany your voice conversations.

The IC-705 is equipped with a sensitive Global Positioning System (GPS) receiver (see Figure 6), and you can use it to send position information using the D-STAR D-PRS format. This is similar to the Automatic Packet Reporting System (APRS), where positions of other stations can be displayed on the IC-705's screen. You can also use the GPS function to plot your course and position, and even store this information to the microSD card for later review (using *Google Earth*, for instance). This is a handy feature if you plan on taking the IC-705 on hiking expeditions.

I didn't try this, but with the right software it's possible to sync your PC clock to the IC-705's internal GPS time. This would be useful for portable operation using digital modes such as FT8 or FT4, where accurate timing is critical and syncing to an internet time server is not possible.

GPS is also used to help you determine which D-STAR repeaters are nearby. The IC-705 ships with the latest list of repeaters in its internal memory. A couple of screen taps is all it takes to bring up a list of machines and their distances from your location. Select the nearest repeater, and the IC-705 configures itself automatically. The D-STAR list can be updated by downloading the latest version to your PC and transferring it to the '705 using the microSD card.

With its VHF/UHF SSB and CW capabilities, the IC-705 would be a worthy radio for contest roving, although you may want to consider adding an amplifier. The '705 also has potential for microwave operating when paired with a transverter. You can reduce the output to as little as 100 mW for compatibility with just about any transverter on the market.

Of course, a review wouldn't be complete without trying the IC-705 on amateur satellites. With 5 W to a small dual-band Yagi, I was able to make a few contacts through AMSAT-OSCAR 91, an FM repeater satellite. I used Icom's free *CS-705* programming software to set up some transmit/receive frequency memories prior to the satellite's arrival. The *CS-705* application does much more than program memories, though. You can use it to configure many aspects of the radio that you'd otherwise have to access through the menu system.

I didn't attempt to use the IC-705 to communicate through any of the SSB/CW linear-transponder satellites. It is possible to use the IC-705 with these satellites, at least in theory, but the transceiver doesn't operate full duplex, so you'd be unable to hear yourself on the downlink and adjust your frequency to compensate for the Doppler effect. Even so, it may still be possible to use the '705 with these satellites if you keep your transmissions very short to minimize the effects of drifting.

A Compact Contender

With its all-encompassing list of features, the Icom IC-705 will offer fierce competition to other portable transceivers. The only thing the IC-705 lacks is a built-in antenna tuner. For those who don't use resonant antennas, this could be an issue, although Icom has announced the AH-705, a tiny companion antenna tuner for the IC-705, which had not been released at press time.

Several well-illustrated manuals for the IC-705 are available for download from Icom's website and are well worth a look for more information about what this radio can do.

Manufacturer: Icom America, 12421 Willows Rd. NE, Kirkland, WA 98034; **www.icomamerica.com**. Price: $1,300. Replacement BP-272 7.4 V/1,880 mAh battery pack, $100. BP-307 7.4 V/3,150 mAh battery pack, $130.

Three High-Power Dry Dummy Loads

Reviewed by Mark Wilson, K1RO
k1ro@arrl.org

A 50 Ω dummy load (sometimes called a dummy antenna) is a great addition to any station for testing equipment or learning how to adjust an amplifier, antenna tuner, or vintage transmitter without transmitting a signal on the air. Years ago, the typical dummy load was a messy affair, consisting of a high-power resistor in a mineral oil bath. This review features three modern dry dummy loads that are lightweight, air cooled, and capable of briefly handling the 1,500 W legal limit. These loads use noninductive ceramic resistors that maintain their resistance over a wide temperature range.

Bob Allison, WB1GCM, tested each load in the ARRL Lab with high- and low-power levels on the 20-meter band. The high-power test was with 1,350 W, the maximum available in the Lab at the time of testing. The Lab also performed swept return loss measurements on each load to check the match to 50 Ω over the specified frequency range, and plots showing those measurements are included here. Additional return loss plots with greater detail for 0 – 30 MHz are available from **www.arrl.org/qst-in-depth**.

Ameritron ADL-2500

The Ameritron ADL-2500, shown in Figure 7, is rated to handle up to 2,500 W over a frequency range of dc to 54 MHz. The case has an SO-239 connector for connecting the station transceiver and/or amplifier on one side, and a 2.1-millimeter jack for 12 V dc power from the station power supply or a wall cube on the other. Power is required for the internal fan, which must be used at high-power levels (the manual doesn't define "high"). The fan runs at a single speed and turns on 12 V dc is applied. There's no **ON/OFF** switch.

The ADL-2500 uses four large power resistors, which are shipped in individual cardboard tubes to prevent damage. The resistors must be installed before use — remove the screws holding the case together and carefully press the resistors into fuse clips. It's a snug fit, and the manual cautions that the resistors are fragile.

According to a chart in the manual, the ADL-2500 can handle 2,500 W for 60 seconds, 1,500 W for 70 seconds, and 300 W indefinitely. The duty cycle is specified at 10% with the fan enabled. In other words, if you transmit into it for 1 minute, let it cool for 10 minutes.

Figure 7 — The Ameritron ADL-2500 power-handling chart and specifications are printed on the top of the case.

Table 3
Ameritron ADL-2500

Frequency range: dc – 54 MHz.

Power rating: 2,500 W maximum (10% duty cycle). Per chart in manual: 1,500 W for 70 seconds, 300 W continuous. Internal fan must be used for high power levels.

Cooling: Internal 12 V dc fan; current consumption 200 mA.

Impedance: 50 Ω.

SWR: Less than 1.3:1 at 30 MHz. See Figure 8.

Size (height, width, depth): 3.8 × 8.5 × 9.2 inches.
Weight: 4.1 pounds.

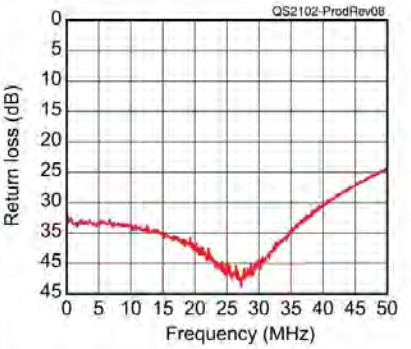


Figure 8 — The swept return loss of the Ameritron ADL-2500 over the range of 0 to 50 MHz. A return loss of 30 dB is the equivalent of an SWR of 1.065:1, 20 dB is an SWR of 1.22:1, and 10 dB is 1.93:1.

The power-handling chart and other specifications are also printed on the case for easy reference.

With 300 W applied for 10 minutes, SWR started at 1.09:1 and was 1.14:1 after 10 minutes. After cool-off, we applied 1,350 W for 80 seconds. The built-in fan

was powered up during these tests, and there were no sign of stress, only warm air blowing out the vents. The fan is not quiet, but the noise seems typical for a 3-inch fan blade in a metal case. We also tried 100 W for 10 minutes without running the fan. The case reached 110 °F, just warm to the touch, with no issues.

Figure 8 shows the swept return loss measured at the SO-239 jack on the rear of the ADL-2500 over the range of 0 to 50 MHz. Return loss ranges from about 34 dB (SWR = 1.04:1) at 160 meters to greater than 40 dB (SWR = 1.02:1) at 10 meters. At 6 meters, return loss is about 25 dB (SWR = 1.12:1).

Manufacturer: Ameritron, an MFJ company, 116 Willow Rd., Starkville, MS 39759; **www.mfjenterprises.com**. Price: $250.

MFJ-264

The MFJ-264 (see Figure 9) uses a single, large power resistor and is rated to handle up to 1,500 W over a frequency range of dc to 650 MHz. An SO-239 is used for connecting the station transceiver and/or amplifier, and cooling is passive (no fan). This load is shipped assembled and ready to use.

Like the ADL-2500, the MFJ-264 manual includes a chart showing maximum transmit power versus time, and this chart is also printed on the case. According to the chart, the MFJ-264 can handle 1,500 W for 10 seconds and 100 W for 10 minutes. The duty cycle is not specified, but the manual says to let the load cool down for 10 to 20 times the load usage (indicating a duty cycle of 5% to 10%). So, if you transmit into it for 10 seconds, let it cool down for 100 to 200 seconds (several minutes).

With 100 W applied for 10 minutes, SWR started at 1.03:1, dropped to 1:1 after a minute and was 1.18:1 after 10 minutes. The case temperature reached 140 °F, measured in the center of the top panel. After the load cooled off, we applied 1,350 W applied for 10 seconds and did this several times with no issues. The instructions warn to never allow the resistor to get hot enough to glow red, and we observed no color change during testing.

Figure 10 shows the swept return loss measured at the SO-239 jack on the MFJ-264 over the range of 0 to 650 MHz. Return loss on the HF bands ranges from about 37 dB (SWR = 1.03:1) at 160 meters to about 30 dB (SWR = 1.07:1) at 10 meters. At 6 meters, return loss is about 25 dB (SWR = 1.12:1); at 2 meters, about 17 dB (SWR = 1.3:1), and at 70 centimeters, about 15 dB (SWR = 1.4:1). It's very usable through the 70-centimeter band, although we did not apply high power in the VHF/UHF range.

Manufacturer: MFJ, 300 Industrial Park Rd., Starkville, MS 39759; **www.mfjenterprises.com**. Price: $90.

Table 4
MFJ-264

Frequency range: 1 – 650 MHz.

Power rating: 1,500 W for less than 10 seconds, 100 W for 10 minutes (per chart in manual). Cool down period must be 10 to 20 times the load usage.

Cooling: Passive.

Impedance: 50 Ω.

SWR: Less than 1.3:1 up to 650 MHz. See Figure 10.

Size (height, width, depth): 3 × 3.2 × 8 inches. Weight: 1.3 pounds.

Figure 9 — The MFJ-264 power-handling chart is printed on the end of the case opposite the connector.

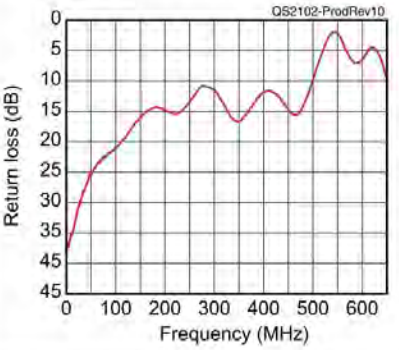


Figure 10 — Swept return loss of the MFJ-264 over the range of 0 to 650 MHz. A return loss of 30 dB is the equivalent of an SWR of 1.065:1, 20 dB is an SWR of 1.22:1, and 10 dB is 1.93:1.

Palstar DL1500

The Palstar DL1500 (see Figure 11) is rated to handle up to 1,500 W over a frequency range of dc to 30 MHz, and lower power at higher frequencies (see Table 5). The case has an SO-239 connector for connecting the station transceiver and/or amplifier. Like the MFJ-264, the DL1500 uses a single, large power resistor and relies on passive cooling. It's shipped assembled and ready to use.

Like the other two loads, the DL1500 manual includes a chart showing maximum transmit power versus time. According to the chart, from 0 to 30 MHz the DL1500 can handle 1,500 W for 10 seconds, and 100 W for 10 minutes. The duty cycle is not specified.

With 100 W applied for 10 minutes. SWR started at 1.19:1, dropped to 1:1 after 7 minutes, and ended at 1.02:1. After this period, the case temperature reached 195 °F in the center of the top panel, so be careful handling it. After cool-down, we applied 1,350 W for 12 seconds and tried this several times. The case got hot once again, but not as hot as during the 100 W continuous test.

Figure 12 shows the swept return loss measured at the SO-239 jack on the DL1500 over the range of 0 to 450 MHz. Return loss on the HF bands is about 20 dB (SWR = 1.22:1) across the range. At 6 meters, return loss is about 18 dB (SWR = 1.28:1); at 2 meters, about 15 dB (SWR = 1.43:1), and at 70 centimeters, about 17 dB (SWR = 1.33:1). It's very usable through the 70-centimeter band, although we did not apply high power in the VHF/UHF range.

Manufacturer: Palstar, Inc., 9676 N. Looney Rd., Piqua, OH 45356; **www.palstar.com**. Price: $200.

Table 5
Palstar DL1500

Frequency range: dc – 450 MHz.

Power rating: 0 – 30 MHz: 1,500 W for 10 seconds, 100 W for 10 minutes (per chart in manual). Maximum 1,000 W at 30 – 60 MHz; 750 W at 60 – 150 MHz; 350 – 500 W at 150 – 450 MHz.

Cooling: Passive.

Impedance: 54 Ω, ±5%.

SWR: Less than 1.3:1 dc – 100 MHz; less than 1.4:1, 100 – 500 MHz. See Figure 12.

Size (height, width, depth): 7.75 × 3.5 × 8 inches. Weight: 1.5 pounds.

Figure 11 — The Palstar DL1500. (The most recent production units have a gold-anodized case instead of the brushed aluminum shown here.)

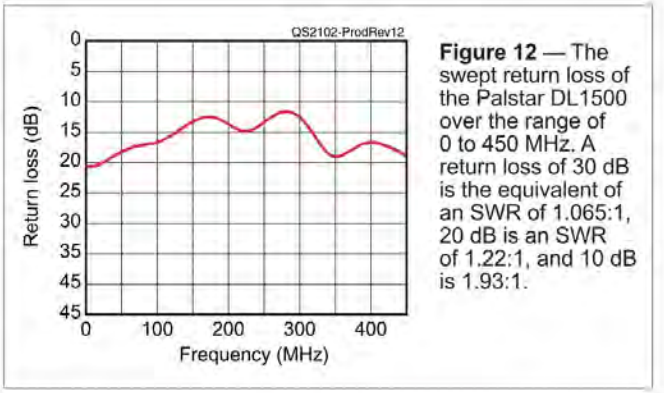


Figure 12 — The swept return loss of the Palstar DL1500 over the range of 0 to 450 MHz. A return loss of 30 dB is the equivalent of an SWR of 1.065:1, 20 dB is an SWR of 1.22:1, and 10 dB is 1.93:1.

The Best of "The Doctor is In"

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

Q Al, WA2VJL, asks: We have power amplifiers to boost our transmit signal strength. That's okay, but, isn't it more cost effective to boost receive? Why don't our amplifiers work both ways?

A Many V/UHF power amplifiers also include receive preamps that do exactly that. The reason you don't see preamps with HF transmit amplifiers is that the signal to noise ratio on HF is generally limited by the noise received at the antenna. At V/UHF the external noise is generally less — as a rule, it goes down with increasing frequency. Thus any extra amplification of an HF signal received by the antenna amplifies the signal and the noise by the same amount so the receive signal to noise ratio is unchanged, unless the receiver was of poor design to start with.

In addition to not helping, an HF receive preamplifier actually will make the situation worse because the receiver with a high gain preamp is more likely to overload and cause spurious signals to be generated in the receiver.

It wasn't always this way. Until the 1960s, receiver preamps or preselectors were quite popular. They generally also included tuned stages that reduced received images, a problem above 20 meters with most single-conversion receivers using a 455 kHz intermediate frequency (IF), a common design in the vacuum tube days. Modern receivers generally have multiple conversions with the first in the HF or VHF range so images aren't a problem. In very quiet conditions, even some modern receivers can benefit from a low-noise preamp on 10 meters.

Note that an antenna system with gain will generally help both transmit and receive signal strength if pointed in the right direction. The transmit amplifier will make your signal stronger at the far end, which is sometimes just what you need.

Q John, HI3/KL7JR, asks: My top floor condo patio is my only place for antennas. I use a 100 W HF transceiver with built-in autotuner and I have an external 100 W autotuner that I rely on to match my loop (main antenna) or various verticals and assorted wire antennas that I can squeeze in for my antenna experimenting. Sometimes on some bands the best match I can get is an SWR of 1.5 or 2:1 using my external tuner. I then hit it with the internal tuner and easily achieve an SWR of 1:1. This technique has worked well for me for over 6 months. Considering my situation, is this good practice?

A Well, it is not unreasonable if you want an exact match, but there are a few issues to consider. There are two likely reasons why your external autotuner may not be able to get a 1:1 match, and the resulting issues are somewhat different.

First, most autotuners use switched discrete components to make their adjustments, not continuously variable inductors and capacitors as in many manual tuners. Sometimes the value needed for a 1:1 match is in between the available choices and the tuner does the best it can.

Usually they can get pretty close, but the difference between the exact match and the best they can do depends on the step size between discrete values, part of the design of your tuner.

The second reason is that the antenna impedance you are trying to match may be beyond the design range of the tuner. Many autotuners are specified to match up to a 10:1 SWR. If you ask such a tuner to match an impedance with a higher SWR, it may not be able to match it to as low an SWR as it would if it were in spec.

In the first case, if the SWR is low enough that it's within the transceiver's spec and it can put full power to the antenna system, there will not be much benefit to using the additional tuner. Since every tuner has some loss, you may end up with less transmitted signal than if you lived with the 2:1 SWR. You can decide either by measuring the antenna current at the antenna in both cases, using a field strength meter or asking other stations if they can tell any difference whether or not your internal tuner is bypassed. It probably won't make much difference.

For the second case, all the above is still true, but there is another consideration. In my experience, antenna tuners can often tune mismatches beyond their rating. If they do, the voltage or current within the tuner components will be above their design value and it is possible to have component damage. The maximum voltage and current in the system will go up by the square root of the SWR. To be safe, measure the SWR of the antenna itself and reduce the transmit power accordingly. For example, with your 100 W transceiver and 100 W antenna tuner rated for a 10:1 SWR, assume the actual antenna SWR is 15:1. That's a factor of 1.5 above the rated SWR.

The voltage or current could thus go up by as much as a factor of 1.22. To reduce your power so that the voltage and current are in spec, reduce your power by 1/1.5 to 67 W.

Q Jim, WA9PYH, asks: I have a Heathkit SB-200 400 W linear amplifier that is causing problems when I try to drive it with a new solid state transceiver. On the 40-meter band only, I can drive the amplifier to full output without difficulty. On 80, 20, 15, and 10 meters, the transceiver cuts back the power dramatically or begins to squeal sometimes, locking up so that I have to cycle power to resume normal operation. This is the case even when driving a Heath Cantenna dummy load with the amplifier. I never had any problems driving the amplifier with my old transceiver with a vacuum tube final amplifier.

I put an SWR bridge between the transceiver and the amplifier and found that the SWR is over 3:1 on 20, 15, and 10 and 2.5:1 on 80 meters. 40 meters is a bit better with the highest SWR of 1.3:1, which explains why it works on that band. The input circuit of the SB-200 is a simple series inductor with a capacitor to ground on the amplifier end on 80, 15, and 10. On 40 and 20 the input circuit is a pi-network. Any suggestions?

A The most likely problem is the mismatch you have noticed. Your old transceiver had adjustable tuning and loading controls that could deal with the mismatch at the input — not so with a modern solid state rig. It is also possible, especially with the squeal, that you have some kind of RFI problem with the higher power getting into your transceiver.

I would suggest, as a diagnosis step, that you borrow a small 100 W antenna tuner to put between the radio and the amplifier. See what happens if it's all matched. If it works as expected, then it isn't an RFI issue or some other exotic problem and you can concentrate on the mismatch.

If that's the case, you have two choices. You can use a tuner there — the optional internal autotuner should do fine, if you have one, and it can remember what to do on each band. You could also use a stand-alone tuner between the transceiver and amplifier. Of course, all tuners have a small amount of loss, so you won't get quite the full drive from your transceiver. If you need the full 100 W at the amplifier for full output, you may be disappointed. You will also have to remember to retune whenever you change bands, or switch the amplifier to bypass.

Alternately, you could see if you can adjust the input circuit for a proper match. You may be in for a lot of tweaking to get it right. With power off, squeeze the turns and see if the SWR gets better or worse. Do more or different as indicated.

To know what to expect, you could also go onto a Heath email forum and see what other people experience. I had an SB-230 linear for many years and never had this kind of problem, so it seems likely that there has been a component change.

Yes, it is quite possible that the input circuitry needs tuning — it isn't a trivial process since the output network interacts with the input tuning — you won't have it fully tuned until the SWR is low when the amp is putting out full output power. Also, the input circuit acts as a buffer between the tube and your rig — there can be significant current spikes in a cable between a tuner and the input circuit of the amplifier. This is explained pretty well in Bill Orr's *Radio Handbook*. So yes, the problem is likely to just be in the input circuit.

Q Jerry, WAØH, asks: I need to feed coax cable through a wall. In terms of standing wave ratio (SWR), is it better to use a bulkhead adapter, or just run the cable directly through a hole in the wall?

A In terms of SWR, at least on HF, it makes absolutely no difference whether or not a bulkhead connector is used. On the other hand, there are some other benefits to using one if we're talking about coming through an exterior wall. For interior walls, I don't think it matters at all, except it will allow breaking the connection to use for some temporary interconnection. I find this helpful on some occasions — if I want to operate from a different room, for example.

If it's an exterior wall, there are a couple of significant benefits to having a bulkhead, especially if it's on a metal "entrance plate." It is best if it is close to ground level and is tied to the station and service entrance grounds. This makes it very easy to ground the shield as it enters the building. If the ground connection is low impedance (short) it will be beneficial for lightning protection and is a good place to install an arrestor. This tends to keep a sizable fraction of lightning-induced current outside the house, where you want it.

It allows the use of a "drip loop" to keep water out of the inside of the wall and building. Even if a drip loop is made on initial installation, without a bulkhead connection the cable tends to migrate or get pulled in, often eliminating the drip loop. It also helps keep out insects and other critters and reduces damage to interior walls. As noted, none of this changes the SWR, except a bit at VHF and above.

The only downside is that there are other potential failure points with the multiple connectors associated with the bulkhead arrangement. While coax connectors don't often fail, they can, especially if outside and not waterproofed.

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

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Hints & Hacks

Certificate Storage, Keypad Repair, Tightening a Support Rope, Isolating Old Gear

Portfolio Protection

After recently remodeling my station, I wanted to find a way of cataloging and protecting my DXCC certificates without putting them in frames. The certificates are 11 × 14 inches, so it took some searching to find a solution. My answer turned out to be the Itoya 11 × 14 Art Presentation Portfolio (see Figure 1). This product, and some similar ones, are available on Amazon for less than $20. It was an ideal fit for the awards (see Figure 2). — *73, Mike Flowers, K6MKF,* **mike.flowers@gmail.com**

Figure 1 — (left) The Itoya Art Presentation Portfolio.

Figure 2 — (right) DXCC certificates are protected and treasured.

A Keypad Solution

I found a good way to recondition keypads that use conductive rubber contacts. I had an old Icom 24AT handheld transceiver and its keypad button had become intermittent. I loved the old radio, so I wanted to see if could repair it myself. The procedure I used was a little unorthodox, but it worked.

I cut a thin strip from a foil gum wrapper and trimmed it into tiny squares. Next, using the tip of a fine-point knife, I put a bit of RTV silicone caulk on the back surface of each button and then attached the foil squares (see Figure 3), with the foil side up. I let it cure for several hours and was happy to discover that it is a permanent fix.

Figure 3 — Place the tiny foil wrapper squares onto the inside back surfaces of the buttons, with the foil side up.

Figure 4 — The inside front needed a little help from some plastic cement, but once everything was reassembled, it worked perfectly.

Strange as it may seem, gum wrappers are ideal for the job because they offer a thin paper backing that adheres well to RTV.

The inside front needed a bit of repair to the four plastic rivets holding the shield (see Figure 4), but with some plastic cement it was soon ready to reassemble. The keypad works like new. — *73, John Gebuhr, WBØCMC,* **wb0cmc@arrl.net**

A Snug Support

I have a dipole antenna supported at both ends by Dacron rope. One end is anchored to a tree, but I had trouble keeping the rope snug. I had to use a ladder to reach the anchor point, and it was hard to keep the rope snug while I tied it off.

Searches for an appropriate tool to secure the rope led me to a mechanical ascender designed for climbing. It employs a cam that allows the device to slide freely in the intended direction of movement, but it provides a firm grip on the rope when pulled in the opposite direction. To prevent an ascender from accidentally coming off the rope, a locking mechanism or trigger is deployed.

I found an imported ascender at an online retailer. I fastened my antenna rope to the ascender, and then clipped it to the support rope from the tree (see Figure 5). Now, I can just slide the ascender along the support rope to tighten the antenna. It is easily removed if needed.
— *73, Joe Gore, WA4RTE,* **joegore1965@bellsouth.net**

Figure 5 — A mechanical ascender is normally used for climbing, but it can also keep an antenna support rope nice and snug.

Isolating Old Radios

I recently acquired a Hallicrafters S-38 receiver at a hamfest for a bargain price. This model uses a two-wire power cord with no ground. There is no power transformer in the radio, so everything runs directly off the ac line. This can create a shock hazard, depending on how the plug is inserted into an ac receptacle, causing the metal case to be dangerously live.

My solution, at least for testing purposes, was a 60 W isolation transformer. You can purchase these new, but they are also common at flea-markets and other outlets. The isolation transformers typically have multiple taps on the input (primary). Mine had taps for 120, 208, 230, and 460 V ac. Consequently, by selecting the correct input, the output could be set at 120, 75, 65, or 45 V ac.

I selected taps to start at lower voltages to test the receiver's electrolytic capacitors. After replacing one capacitor and running for several hours at full power, the radio worked perfectly.

Figure 6 — A 60 W isolation transformer mounted onto a case with a neon light indicator.

This testing method also worked on my vintage Heathkit HR-10B receiver and DX-60B transmitter. I decided to make the transformer a permanent part of my workbench.

I mounted the isolation transformer on a case (see Figure 6) and attached a neon indicator light to the case using a hot glue gun. It wasn't elegant, but it was quick, and it worked. I also installed a switch for the inputs, so that I could select either a 120 or 65 V ac output. A multiposition rotary switch would be even better for this purpose. Also consider a larger transformer for testing bigger radios, such as a HW-100 transceiver.
— *73, Arthur Horovitch, VE3AIH,* **suzanandart@gmail.com**

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

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

US Amateur Radio Bands

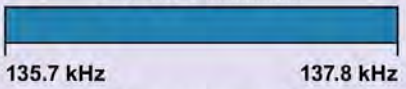
Operator license classes: **E** = Amateur Extra **A** = Advanced **G** = General **T** = Technician **N** = Novice
CW operation is permitted throughout all amateur bands. Except as noted, all frequencies are in megahertz (MHz).

= 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

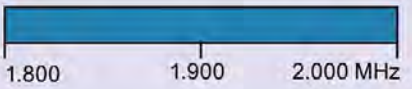


MF – Medium Frequency bands

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**

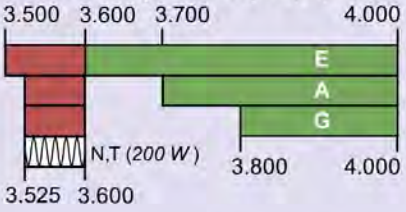
160 Meters (1.8 MHz) E,A,G



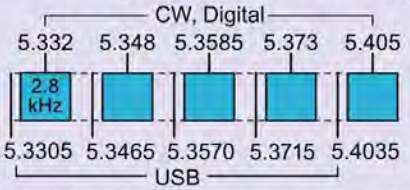
Amateurs wishing to operate on **2200 or 630 meters** must first register with the Utilities Technology Council online at **https://utc.org/plc-database-amateur-notification-process/.** You need only register once for each band.

HF – High Frequency bands

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

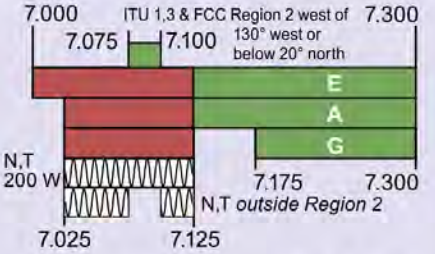


60 Meters (5.3 MHz) E, A, G (100 W)

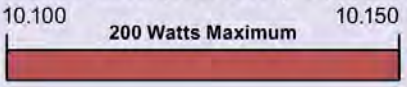


Gen, Adv, and Extra licensees may operate on a secondary basis with a maximum ERP of 100 W maximum.

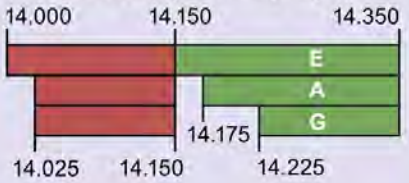
40 Meters (7 MHz) E,A,G,T,N



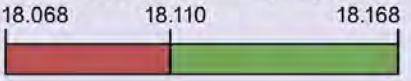
30 Meters (10.1 MHz) E,A,G



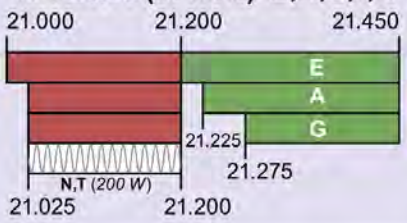
20 Meters (14 MHz) E,A,G



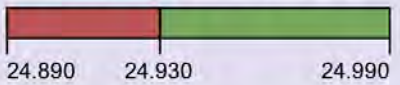
17 Meters (18 MHz) E,A,G



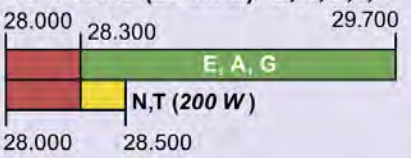
15 Meters (21 MHz) E,A,G,T,N



12 Meters (24 MHz) E,A,G

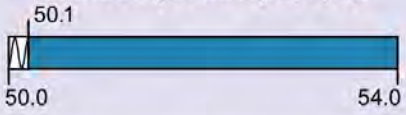


10 Meters (28 MHz) E,A,G,T,N

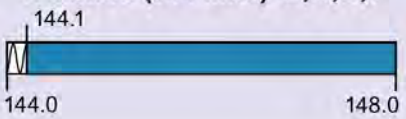


VHF – Very High Frequency bands

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



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

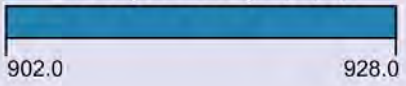


1.25 Meters (222 MHz) E,A,G,T,N

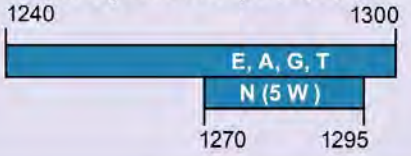
UHF – Ultra High Frequency bands

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

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



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



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 High-Speed Go-Kit for Mesh Networking

This plug-and-play kit allows for increased portable capabilities.

Frank Kostelac, N7ZEV

A mesh networking system works off several nodes wirelessly connected to one another. The infrastructure nodes, such as bridges and switches, are connected to as many other nodes as possible, cooperating with one another to route data. Because the nodes are connected in a non-linear pattern, if one module can't relay information to another, it'll try another route. Some benefits of mesh networks include better coverage, the minimization of dead zones, easy configuration, and less connection failure.

I've created a high-speed go-kit for mesh networking. The whole system has been fabricated in the typical go-kit packaging of a plastic ammo box. Considerable thought has been given to equipment selection, with a focus on a plug-and-play approach to both the construction and the actual use when deployed.

Figure 1 — External ports must be included in your mesh network go-kit for use in the field.

Gathering Equipment

After selecting your mesh radio and updating to the current Amateur Radio Emergency Data Network (AREDN) code, you'll need to consider a support system of power supply, Ethernet hardware, power over Ethernet (POE) injectors, analog telephone adapter, and cabling it all together for an operational node.

The kit should have specific features, such as portability; on-board ac and external dc power; ruggedness for field use; easy set-up and take-down; and support for a Voice over Internet Protocol (VoIP) phone, internet protocol (IP) camera, and an access point. The power supply must be capable of supplying the needed current. All the dc connections on the Ethernet switch, phone adapter, and POE injectors must be the same 2.1-millimeter coaxial connectors. Additionally, the kit must have all ports available on the outside for use in the field (see Figure 1).

Figure 2 — For a secure base, install the power supply through a hole on the bottom of the box with a hose clamp. Notice that the data jack plate is installed.

Figure 3 — The red cables are for the POE injectors and the blue cables are for the data connections. Note that there are port numbers on the hardware.

Power Supply System

A small security system provides a nice power supply designed to support a digital video recorder (DVR) and cameras. This supply comes with a spider box (portable power distribution system) that, depending on the model, has a number of 2.1-millimeter coaxial connectors.

This power supply has an integrated ac supply jack and a single connector feeding the spider distribution harness, making the addition of a single-pole double-throw (SPDT) switch a simple fix for an external dc source. You will also want to add an external dc connector. I used a 2.1-millimeter connector, but Molex Electronic Solutions or Power-Pole connectors would also work. There may be some unused power connectors.

Installing the power supply through a hole in the side on the bottom of the box with a hose clamp creates a secure base. Note that the openings will be sealed with clear silicone once construction is complete (see Figure 2).

Ethernet Switch and Telephone Adapter

Many versions of an unmanaged five-port switch are available. Be sure to select one that's 12 V and has a 2.1-millimeter dc connector. I prefer one that has the lights on the front and the connectors on the back, but any configuration will work.

The analog telephone adapter comes in many versions as well. Any that physically fit and have the 2.1-millimeter dc jack will be fine. Be sure to note that even though the output jack on the telephone adapter is a six-pin jack, only the middle two pins are used for the tip and ring.

Figure 4 — A bright LED light was installed on a connector to test the red jacks. Many mesh radios and IP cameras require voltages other than the 12 V dc used here. Adjustments would need to be made externally to accommodate the hardware accordingly.

When installing the units, be sure to connect the dc cables as you install the hardware. I found hook-and-loop fastener with adhesive backing to be the ideal mounting solution for the switch and adapter.

Power over Ethernet Injectors

Again, many versions are available for this aspect of the build. The only consideration here is the 2.1-millimeter dc jack. On the injectors used here, I found that removing the screw holding the two case halves together allowed me to drill a ⅛-inch hole, which made mounting to the side of the case much easier. The white and gray cables should be in place at this point.

The external jacks are mounted on a standard data jack face plate, which allows you to choose a color code for the function of the jacks. I used red for POE, gray for the PC, and white for the phone. I used the normal punch down jacks and built my own cables,

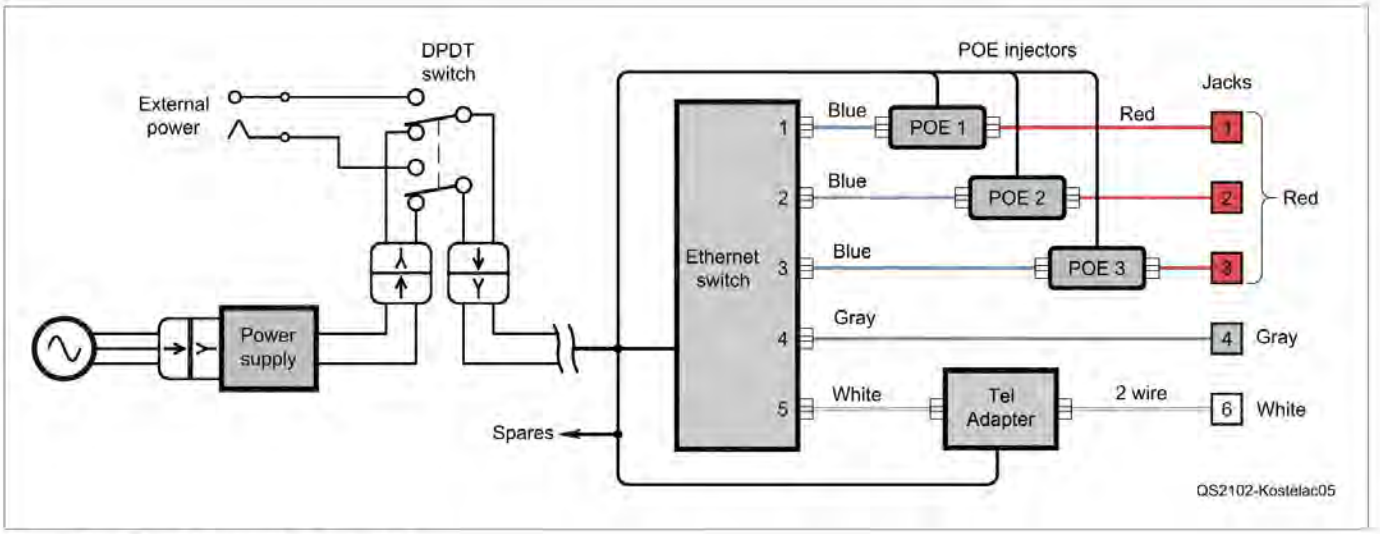

Figure 5 — The schematic for the go-kit.

but you may want to use couplers in the holes on the plate and purchase short cables. I don't recommend building your own cables unless you have a tester available.

To complete construction, I used a red cable for the POE injectors and a blue cable for the data connections (see Figure 3).

Testing Your Work

Now that the build is complete, you'll want to turn on your go-kit and check for the presence of lights and absence of smoke. When testing the POE injectors, I took a bright LED light and installed it on a connector for testing the red jacks (see Figure 4).

Frank Kostelac, N7ZEV, earned his license in 1992, and is active in amateur television (ATV), Automatic Packet Reporting Systems (APRS), and HF and satellite communications. He enjoys creating things related to any form of RF communications and operating in the outback whenever possible. Frank serves as Nevada Section Technical Coordinator and is the COML for Clark County, Nevada, ARES Races. He can be reached at **frank@kostelac.com**.

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

New Products

SSB-Electronic Germany SP 400 Low-Noise 70 MHz Preamplifier

SSB-Electronic 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**.

TurboLog 4.17 Update Now Available

TurboLog Communications has released TurboLog 4.17, the latest update of this station management program, which is immediately available on the TurboLog website. Some of the new features include real-time logging directly into Club Log; automatic feeding of contact information into the online QSL request system, OQRS; a progressive logbook search feature; WebHelp and Manual upgrades to the context-sensitive online help; new transceiver models have been included, and specific new features have been implemented in the code. For example, Power ON/OFF from within TurboLog 4 can now be commanded via the CAT interface, the Packet facility has been enhanced by specific alarm functions and displays, and the embedded *WSJT-X* and *JTDX* plug-ins have been improved. The full range of new features is presented at **http://www.turbolog.de**.

Activating Historically Rich Egypt

Strict security and special operating privileges made this unique location possible.

Martti J. Laine, OH2BH

In the world of amateur radio, Egypt is a mysterious country due to many of its existing radio practices presenting unique challenges. In 2019, the World Radiocommunication Conference (WRC) was held in Egypt from October 28 to November 22, making it the first time in 20 years that the WRC was held outside of its Geneva-based headquarters.

In this article, I'll explain why there aren't many amateur radio operators in Egypt and why a visitor can only dream about bringing their radio to various Egyptian destinations. One such dream location is Sharm El-Sheikh (Sharm), which was the location not only for WRC-19, but also for the featured on-air activity presented there.

Sharm is located at the southern tip of the Sinai Peninsula, some 500 kilometers by road from the country's capital, Cairo. What was once a small fishing village has become a major tourist attraction, with a population of nearly 80,000 and more than 500 hotels. The town is built on a desert, with its hotels along the shore of the Red Sea.

Operating Permissions

The Egyptian National Telecom Regulatory Authority (NTRA) played a key role as a local host organization. Their executives acted in many chair positions at the WRC working groups. It was also the highest honor for the Egyptian Radio Amateurs Society for Development (ERASD) to have three hams included in an official position in their national WRC delegation. ERASD President Said Kamel, SU1SK, led the amateur radio contingent.

To honor this special event, NTRA granted ERASD special operating privileges as SU8WRC and SU8X, not only for operating in Sharm, but also for importing modern equipment and using bands that had never before been allowed in Egypt. As an ERASD invitee, I was given SU/OH2BH as a personal license in addition to the group authorizations.

We came up with the concept of a showcase amateur radio station, where visiting WRC delegations from rare countries would be introduced to Amateur Radio 2.0 (a program where hams and their supporters team up for a good cause by bringing their resources to remote societies at large) and modern equipment in a private facility.

We had been authorized to operate at the Hilton Sharm Waterfalls Resort. As an addition to our personal invitations, Said found interesting delegates that we wanted to host at the private showroom. The countries we invited typically had no established Amateur Radio Service, so our list resembled the "most wanted" DX countries. We shared these interests with our valued supporting partners — the International Amateur Radio Union (IARU), International DX Association (INDEXA), SEISA Group (founded by Zorro Miyazawa, JH1AJT), and the Yasme Foundation.

Rigorous Security

Recent civil unrest in Egypt resulted in strict security measures to ensure the safety of foreign delegates from all ITU member countries, as well as attendees. Amateur radio and related equipment were also affected. Many expected that we wouldn't get through with our lineup of radios and antennas, not to mention getting them installed on top of a building of high visibility, such as the Hilton Sharm Waterfalls Resort.

From left to right: Dave Sumner, K1ZZ (IARU); Said Kamel, SU1SK (ERASD), and Dave Court, EI3IO (IARU R1).

The four-band Spiderbeam vertical antenna (10 meters). The 80-meter radiator was L-shaped.

This SU8X QSL card emphasizes the promotion of WRC to the amateur radio population.

One of the rare Egypt QSL cards.

However, with the proper permits issued, the undertaking was successful. We were expected at the airport and bypassed the arrival check. Security personnel were present at our antenna-raising party, and kindly helped out when needed. Despite the many checkpoints throughout the city and every person and bag being x-rayed at hotel entrances, this was the most secure and friendly DX operation I've ever been involved with. Thanks to the NTRA for being so welcoming.

Unique Operating Challenges

Because the individual license procedure involves multiple steps and a multifaceted screening of personal records, there are only 25 amateur radio operators in Egypt. There aren't any amateur radio regulations, rendering it difficult to take an exam. Only one transceiver (the Icom IC-718) is type-approved, therefore everyone must have that radio. That is, if they can still find one.

▲As a test run prior to WRC-19, the team set up for the CQWW SSB Contest on October 26 – 27. SU8X was an attractive dual multiplier for the contesting community. From left to right: Said Kamel, SU1SK; Martti Laine, OH2BH; Yasser Mahdy, SU3YM; Tarek Abdallah, SU2TA, and Niko Halminen, OH2GEK.

◀Stella Erabor from the Nigerian Communications Commission (NCC) was impressed with the non-audible radio communication made by FT8 through the heavy noise.

ERASD hosts several group events and activities such as Jamboree on the Air (JOTA) and other special occasions where youth can operate the special event station. SU9 stations are residential foreign hams who also need to pass an extensive security check.

Egypt and Sudan form CQ Zone 34 — one of the rarest. Both countries present limited activity on the HF bands. We were offered the call sign SU8WRC for the duration of WRC-19, and asked for another permit, SU8X, for participation in the CQWW DX SSB Contest held on October 26 – 27, to do some test runs prior to the conference.

When we turned our radio on for the first time, we noticed large inverter-controlled power units on the rooftop. They're typically severe noise generators, and together with thousands of LED lights, they worked against our potential success. Because of all the security issues, moving to an alternative location wasn't an option. Our low-band signals were reported as loud, but we were only able to copy the signals that broke through the S9+ noise, and there weren't many. We contacted only 79 US stations. But we worked hard and ended up with 4,281 contacts.

A Successful Event

The WRC delegates found FT8 fascinating in many ways. They find voice and Morse code to be ancient, but when they observed us decoding under the noise level in civilized operating comfort, avoiding disorderly chaos, they were impressed.

Running FT8 (FT4) in front of respected people, along with providing sophisticated and fair explanations, gave amateur radio a friendly face. We left already planning to figure out how we can best facilitate FT8 as a novel stream of amateur radio, and how we can explain it in such a light to those who set regulations.

The SU8WRC/SU8X delegation consisted of Said Kamel, SU1SK; Mohmed Atef, SU1AO; Tarek Abdallah, SU2TA; Yasser Mahdy, SU3YM; Niko Halminen, OH2GEK, and Martti Laine, OH2BH.

Martti J. Laine, OH2BH, has lived and worked in several countries and continents as a telecom executive. While on the road, he has been the first to activate a total of 12 new DXCC entities. Most recently, he has focused on the future of amateur radio through FT8, as well as supporting youth activities. Martti is a member of the ARRL Maxim Society and is a director of the Yasme Foundation. Martti can be reached at **martti.laine@kolumbus.fi**.

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New Ham Kit

A Way for Clubs to Help Get New Hams on the Air

A New York radio association created a valuable tool for new operators.

Bryan Jackson, W2RBJ

It's a common occurrence in amateur radio for test applicants to pass their licensing exams and never get on the air. Our club, the East Greenbush Amateur Radio Association (EGARA) located in New York's Capital District, found that the biggest challenge facing many new hams was simply where to start. To help with this, EGARA provides Technician-class licensees with a copy of our New Ham Kit. We've found it to be a valuable tool in getting newcomers on the air by offering easy-to-understand information on equipment basics, operating guidelines, and helpful tips.

Kit Details

First, our kit urges newly licensed hams to join an amateur radio club. In addition to including applications to join EGARA and ARRL, we offer a free membership to EGARA for the first year. We point out that joining a club full of experienced hams (especially mentors) can provide the encouragement and guidance new operators need. As a result, our club has grown its membership and recruited younger operators vital to keeping our hobby alive.

Additionally, we provide new hams with an overview of the equipment they'll need to get on the air, including a brief review of entry-level handheld transceiver radios. We also encourage them to search the internet and YouTube to find resources and guidance available for new hams. We request their email address during their Volunteer Examiner (VE) session to add them to the mailing list for our monthly newsletter. This helps maintain our contact with these new hams and keeps our club in the forefront.

A look at the inside of the East Greenbush Amateur Radio Association's New Ham Kit.

In describing repeater basics, the kit includes an explanation of frequency offsets and CTCSS tones, how they work (with an illustration), as well as a detailed chart that lists offsets for each band. There's also a complete list of the frequencies and CTCSS tones for our local club repeaters.

Additionally, the kit includes information on how to make a call, upgrade your license, and other topics. While the kit doesn't address specific equipment controls, it does refer new hams to our club's website (**www.egara.club**), where they can find a wealth of resources and relevant information,

such as links to sites offering operating tips, repeater directories, ham radio equipment classifieds, and organizations such as ARRL, FCC, and SKYWARN.

Because our club maintains several repeaters, we include their frequencies and urge our new hams to use them. In particular, we emphasize not to be intimidated about pressing the push-to-talk (PTT) button, explaining that experienced hams are happy to help new operators.

We also include excellent resource materials from ARRL, many of which are free. Our kit usually runs about six pages of our own material, and three to four flyers provided by ARRL.

The information included in our kit was culled from EGARA members, ARRL, and reliable amateur radio sources.

Creating Your Own Kit

Like any project, producing your own kit will require a point person to manage it. If your club has a newsletter editor or webmaster, this might be the logical lead person. Creating the kit itself doesn't require anything more than a standard word processing program, although using a desktop publishing program such as Adobe InDesign or Microsoft Publisher can make the layout of text, graphics, and photos look more professional.

Adding visual elements can make concepts such as repeaters easier to understand. Helpful photos and graphics can be found online and are often royalty-free when they are used for non-commercial purposes. However, if you have club members who are adept at photography, you can create your own images.

Once you have a prototype kit assembled, have it reviewed for accuracy and content by several people — preferably by those who didn't work on it. You'll want to make sure that the information flows logically, is understandable, and that technical concepts are presented in a way that new operators can easily comprehend them. It's also a good idea to ask a non-ham to review your draft.

Once you're ready to go to press, remember that the presentation of your New Ham Kit is important too. Poorly reproduced copies and sloppy assembly of its contents will defeat your hard work and reflect negatively on your club. We usually only produce a dozen or so at a time, based on numbers from our past VE sessions, using either an inkjet or laser printer. Office supply stores with printing centers are also an option.

We finish our kits by neatly placing the pieces in a pocket folder. These can be purchased for around 25 cents each, and some have a cutout for a business card. "New Ham Kit courtesy of the East Greenbush Amateur Radio Association" is neatly printed on a label and placed on the front of the folder. The completed kits are kept with our VE exam materials and brought to each testing session.

Finally, our cost per kit runs under a dollar. This small investment has allowed us to gain and retain a dozen or so new members over the past couple of years since we began handing out our New Ham Kit. Hopefully your club will enjoy similar results.

New Ham Kit Contents

- ✔ Cover Sheet
- ✔ Congratulations On Getting Your New Amateur Radio License
  1. Overview of What's Next to Get On the Air
  2. Joining a Club
  3. Basic Equipment for Technicians
  4. Technician Operating Privileges
  5. Understanding the Band Chart
- ✔ Club Membership Application
- ✔ Getting On the Air
  1. Repeater Basics (with graphic)
  2. Offsets, CTCSS Tones
  3. How to Make a Call — Basic Call Script
  4. Talking to Other Stations, Dos and Don'ts
  5. Getting Experience
  6. Upgrading to a General License and Expanded HF Operation
- ✔ ARRL Information Flyers and Band Chart

Bryan Jackson, W2RBJ, holds an Amateur Extra-class license, is an ARRL sanctioned Volunteer Examiner, and serves as President of the East Greenbush Amateur Radio Association. He is a former Press Officer to two New York governors and previously served as State Capitol Correspondent for NBC, WNYT-TV, and WOR Radio. From 1991 to 1996, he built, owned, and managed WCDA-FM in Albany, New York. Today, he is semi-retired, but enjoys working as a substitute teacher and encouraging his students to explore amateur radio. Bryan can be reached at **w2rbj@outlook.com**.

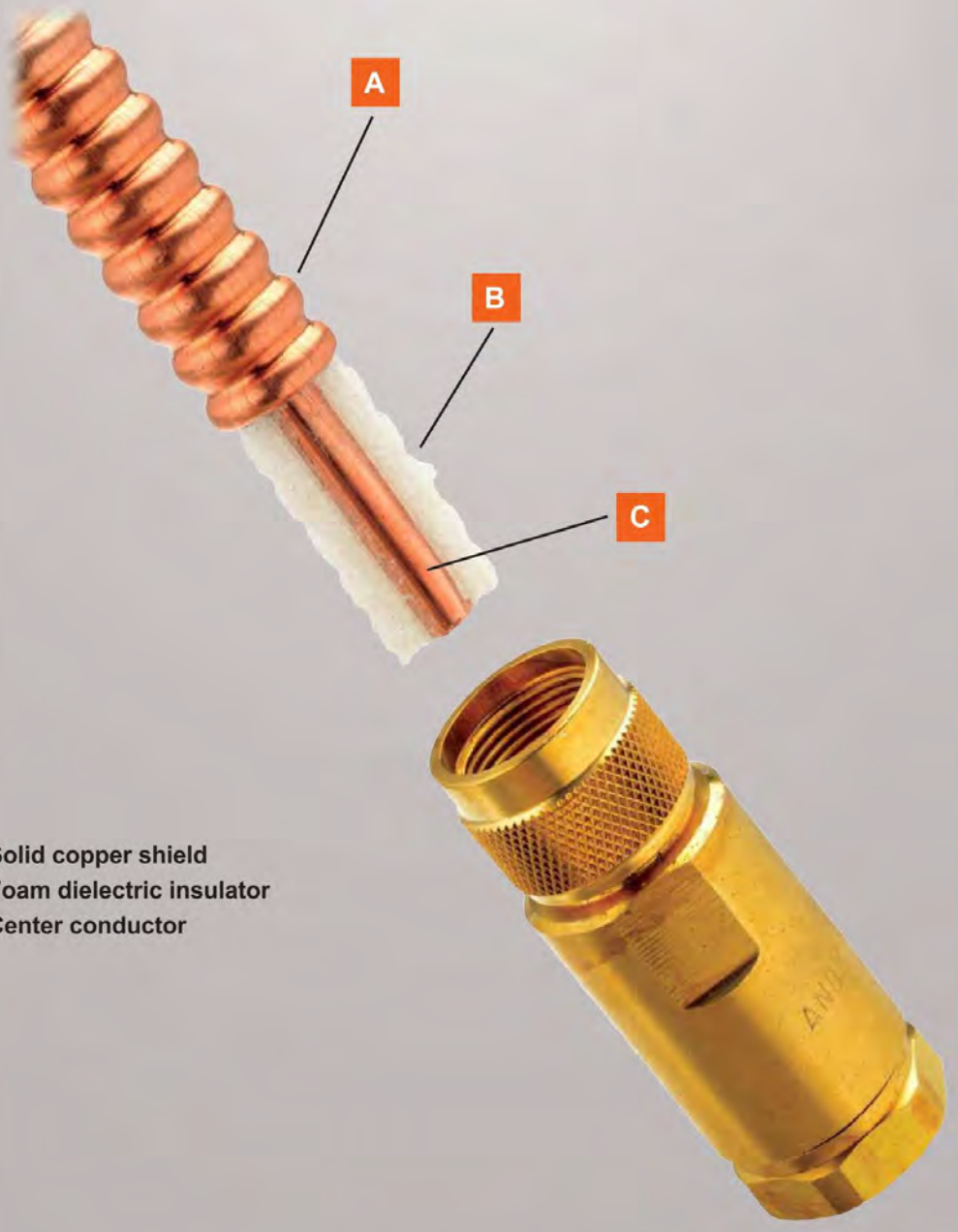
For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

Close Up

Heliax®

Heliax is one of the most popular "hardline" coaxial cables in commercial and amateur radio use today. Rated for operation up to 9 GHz, the ½-inch variety shown here has been stripped of its black outer jacket. At 30 MHz, the matched attenuation of 100 feet of Heliax is only about 0.4 dB; the frequency must rise above 200 MHz before the matched attenuation finally reaches just 1 dB.

Near the dissected Heliax, you can also see a precision UHF Heliax connector.



A — Solid copper shield
B — Foam dielectric insulator
C — Center conductor

Rick Lindquist, WW1ME, ww1me@arrl.org

Happenings

ARRL Announces
Director, Vice Director, and Section Manager Election Results

The ARRL Dakota Division has a new Director, and the Great Lakes and Midwest Divisions have new Vice Directors as of January 1. The results of four contested elections for Director and Vice Director in three ARRL Divisions were announced on November 20, 2020, after ballots were tallied at ARRL Headquarters.

In the Dakota Division, incumbent Matt Holden, KØBBC, lost his re-election bid to challenger Vernon "Bill" Lippert, ACØW. The vote was 982 to 485. Holden had served as Director since 2018.

In the Great Lakes Division, incumbent Director Dale Williams, WA8EFK, retained his seat in a challenge from Michael Kalter, W8CI. The vote was 1,840 to 1,398. In a three-way contest for Great Lakes Division Vice Director, Ohio Section Manager Scott Yonally, N8SY, received 1,670 votes to outpoll Jim Hessler, K8JH, with 975 votes, and Frank Piper, KI8GW, who received 611 votes. Incumbent Vice Director Tom Delaney, W8WTD, did not run for another term.

In the Midwest Division, Dave Propper, K2DP, is the new Vice Director. He received 1,164 votes to 623 votes for challenger Lloyd Colston, KC5FM.

Declared Elected Without Opposition

In the Atlantic Division, Director Tom Abernethy, W3TOM, who has held the seat since 2015, and Vice Director Bob Famiglio, K3RF, elected to a 3-year term (2015 – 2018) and then appointed in 2019 to fill a vacancy when the incumbent stepped down.

Michelle Patnode, W3MVP, of the ARRL Headquarters staff was among those helping to count Director/Vice Director election ballots on November 20. [Eric Casey, KC2ERC, photo]

In the Dakota Division, Vice Director Lynn Nelson, WØND, in office since 2018.

In the Delta Division, Director David Norris, K5UZ, who's served since 2012, and Vice Director Ed Hudgens, WB4RHQ, appointed in 2013.

In the Midwest Division, current Vice Director Art Zygielbaum, KØAIZ, will become the new Director in January. He was unopposed to succeed Rod Blocksome, KØDAS, who stepped down last year. Zygielbaum had been Vice Director since 2014.

New York City-Long Island Section Manager Re-Elected

New York City-Long Island Section Manager Jim Mezey, W2KFV, was re-elected in the fall Section Manager election cycle. Ballots were counted in November at ARRL Headquarters. Mezey, of Carle Place, received 527 votes to 136 for challenger Donnie Katzovicz, W2BRU. The race for NYC-LI SM was the only contested election. Mezey began a new 2-year term of office on January 1. He has served as New York City-Long Island Section Manager since 2013.

In the West Central Florida (WCF) Section, Michael Douglas, W4MDD, is the new Section Manager. The only nominee for the post, Douglas was currently Affiliated Club Coordinator, a Technical Specialist, and an Official Emergency Station. WCF Section Manager Darrell Davis, KT4WX, did not run for a new term after serving for the past 6 years.

These incumbent Section Managers were the only candidates for re-election and began new terms on January 1: Tom Walsh, K1TW (Eastern Massachusetts); Cecil Higgins, ACØHA (Missouri); Matt Anderson, KAØBOJ (Nebraska); Thomas Dick, KF2GC (Northern New York); Marc Tarplee, N4UFP (South Carolina); Tom Preiser, N2XW (Southern New Jersey), and Joe Shupienis, W3BC (Western Pennsylvania).

ARRL Asks FCC to Allow 3.4 GHz Operation Until Spectrum is Occupied

In comments to the FCC, ARRL has argued that radio amateurs be allowed to continue shared operation in the 3.4 GHz band until 5G licensees who purchase the spectrum when the FCC puts it up for auction initiate incompatible operations. In its *Further Notice of Proposed Rulemaking* (*FNPRM*) in WT Docket 19-348, the FCC had proposed to sunset the band for amateur radio in two phases, governed by when new licenses are issued rather than when the new licensees begin to use the spectrum. In the *FNPRM*, the FCC solicited comments on whether alternatives exist to its proposal.

"Amateur activities further the public interest and should be permitted to continue on a secondary basis unless and until a new primary licensee is ready to occupy the spectrum in a preclusive manner," ARRL told the FCC. "At a minimum, amateur operations should be permitted to continue indefinitely in the 3.3 – 3.45 GHz spectrum, where no new flexible licenses are under immediate consideration. The Commission could consider whether a registration or other mechanism similar to that found in §97.303(g) would facilitate avoiding interference." §97.303(g) contains specific frequency-sharing requirements for the 2200- and 630-meter amateur bands.

"Amateurs often select the 3.4 GHz spectrum precisely because other spectrum choices are sub-optimum or simply not available. Amateurs also are only secondary users on most of the other spectrum suitable for similar purposes," ARRL said. "Links must be carefully engineered because of that secondary status, which applies to most of the 2.4 and all of the 5.8 GHz bands available to amateurs." ARRL emphasized the importance of allowing amateurs to continue to use the 3.4 – 3.45 GHz portion in particular.

ARRL pointed out that in many geographic areas it could be years before the 3 GHz spectrum is actually put into use by commercial users, and argued that amateur radio should be allowed to continue to operations on a secondary, non-interference basis as it has done for decades with federal primary users, until new uses actually begin, rather than when licenses are issued.

ARRL petitioned the FCC last November 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."

Yasme Foundation Announces Excellence Awards

The Yasme Foundation announced new recipients of the Yasme Excellence Award last fall. They are Brett Ruiz, PJ2BR, and Helena Ruiz, PJ2ZZ; Bob Wilson, N6TV; Jari Perkiömäki, OH6BG, and Jim Brown, K9YC. The Yasme Excellence Award recognizes individuals and groups who, through their own service, creativity, effort, and dedication, have made a significant contribution to amateur radio. This may be a technical, operating, or organizational achievement.

Brett and Helena Ruiz have been active leaders of the VERONA Radio Club, Curaçao's International Amateur Radio Union (IARU) member-society, for more than 20 years. Their participation has included technical activities, disaster preparedness and relief, and training of potential radio amateurs. They serve as liaisons to government and international organizations, and contribute to important events, such as the Global Amateur Radio Emergency Communications Conference (GAREC) and IARU conferences and meetings. Brett Ruiz is also active in long-distance VHF propagation and digital communication.

Yasme recognized Bob Wilson, N6TV, for his technical support to hundreds of hams through various

The YASME FOUNDATION
www.yasme.org

radio manufacturers' user groups and logging software communities, and for assistance to Reverse Beacon Network (RBN) hosts in keeping their equipment configured and running. He also provides invaluable support to traveling hams worldwide. "Along with being technically talented, he is exceptionally selfless in using that talent to help others; quick to encourage others in many areas," the Yasme Foundation said in announcing the awards.

Jari Perkiömäki, OH6BG, has volunteered to support the online *VOACAP* software and website for nearly 20 years, making world-class HF propagation prediction and modeling services available to any radio amateur. "He believes in teamwork, acknowledging the contributions and ideas from the ham community for further development of the service, but especially from James Watson, MØDNS/HZ1JW, and Juho Juopperi, OH8GLV," Yasme said. Perkiömäki estimates that *VOACAP* online serves thousands of users from more than 100 countries every month, including integration with the DX Summit and Club Log services.

Jim Brown, K9YC, was cited for his extensive contribution to amateur radio regarding ferrite materials and their use in combating RF interference, feed-line applications, and transformers. "His efforts to improve transmitter performance and operating practices are also greatly appreciated, as are the extensive set of personal publications available to the public and performing reviews of technical material for amateur radio publishers," Yasme said.

In Brief...

- **"The Gathering" will be the theme for the 2021 Dayton Hamvention®.** Hamvention General Chair Rick Allnutt, WS8G, said the theme reflects what has been missing from our lives most of this year. "We have spent the last 6 months being bound to our houses and small groups," he said. "We are very optimistic that when May arrives, we will be allowed to get together." Allnut, a medical doctor with a Master's degree in public health, said Hamvention management is closely following the coronavirus situation and believes it will improve enough by May that government restrictions on travel and large groups will be relaxed. The Hamvention team will continue to follow developments. Hamvention 2021 will be held May 21 – 23 at the Greene County Fairgrounds and Expo Center in Xenia, Ohio.

- **Lee Finkel, KY7M, is the New *National Contest Journal* (*NCJ*) editor.** He began his tenure with the magazine's January/February issue. An ARRL publication, *NCJ* is in its 48th year. Finkel, the 17th Editor, takes over the reins from Scott Wright, KØMD, a noted and regular amateur radio contester, who has helmed *NCJ* since January 2017. "My hope is that I will be able to build on Scott Wright's hard work and that of my other predecessors, the very supportive ARRL staff, and the impressive cadre of columnists and other writers, to continue making *NCJ* a valuable resource for the contesting community," Finkel said. Most contesters will recognize his call sign from his regular contest activity. He's also been a contributing writer for *NCJ* and other publications. Finkel is a retired lawyer, mediator, arbitrator, and educator, and has been licensed since 1962.

- **Arecibo Observatory's 305-meter radio telescope suffered a fatal blow as the 900-ton instrument platform fell into the already damaged dish below on December 1.** No one was reported injured. Head of Telescope Operations Angel Vazquez, WP3R, called December 1 "indeed a sad day." He told ARRL that strands of the support cables remaining after one broke in August and fell into the dish "were starting to pop all weekend long, and it was just a matter of time." He said the instrument panel dome "was smashed like an eggshell." Vazquez said the observatory still has a 12-meter dish that will be used for radio astronomy, as well as a LIDAR Lab and an Optical Lab with photometers. "The site by no means is closed and it wasn't the intent of NSF to close the facility," he said.

FCC to Require Email Addresses on Applications

Amateur radio licensees and candidates will have to provide the FCC with an email address on applications, effective in mid-2021. If no email address is included, the FCC may dismiss the application as defective. The FCC is fully transitioning to electronic correspondence and will no longer print or provide wireless licensees with hard-copy authorizations or registrations by mail. A *Report and Order* (*R&O*) on "Completing the Transition to Electronic Filing, Licenses and Authorizations, and Correspondence in the Wireless Radio Services" in WT Docket 19-212 was adopted on September 16. The new rules will go into effect 6 months after publication in the *Federal Register*, which had not happened by the time this was written, but the FCC is already strongly encouraging applicants to provide an email address. When an email address is provided, licensees will receive an official electronic copy of their licenses when the application is granted.

Under §97.21 of the new rules, a person holding a valid amateur station license "must apply to the FCC for a modification of the license grant as necessary to show the correct mailing and email address, licensee name, club name, license trustee name, or license custodian name." For a club or military recreation station license, the application must be presented in document form to a club station call sign administrator who must submit the information to the FCC in an electronic batch file.

Under new §97.23, each license will have to show the grantee's correct name, mailing address, and email address. "The email address must be an address where the grantee can receive electronic correspondence," the amended rule will state. "Revocation of the station license or suspension of the operator license may result when correspondence from the FCC is returned as undeliverable because the grantee failed to provide the correct email address."

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 Palm, K1CE, k1ce@arrl.net

Public Service

Major Drills Demonstrate Evolving Partnerships with Red Cross and USGS

Subtropical Storm Theta, formed on November 10, made the 2020 Atlantic hurricane season the most active on record, and was the 29th named storm of the season. Activations by radio amateurs this past season showed the close ties between the amateur radio community and American Red Cross, which has a longstanding, formal memorandum of understanding and cooperation with ARRL.

The Red Cross and amateur radio connection got a boost this past year from two major Red Cross and Amateur Radio Emergency Service® (ARES) nationwide drills. This month's column will discuss the Red Cross and ARES Winlink messaging drill held on November 14, and the evolving relationship between the amateur community and the United States Geological Survey's (USGS) crowdsourced "Did You Feel It?" seismic activity reporting and assement program — also involving Winlink — demonstrated on ShakeOut Day 2020, held in October.

Juan Saer, YV4KW, from Valencia City, Venezuela, operated Winlink for the American Red Cross and ARES Nationwide Emergency Communications Drill on November 14, 2020. [Wayne Robertson, K4WK, photo]

November Messaging Drill

The Red Cross and ARES Winlink messaging drill in November was a demonstration of ARES and other operators' abilities to send digital messages in the official Red Cross message format (ARC-213) to Red Cross Divisional Clearinghouses via Winlink, the hybrid radio and email network. This ability supports radio amateurs, as well as the Red Cross shelter managers they serve, in getting messages to regional and upper ranks of the organization.

Participating operators used a variety of Winlink modes on HF, VHF, UHF, and Telnet (most modes are available with virtual terminal node controllers) to become familiar with Winlink and its associated message templates, including the ARC-213 found in the Winlink subfolder of form templates. The drill provided a minimum of 9 hours for each operator to create and send their single message. The scenario involved major weather events that caused outages and hazardous conditions across the country.

The fall drill featured streamlined requirements. The organizers developed a three-level performance structure for Basic, Intermediate, and Advanced Winlink capability. The Winlink Workshop Series training events were held on the popular SEC-ARES Zoom meetings prior to the drill to help operators get up to speed. Winlink training events are expected to continue into the future as interest in the digital message system grows.

Impressive Results

Red Cross Divisional Clearinghouse managers reported 1,750 messages sent by 1,550 amateur radio operators in 47 states, Puerto Rico, Venezuela, and Canada (about double the number of the successful spring drill). Messages were sent to seven Divisional Clearinghouses — Northeast, Atlantic, Southeast, Southwest, Pacific, Central, and Hawaii — using Winlink tactical call signs. Each operator was asked to send a message with basic information using an ARC-213 message template. The Venezuelan station demonstrated that Winlink HF can be used to communicate internationally during an emergency. Planning is under way for a spring 2021 drill.

Winlink Upgrade Prompted by Drill

For my participation in the Red Cross and ARES Winlink messaging drill, I filled out the American Red Cross message form (ARC-213 template) according to the easy-to-follow instructions provided by the drill organizers and uploaded it to my Winlink message outbox. The 40-meter band Radio Mail Servers (RMS) gateway stations were busy, and I ended up sending my message via Telnet Winlink. I tried using the WINMOR Winlink mode unsuccessfully (it had been retired earlier in the year in favor of faster, more robust virtual terminal node controllers such as VARA HF Winlink). I downloaded the VARA HF 4.0 software, learned how to set it up and use it with my Winlink Express platform, and enjoyed immediate success in sending and receiving messages.

ShakeOut 2020

This year's nationwide earthquake drill, ShakeOut 2020, was held October 15, and was a success for amateur radio operators who used the Winlink network and "Did You Feel It?" (DYFI) report template to send 175 reports to the USGS. Most of the reports were received from southern and central California, Washington, and Hawaii.

Amateurs practiced sending DYFI reports via Winlink to USGS from simulated areas without internet access: ARES operators from the northeast district of Los Angeles, California (ARES LAX Northeast) aggregated DYFI reports via VHF using a gateway, which then auto-forwarded the reports on HF to out-of-area gateways with internet connections. The Ventura, California, ARES/Auxiliary Communications Service and ARES LAX High Desert District relied on individual HF stations to send reports out of area. These groups demonstrated flexibility and adaptability of their efforts based on variations of local conditions.

USGS created a web page that showed the amateur radio responses in southern and central California, with the clusters of responses from Los Angeles County, Ventura County, and San Diego County (**https://earthquake.usgs.gov/scenarios/eventpage/usares20_1_se/dyfi/intensity**). For a given area, 20 or more responses allowed for a decent estimate of earthquake intensity in that area. Transmitting a critical mass of DYFI reports to USGS in a timely manner was a core objective achieved during ShakeOut 2020. Timely information is of the essence, as DYFI data informs ShakeMap and Pager, two USGS products that are used by governments, non-governmental organizations, public and private companies, and the public to assess the impact of seismic events and organize their responses. During ShakeOut, the bulk of DYFI reports were sent in the first hour after the simulated earthquake had occurred, achieving a second objective of ShakeOut 2020 for amateur radio operators.

Thanks to Drill Organizers

Special thanks to organizers Wayne Robertson, K4WK, of the American Red Cross, and Mike Walters, W8ZY, of Connecticut ARES, for their contributions to this article, and the other organizers of the Red Cross/ARES Nationwide Emergency Communications Drill that captured the attention of the US and international amateur radio communities.

I'd like to also thank Oliver Dully, K6OLI, District Emergency Coordinator for the ARES LAX Northeast District, for his contribution to the DYFI program and ShakeOut 2020 discussion.

Field Organization Reports

November 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**.

577
WA7PTM

520
N9VC

480
WA3EZN

469
W7PAT

440
KD8TTE

349
KE8BYC

261
NI2W

260
KB2RTZ
KW9EMG

258
W9GRG

245
W0PZD

240
AL0Y

237
W3GWM

236
N2WGF
AD8CM

235
KT2D

223
KD2LPM

201
WA2CCN

200
KD2NMG
ND8W

191
W9RY

190
WB9WKO
KM8V

175
W2PH
KB3YRU
WD8USA

160
K0RCJ
KE8KOC

159
KB8RCR

157
WM2C

156
W8IM

150
W8MAL
W4DNA
WO2H

145
W8DJG

143
WA2BSS

140
WB9QPM
N8SY
KK3F
K4IWW

139
AI9F
KD8ZCM

135
W3YVQ
N5MKY

131
KY2MMM

130
WA4VGZ
AC0KQ
K9LGU
W7EES
N1LL
NA7G
KW1U
WK4WC
N2JBA

129
KB5PGY

127
KD2GRS

125
AG9G

123
W4CMH

120
W4NWT
N0UMP
WC4FSU
WA0QLW
W0LAW
K2TV
K3JL
K1XFC
KB8PXM
KA9QWC
N7IE
KY2D

115
AD3J
N1TF

111
N3KRX

110
W1XK
KD0HHN
AD4DO
KA9MZJ
KC9FXE
K1HEJ
AB8MW
KC8WH
N3SW
AF4NC
N2DW
WB1NAL
KB1NMO
K3IN
N1IQI
W1RVY
KB2QO
K6HTN
KD2IWN
WB8TQZ

108
K8MDA

105
W2PAX

101
AC8NP

100
WB4RJW
KZ8Q
KN9P

NX9K
KD8UUB
WB8SIQ
K3RC
AA3SB
N1LAH
KC1KVY
WB6UZX
W3CJD
KJ7BHO
KB2YAA

99
N2LC
WV5Q

98
AB3WG

96
KC1HHO

95
W9EEU

93
KC8YVF

92
KV8Z
WX2DX

91
KA9IKK
WB8YYS
K7OED

90
KM4WHO
K9GDF
K8KRA
KB8HJJ
W3ZR
AB9ZA
K8MIY
KD2JKV
K2MJF
KA2HZP
W2AH
AA3N
K2EAG
W2JPS
WD0BFO
WB8WKQ
K8ED

89
W4TTO
N6IET

88
N4ZM

86
N8CJS

85
KF5LMJ
N3JET
KE1ML
KF7GC
WD0DBK

84
KA1G

83
W9BGJ

81
W4INK
WA1LPM
K8RDN

80
WA1URS
WB4ZDU
KL7RF
KD8UOT
N8MRS
KC1MSN
KG7QWR
WB8R

78
KA2GQQ

77
AA4XZ
KD2GXL
N3RB

76
KN4AAG
W5XX

75
K0FBS
K1STM

73
K4FHR
KE4DRF

71
NV1N

70
K6RAU
KT5SR
KB8PGW

The following stations qualified for PSHR in previous months, but were not reported in this column: (Oct.) KF5LMJ 120, KT5SR 87. (Aug.) KF5IOU 110, KE5YTA 105.

Section Traffic Manager Reports

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

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: ENY, IN, KY, MDC, MI, MN, MO, MS, ND, NLI, NM, NNJ, NV, OH, OR, PAC, SCV, SFL, SJV, SNJ, STX, UT, VA, VI, WCF, WI, WMA, 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.

KY2D 2,937, NX9K 1,602, WB9WKO 945, KW1U 879, K6HTN 855, W3CJD 518.

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

Contest Corral

February 2021

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

Start - Finish				Bands	Contest Name	Mode	Exchange	Sponsor's Website
Date	Time	Date	Time					
1	0000	1	0100	3.5-14	K1USN Slow Speed Test	CW	Name, SPC, 20 WPM max	www.k1usn.com/sst.html
1	2000	1	2130	3.5	RSGB 80-Meter Club Championship, SSB	Ph	RS, serial	www.rsgbcc.org/hf
2	0100	2	0159	1.8-50	Worldwide Sideband Activity Contest	Ph	RS, age group (OM, YL, or youth)	wwsac.com/rules.html
2	0200	2	0400	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqrp.blogspot.com
2	1700	2	1900	3.5-14	RTTY OPS Weeksprint	Dig	Other station's call, your call, serial, name	rttyops.wordpress.com
3	1300	3	1400	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
3	1700	3	2000	144	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
3	1900	3	2000	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
3	2000	3	2100	3.5	UKEICC 80-Meter Contest	Ph	6-char grid square	ukeicc.com/80m-rules.php
4	0300	4	0400	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
4	1800	4	2200	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	nrricontest.no/index.php
4	2000	4	2200	1.8-50	SKCC Sprint Europe	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
5	0145	5	0215	1.8-21	NCCC RTTY Sprint	Dig	Serial, name, QTH	www.ncccsprint.com
5	0230	5	0300	1.8-21	NCCC Sprint	CW	Serial, name, QTH	www.ncccsprint.com
6	0000	7	2359	1.8-UHF	Vermont QSO Party	CW Ph Dig	RS(T), county or SPC	www.ranv.org/vtqso.html
6	0001	7	2359	28	10-10 International Winter Contest, SSB	Ph	Name, mbr or "0," SPC	www.ten-ten.org
6	0300	6	1200	1.8-28	EurAsia HF Championship	CW Ph	RS(T), 6-char grid square	www.eurasia-contest.com
6	1200	7	1200	1.8	KCJ Topband Contest	CW	RST, JA Prefecture/District or continent	www.kcj-cw.com/e_index.htm
6	1200	7	1200	3.5-28, 144	F9AA Cup, CW	CW	RST, serial	www.site.urc.asso.fr
6	1200	7	2359	3.5-28	Mexico RTTY International Contest	Dig	RST, XE state or serial	www.rtty.fmre.mx
6	1400	6	2359	1.8-28	Minnesota QSO Party	CW Ph Dig	Name, county or SPC	www.w0aa.org/mnqp-rules
6	1400	6	2359	1.8-28	FYBO Winter QRP Sprint	CW Ph Dig	RS(T), SPC, name, power, temperature	arizonascqrpions.apps-1and1.com
6	1600	6	1800	3.5-28	FISTS Saturday Sprint	CW	RST, SPC, name, mbr or "0"	fistsna.org
6	1600	6	1900	3.5	AGCW Straight Key Party	CW	RST, serial, class, name, age	alt.agcw.de/index.php/en
6	1600	7	2359	1.8-28	British Columbia QSO Party	CW Ph Dig	RS(T), VE7 District or SPC	orcadxcc.org/bcqp_rules.html
6	2300	7	0300	3.5-14	North American Sprint, CW	CW	Other station's call, your call, serial, name, SPC	ncjweb.com
8	1300	12	2359	All, no WARC	ARRL School Club Roundup	CW Ph	RS(T), class (I/C/S), SPC	www.arrl.org/school-club-roundup
10	0130	10	0330	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
10	1700	10	2000	432	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
10	2000	10	2130	3.5	RSGB 80-Meter Club Championship, Data	Dig	RST, serial	www.rsgbcc.org/hf
13	0000	14	2359	3.5-28	CQ WW RTTY WPX Contest	Dig	RST, serial	www.cqwpxrtty.com
13	1000	14	1000	1.8-28	SARL Field Day Contest	CW Ph Dig	RS(T), # of transmitters, category, QTH	www.sarl.org.za
13	1100	13	1300	7, 14	Asia-Pacific Spring Sprint, CW	CW	RST, serial	jsfc.org/apsprint/aprule.txt
13	1200	14	1200	1.8-28	Dutch PACC Contest	CW Ph	RS(T), province or serial	pacc.veron.nl
13	1200	14	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
13	1400	15	0200	All	YLRL YL-OM Contest	CW Ph Dig	Serial, RS(T), SPC	ylrl.org/wp/yl-om-contest
13	1500	14	1500	1.8-28	OMISS QSO Party	Ph	RS, SPC, mbr or "none"	omiss.net/Facelift/qsoparty.php
13	1900	13	2059	1.8-28	Feld Hell Sprint	Dig	RST, name, mbr, QTH, grid	sites.google.com/site/feldhellclub
13	1900	13	2300	1.8	RSGB 1.8-MHz Contest	CW	RST, serial, district code (if UK/EI)	www.rsgbcc.org/hf
13	2300	14	2300	1.8-14	AWA AM QSO Party	Ph	Name, SPC	antiquewireless.org/homepage
14	0000	14	2359	1.8-7	PODXS 070 Club Valentine Sprint	Dig	Name, OM/YL, SPC	www.podxs070.com
14	1300	14	1700	3.5, 7	Balkan HF Contest	CW Ph	RS(T), serial	arabih.ba
15	0100	15	0259	3.5-14	CQC Winter QSO Party	CW	RST, SPC	coloradoqrpclub.org/contests
15	0100	15	0300	1.8-28	4 States QRP Group Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqrp.com
15	2000	15	2130	3.5	RSGB FT4 Contest Series	Dig	4-char grid square	www.rsgbcc.org/hf
17	1900	17	2030	3.5	AGCW Semi-Automatic Key Evening	CW	RST, serial, 2-digit year first used a bug	alt.agcw.de/index.php/en
20	0000	21	2359	1.8-28	ARRL International DX Contest, CW	CW	W/VE: RST, SP. Non-W/VE: RST, power	www.arrl.org/arrl-dx
20	1200	21	1159	1.8-28	Russian PSK WW Contest	Dig	RST, oblast or serial	www.rdrclub.ru
21	2100	21	2300	3.5-28	FISTS Sunday Sprint	CW	RST, SPC, name, mbr or "0"	fistsna.org
21	2300	22	0100	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
24	0000	24	0200	1.8-50	SKCC Sprint	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
24	2000	24	2100	3.5	UKEICC 80-Meter Contest	CW	6-char grid square	ukeicc.com/80m-rules.php
25	2000	25	2130	3.5	RSGB 80-Meter Club Championship, CW	CW	RST, serial	www.rsgbcc.org/hf
26	2200	28	2200	1.8	CQ 160-Meter Contest, SSB	Ph	W/VE: RS, SP. DX: RS, CQ Zone	www.cq160.com
27	0600	28	1800	3.5-28	REF Contest, SSB	Ph	RS, department or serial	concours.r-e-f.org/reglements
27	1200	28	1200	3.5-28	FTn DX Contest	Dig	RST, SP or serial	europeanft8club.wordpress.com
27	1300	28	1300	3.5-28	UBA DX Contest, CW	CW	RST, serial, province (if ON)	www.uba.be/en
27	1500	28	0159	1.8-50	South Carolina QSO Party	CW Ph Dig	RS(T), county or SPC	scqso.com
27	1800	28	0559	3.5-28	North American QSO Party, RTTY	Dig	Name, SPC	www.ncjweb.com
27	1800	28	0559	3.5-28	NA Collegiate Championship, RTTY	Dig	Name, SPC	www.w9smc.com/nacc
28	1400	3	0800	1.8-144	Classic Exchange, CW	CW	Name, RST, SPC, rig manuf/model	www.classicexchange.org
28	1400	28	1700	3.5-28	High Speed Club CW Contest	CW	RST, mbr or "NM"	www.highspeedclub.org
28	1500	1	0059	3.5-144	North Carolina QSO Party	CW Ph Dig	County or SPC	ncqsoparty.org/rules

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.*

Rus Healy, K2UA, k2ua@arrl.net

2020 ARRL 10 GHz and Up Contest Results

This year's ARRL 10 GHz and Up Contest took place August 15 – 16 and September 19 – 20, 2020.

Logs Received by Call Area

Call Area	Entries
0	14
1	22
2	8
3	10
4	2
5	8
6	21
7	3
8	10
9	10
VE	14

Top Ten Scores

10 GHz Only		10 GHz and Up	
Call	**Score**	**Call**	**Score**
WB0LJC	45,662	W6QIW	53,001
N6RMJ	37,663	N9JIM	45,753
W6DL	35,899	AF1T	41,643
KB8U	28,329	W1MKY	39,165
W9FZ	25,149	K9PW	38,485
KA9VVQ	24,078	KD6W	36,981
K6WCI	22,821	VA3ELE	33,288
N5BF	21,419	K2UA	33,159
AF6NA	19,240	K2DH	32,514
N0KP	18,707	VA3TO	31,765

Best Terrestrial DX by Band

Call	Band	Distance (km)
N6RMJ	10 GHz	673
N9JIM/W6QIW	24 GHz	284
KA1NKD/KA1OJ/N1JEZ/W1FKF	47 GHz	126
K8ZR/KA1NKD/W1FKF	75 GHz	93
AF1T/K1RZ/K3WHC/K8ZR/W1MKY	123 GHz	8

Full Results Online

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

Andrew Mitchell, VA3CW, enjoyed his first microwave contest during the 2020 ARRL 10 GHz and Up Contest. He set up his 10 mW transverter in grid square FN03, and completed two 10 GHz contacts with Andrew Flowers, KØSM, in grid square FN12 — a 219-kilometer path. [Andrew Mitchell, VA3CW, photo]

Call Area Leaders

10 GHz		10 GHz and Up	
Call	**Score**	**Call**	**Score**
Area 0		**Area 0**	
WB0LJC	45,662	WA0CNS	390
W9FZ	25,149	AF4JF	390
KA9VVQ	24,078		
N0KP	18,707		
N0UK	16,637		
Area 1		**Area 1**	
W1AIM	14,255	AF1T	41,643
K1GX	10,431	W1MKY	39,165
N1DPM	6,606	W1GHZ	26,845
K1TR	6,033	N1JEZ	22,819
K1ZE	5,601	W1FKF	20,888
Area 2		**Area 2**	
K0SM	13,053	K2UA	33,159
N2WK	12,964	K2DH	32,514
N3RG	9,458	N2MG	25,796
		KA2LIM	14,128
		W2FU	11,216
Area 3		**Area 3**	
WA3GFZ	13,869	K1RZ	29,223
WA3PTV	6,335	W3SZ	11,141
NN3Q	6,195	W3HMS	2,685
K3WGR	3,949		
W3EKT	2,879		
Area 4			
W3IP	5,963		
N9ZL	5,143		
Area 5		**Area 5**	
WQ5S	8,620	W5LUA	8,156
W5VY	3,339	AA5C	6,969
WA5TKU	712	AA5AM	3,929
K5SOP	435		
N5RJX	242		
Area 6		**Area 6**	
N6RMJ	37,663	W6QIW	53,001
W6DL	35,899	N9JIM	45,753
K6WCI	22,821	KD6W	36,981
N5BF	21,419	N6TEB	21,489
AF6NA	19,240	K6ML	16,625
Area 7			
W7GLF	2,221		
KD7UO	903		
NJ7A	241		
Area 8		**Area 8**	
KB8U	28,329	K8ZR	25,621
WA8VPD	925	WB8TGY	14,611
W8RU	687	K3SIW	14,098
		K2YAZ	13,179
		KB8VAO	9,617
Area 9		**Area 9**	
K0KFC	18,271	K9PW	38,485
WA2VOI	15,205	W9SZ	14,901
WA9TT	12,416	AA9IL	9,968
W8BYA	10,730		
K9TMS	5,385		
Area 15 (Canada)		**Area 15 (Canada)**	
VE3KH	16,064	VA3ELE	33,288
VE3FN	6,048	VA3TO	31,765
VE3EG	4,162	VE3SMA	22,703
VA3CW	1,613	VE2UG	19,988
VE7FYC	1,352	VE3FHM	10,264

Top Unique Call Leaders

10 GHz		10 GHz and Up	
Call	**Unique Calls**	**Call**	**Unique Calls**
N5BF	35	K2DH	52
N6RMJ	35	K1RZ	50
W6DL	34	K2UA	49
K1GX	32	K8ZR	49
K6WCI	31	AF1T	48
W1AIM	30	N2MG	47
AF6NA	29	W1MKY	47
WA3GFZ	28	W1GHZ	44
VE3KH	27	K3WHC	38
KB8U	22	W6QIW	38
N2WK	22		

Top Ten QSO Leaders

10 GHz	
Call	**Total QSOs**
WB0LJC	166
N6RMJ	148
W6DL	112
KB8U	110
W9FZ	98
KA9VVQ	95
N0UK	88
K6WCI	88
N0KP	83
K0HAC	77
N5BF	77

10 GHz and Up	
K9PW	200
VA3ELE	198
W6QIW	197
VA3TO	188
K2UA	159
N9JIM	155
VE3SMA	150
AF1T	145
K8ZR	142
K2DH	140
W1MKY	140

Best DX by Band in Kilometers

10 GHz		47 GHz	
Call	**Best DX**	**Call**	**Best DX**
N6RMJ	673	KA1NKD	126
VA3ELE	671	KA1OJ	126
VA3TO	671	N1JEZ	126
W8BYA	671	W1FKF	126
AF1T	670	K3SIW	112
K2UA	670	K9PW	112
W1MKY	670	VA3ELE	104
W3IP	670	KB8VAO	98
N5BF	669	VE2UG	98
W6QIW	669	K8ZR	98
		VA3TO	98

24 GHz		75 GHz	
Call	**Best DX**	**Call**	**Best DX**
N9JIM	284	K8ZR	93
W6QIW	284	KA1NKD	93
KB6BA	257	W1FKF	93
AF1T	243	W5LUA	23
KA1NKD	243	AA5AM	23
N1JEZ	243	WB8TGY	19
W1FKF	243	KB8VAO	8
W1MKY	243		
W1EX	243		
K2DH	240		

123 GHz	
Call	**Best DX**
K1RZ	8
K8ZR	8
W1MKY	8
AF1T	8
K3WHC	8
K2UA	4
K2DH	4
N2MG	4

Brian Thorson, AF6NA, set up his 10 GHz equipment on the 16th-floor balcony of his hotel room in San Diego, California. He completed a 640-kilometer contact with Jim Moss, N9JIM — his best DX contact in the contest. [Brian Thorson, AF6NA, photo]

The next ARRL 10 GHz and Up Contest will be held August 21 – 22 and September 18 – 29, 2021.

Paul Bourque, N1SFE, n1sfe@arrl.org

2020 ARRL 222 MHz and Up Distance Contest Results

This year's event was held August 1 – 2, 2020.

Regional Winners

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

Region	Category	Call	Score
1	R	KE7MSU/R	8,965
	SOF	VE7FYC	8,115
2	SOF	W7ID	1,160
3	R	K6MI/R	17,670
	SOF	W6TV	16,418
	MOF	WB6HUM	944
4	SOF	K7ULS	16,077
5	R	K6VHF/R	3,161
	SOF	K7EME	13,642
	MOF	KC5MVZ	150
6	R	K0BBC/R	1,220
	SOF	W7XU	19,587
7	SOF	K0TPP	14,653
8	R	W5VY/R	18,705
	SOF	K5LLL	26,250
9	R	K9JK/R	15,933
	SOF	K2DRH	104,952
	MOF	K9JK	3,232
10	R	W0ZQ/R	103,459
	SOF	AC0RA	34,012
11	R	NN3Q/R	74,495
	SOF	KE8FD	33,575
	MOF	W2RME	756
12	R	AG4V/R	40,461
	SOF	N4QWZ	38,442
13	R	NV4B/R	15,402
	SOF	KU4XO	9,784
	MOF	N4SVC	43,424
14	SOF	K1RZ	138,437
15	R	K1DS/R	14,439
	SOF	N3RG	72,705
16	R	W1RGA/R	29,206
	SOF	K1TEO	191,602
17	No Entries		
18	No Entries		

Affiliated Club Competition

Club	Score	Entries
Medium		
Mt. Airy VHF Radio Club	463,892	12
North East Weak Signal Group	278,432	12
Northern Lights Radio Society	223,350	15
Society of Midwest Contesters	144,329	5
Florida Weak Signal Society	55,937	3
The Ontario VHF Assn.	47,333	6
North Texas Microwave Society	40,805	3
Pacific Northwest VHF Society	32,287	11
Arizona VHF Society	29,216	4
DFW Contest Group	5,732	3
Southern California Contest Club	2,792	4

Top Ten Scores

Single Operator, Fixed		Multioperator, Fixed		Rover	
K1TEO	191,602	N4SVC	43,424	W0ZQ/R	103,459
K1RZ	138,437	K9JK	3,232	K9PW/R	81,544
K2DRH	104,952	WB6HUM	944	NN3Q/R	74,495
N3RG	72,705	W2RME	756	AG4V/R	40,461
AF1T	67,625	KC5MVZ	150	W1RGA/R	29,206
W3SZ	61,177			W5VY/R	18,705
WZ1V	47,054			K6MI/R	17,670
N1JEZ	41,474			K9JK/R	15,933
N4QWZ	38,442			NV4B/R	15,402
AC0RA	34,012			K1DS/R	14,439

The next ARRL 222 MHz and Up Distance Contest will be held August 7 – 8, 2021.

Full Results Online

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

Pat Patterson, Jr., W5VY, operated Rover during the 2020 ARRL 222 MHz and Up Contest. He operated seven bands from 222 MHz through 10 GHz. Pat was able to work Steve Clark, AG4V, on all seven bands over a 72-kilometer obstructed path. He reported his best DX contact was two 730-kilometer contacts with Greg Carter, KX4R, on 222 and 432 MHz. [Pat Patterson, Jr., W5VY, photo]

Certificate of Code Proficiency Recipients

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

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, WBØIXV	25
Albert H. Ziegler, KD2ST	25
William R. Gardner, KØUG	40

November 2020

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

Congratulations to all the recipients.

February 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.

February Qualifying Runs will be transmitted by W1AW in Newington, Connecticut at the times shown at 1.802.5, 3.581.5, 7.047.5, 14.047.5, 18.097.5, 21.067.5, 28.067.5, 50.350, and 147.555 MHz. The West Coast Qualifying Runs are tentatively scheduled to be transmitted by KH6TU on Wednesday, February 24 at 6 PM HST (0400 UTC on February 25) on 7047.5 and 14047.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 40 WPM.

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

Legibly copy at least 1 minute of text by hand, and mail the sheet to: W1AW Qualifying Runs, 225 Main St., Newington, CT USA 06111.

Include $10 (check or money order) if this is a submission for your initial Code Proficiency certificate; $7.50 if you are applying for an endorsement (available for speeds up to 40 WPM). Your test will be checked against the actual transmissions to determine if you have qualified.

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

Monday	Tuesday	Wednesday	Thursday	Friday
2/1 4 PM – 2100Z 10 – 35 WPM	**2/2** 7 PM – 0000Z **(2/3 – UTC)** 35 – 10 WPM		**2/4** 10 PM – 0300Z **(2/5 – UTC)** 10 – 40 WPM	**2/5** 9 AM – 1400Z 10 – 35 WPM
	2/9 4 PM – 2100Z 10 – 35 WPM	**2/10** 7 PM – 0000Z **(2/11 – UTC)** 10 – 40 WPM	**2/11** 9 AM – 1400Z 35 – 10 WPM	**2/12** 10 PM – 0300Z **2/13 – UTC)** 10 – 35 WPM
	2/16 9 AM – 1400Z 10 – 35 WPM	**2/17** 10 PM – 0300Z **(2/18 – UTC)** 35 – 10 WPM	**2/18** 7 PM – 0000Z **(2/19 – UTC)** 10 – 35 WPM	**2/19** 4 PM – 2100Z 10 – 40 WPM
2/22 10 PM – 0300Z **(2/23 – UTC)** 10 – 40 WPM		**2/24** 9 AM – 1400Z 35 – 10 WPM	**2/25** 4 PM – 2100Z 35 – 10 WPM	**2/26** 7 PM – 0000Z **(2/27 – UTC)** 10 – 35 WPM

Bernie McClenny, W3UR, w3ur@arrl.org

How's DX?

Tribute to John Devoldere, ON4UN

Johan "John" A. Devoldere was born in 1941. He first became interested in amateur radio when he was 11 years old, thanks to his uncle Gaston Geirnaert, ON4GV, who was John's mentor. Gaston supplied young John with surplus World War II radio components, and by age 12, John had built his first transmitter.

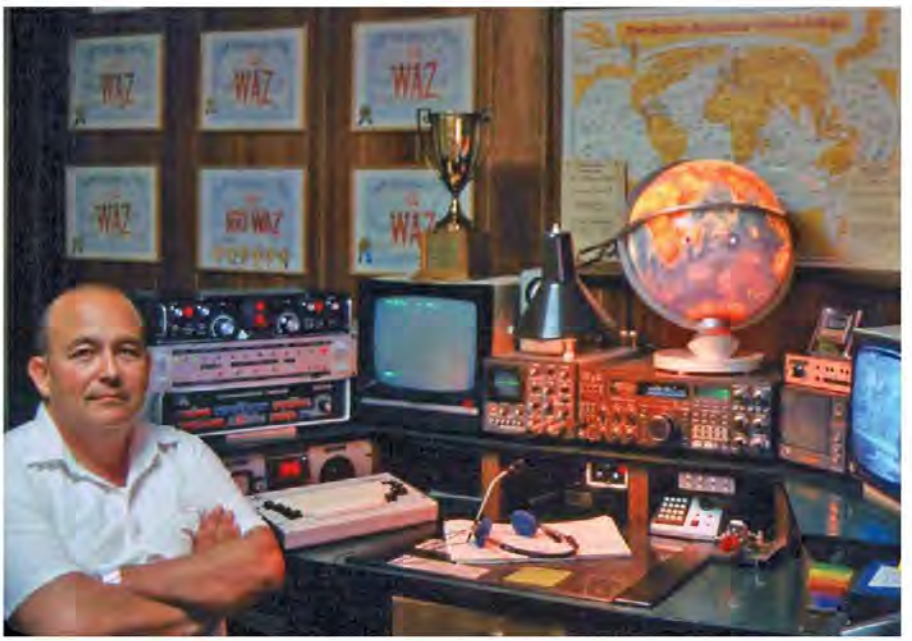
John Devoldere, ON4UN, in his shack in 1962. [Photo courtesy of Marleen Devoldere]

John was first licensed at age 20 in 1961 as ON4UN. His first station was all homebrew, except the receiver, a Geloso G209. His first station was at his parents' home using a Hy-Gain 12AVS three-band vertical and dipoles for 40 and 80 meters. His first contest win was in February 1962 in the UBA CW Contest, sponsored by the Union Royale Belge des Amateurs-Emetteurs, Belgium's IARU society.

80 Meters

In the early 1960s, John began DXing on 80 meters and had his 100th country within 5 years, while still operating from his parents' home with an 18-meter-tall quarter-wave vertical. He later earned the number one DXCC certificate for this band.

Less than 5 years later, he had confirmed his second 100 countries on the 80-meter band. In 1968, he married Frieda, and they moved into their own home. He reached the 300 level on 80 meters in 1977. By 2018, John had reached an amazing 364 DXCC entities on 80 meters, six countries ahead of the number two 80-meter DXers. The only current entity John did not work on 80 meters was North Korea (P5). John obtained the Five Band DXCC award in 1978 and the Five Band Worked All States award the following year. Early in 1979, *CQ* Magazine introduced the Five Band Worked All Zone award, and by June of that same year, John was the first DXer to win the award. John was the fourth DXer to earn the 80-meter Worked All Zone award.



John Devoldere, ON4UN, in his shack in 1989, with his growing collection of award certificates hung on his wall. [Marleen Devoldere, photo]

John Devoldere, ON4UN, had a collection of over 140,000 QSL cards. His own QSL card was made up of compiled photos celebrating his amateur radio career. [Photo courtesy of Bernie McClenny, W3UR]

160 Meters

In 1987, Belgian amateur radio operators gained authorization to the 160-meter band, and John was seeking a new challenge because he then had 325 countries on 80 meters. John set up a 25-meter-tall vertical and 12 Beverage antennas ranging from 150 to 300 meters long, and by the end of the first year, John had logged some 159 countries on 160 meters. John erected a 39-meter quarter-wave vertical on 160 meters in 1991. His DXCC record on Top band showed 200 (1990), 250 (1993), 300 (2005), and 325 (2018).

In the preface of his first edition of *ON4UN's Low Band DXing*, John credited the "knowledge [he] had accumulated on 80 meters" for his success in earning the Top Band. To get all DXCC entities, John only needed 23 current ones, including Scarborough Reef (BS7), North Korea (P5), Crozet Island (FT#W), and 20 more in the Pacific. By 1988, John had reached the 160-meter Worked All Zones award (#3) and the 160-meter Worked All States award. John's most memorable 160-meter contacts included FOØCI, FK8CP, FT5ZR, 3YØPI, JTØXC (for his last zone), and each time he worked his friend Jack, KH6CC.

Other Accomplishments

John was very high in the ARRL SSB DXCC standings with 340/373 (current/total) entities confirmed. He had 373 confirmed on SSB, 352 on CW, 356 on 40 meters, and 370 on 20 meters. John also worked and confirmed all 3,086 US counties on SSB. John was not only a DXer, but a serious contest competitor. His most successful contesting took place between 1993 and 2008, with over a dozen worldwide first-place finishes and 54 first-place finishes in Europe. John was inducted first into the CQ Contest Hall of Fame in 1997 and then into the CQ DX Hall of Fame in 2008. He was one of only four people to be inducted into both.

Author

John wrote many articles throughout his life. In 1977, he wrote *80 Meter DXing*, a booklet published by *Radio* magazine. A year later, he wrote the *80 Meter DX Handbook*, followed by a second edition the year after. He also wrote five editions of *Low Band DXing*, the first in 1987 and the last in 2010, with some 650 pages. John also teamed up with his good friend Mark Demeuleneere, ON4WW, with their guidebook, *Ethics and Operating Procedures for the Radio Amateur* (see **www.hamradio-operating-ethics.org**), which has since been translated into 40 different languages.

ON4UN Gives Back

In addition to being a great DXer, contester, and author, John also gave back to our hobby. He served as the president of UBA, Belgium's IARU society, from 1998 to 2007. John was also a member of UBA's HF Committee from 1983 to 2016. Many who worked the 1997 VKØIR DXpedition to Heard Island will remember John was the European Pilot Station and was the liaison between the DXpedition team and the rest of the amateur radio community.

The Passing of a Low-Band Titan

Throughout 2020, John's health had steadily deteriorated, and in his last days, John was with his family before passing on November 9. He was 79.

I had the pleasure of meeting John multiple times at Ham-Com (W5DXCC) and the Dayton Hamvention. John had a good sense of humor and loved to take photos. The first time we met, he called me Barney, and though I corrected him, he also teasingly said "Hello, Barney," each time we spoke. John will be missed by his many friends around the globe, but he has left an amazing legacy for generations to come. Those who missed the digital farewell ceremony on November 21 can view it at **https://cmore.be/afscheid-john-devoldere**.

Wrap-Up

That's it for this month, with thanks to Marleen Devoldere and ON4WW for their input. If you have any news, photos, or club newsletters, please forward them to **bernie@dailydx.com**. Until next month, see you in the pileups! — *Bernie, W3UR*

Jon Jones, NØJK, n0jk@arrl.org

The World Above 50 MHz

Fall VHF Grid Expeditions

Rover Road Trip

Wyatt Dirks, ACØRA, operated a rover on a 3-day road trip and grid expedition on 6 meters (see Figure 1). He went on the second weekend of November, operating from 11 different spots and covering 1,900 miles over 13 grids. "I consulted the FFMA (Fred Fish Memorial Award) most-wanted grid map and set a route covering grids in Wisconsin, Minnesota, and South Dakota," Wyatt said. He took advantage of the 6-meter propagation and meteor scatter, using a three-element Yagi and KW amplifier with MSK144 in *WSJT-X*. He made contacts with FFMA chasers, reaching a total of 282 contacts with MSK144, with the exception of one FT8 contact.

I, NØJK, worked Wyatt in EN28 on 6 meters using MSK144 on November 14 at 1554Z. I saw him calling N3XX and KG5JJ. Wyatt's activity shows that you can be successful going on a grid expedition on 6 meters any time of year using meteor scatter.

Portable from Rare Grid EM07

Larry Lambert, NØLL, conducted a fixed portable rare grid operation for FFMA enthusiasts in mid-October (see Figure 2). Larry chose this time to take advantage of the Orionid meteor shower. While meteors are present year-round, they are more plentiful during a meteor shower. The Orionids is typically not a major

Figure 1 — Wyatt Dirks, ACØRA, went on a 6-meter MSK144 meteor scatter grid expedition, including a stop in northern Minnesota (EN28) on November 14, 2020. [Wyatt Dirks, ACØRA, photo]

Figure 2 — Larry Lambert, NØLL, operated from a wheat field near Stafford, Kansas. [Larry Lambert, NØLL, photo]

shower like the Perseids or Geminids. Rates can be up to 20 – 30 meteors an hour. The Orionids are among the fastest meteors at 67 kilometers per second. Thus, they can support higher MUF paths and "long meteor burns." The peak of the 2020 Orionid meteor shower was predicted to be the morning of October 21.

Larry operated from a wheat field near Stafford, Kansas. He ran only 70 W to a five-element Yagi on 6 meters. The first evening (October 20) Larry worked KO9A (EN52) and AB9LM (EM59) on MSK144. The next morning, Larry made 40 contacts. He had near misses with N2QT in FM07 and worked W3IP (FM19). He gave NØAKC (EN44) his last grid in the "EM field." His best DX was with XE2AT (DL81). Larry called him 23 times before completing the contact. He worked AAØMZ (EM29) and NØJK (EM28) on tropo. His last contact was with KE7NR (DM33). He made about 70 contacts in all.

In trying to distinguish between everyday meteors and Orionids meteors, Larry noted, "I have come to decide Orionids come in groups with several minutes between groups. Most of the time, random meteors are weaker but more predictable."

Larry appreciates the assistance of Mayor Julie Clark, who is also manager of the Stafford Motor Inn. She helped in arranging his wheat field operating location.

On the Bands

50 MHz. The Leonid meteor shower peaked on November 17. Like the Orionids, the Leonid meteors are fast. But they were sparse this year. Rich, K1HTV, was on and said:

> I had much more success with the Orionids than with the Leonids. I was on for the predicted peak time just before 1100Z, but according to Ping Jockey, everyone was having poor results with the Leonids at that time.

Figure 3 — A DX map that shows several 50 MHz contacts on November 22. [**dxmaps.com**]

> Then around 1230Z, things got much hotter with plenty of rocks flying on 6 meters. I went up to 2-meter MSK144 and got a few PSKR flags, but I didn't make any contacts. I went back to 6-meter MSK144 and I spotted a number of Ø and 9 land calls on Ping Jockey. I quickly made contacts with VE1SKY in FN74, WGØG in EN35, and K2DRH in EN41, but it certainly wasn't a shower to write home about.

Rich was able to observe the Leonid meteor shower storm in 1966, and said it was something he would never forget. He said, "The peak has thousands of rocks per minute. On 2 meters it sounded like there was sporadic E in all directions out to 1,200 miles from northern WØ states to Florida. It was a once in a lifetime opening." There were good Leonid showers in 1999, 2001, and 2002. The next potentially strong Leonid shower will be in 2034. But sadly in 2028, the planet Jupiter is predicted to disturb the Leonid stream. The 2034 Leonid meteor shower likely will not be a storm. It may be 200 years before another Leonid meteor shower storm is observed.

Larry, NØLL (EM09), noted some sporadic E on November 20. Larry made 12 FT8 contacts to Alabama and Georgia. Ron, K3FR (FM18), caught his first 6-meter opening via E_s that evening out to Oklahoma working N5WX (EM15) and KG5JJ (EM26). On November 22, XE1MEX worked E51DL (see Figure 3), and Lance, W7GJ (DN27), worked ZL1RS (RF64) in New Zealand. ZL1RS peaked to –5 dB. This could have been a result of sporadic-E connecting to afternoon TEP across the Pacific Ocean. Lance noted that the K index was 5, and sporadic-E occurred in the Midwest and along the west coast. The next day, Nelson, KD2CYU (FN20), made 20 contacts via westward E_s to Texas. K3FR in Virginia made nine contacts via E_s to Kansas, Missouri, Oklahoma, and Texas. Ron uses a Moxon antenna and Icom-7100. He was first licensed in 1959, and he isn't used to 50 MHz. Ron said, "Overall, I'm having a great time getting acquainted to a new band." On November 25, AC4TO (EM70) worked stations in Brazil, including PY1MHZ and around 0100z. This may have been E_s linked to a TEP opening.

144 MHz. On November 12, Sam, K5SW (EM25), found tropo to KR4SO (EM50) in Mississippi and WA3GWK (EM60) in Alabama at 904 kilometers on SSB. Carl, N4PY (EM96), worked into New England via tropo on November 27. He logged W1VLF and WA1EAZ on FT8 running 80 W to a 10-element Yagi at 30 feet.

902 MHz. Ron, W9ZIH, worked WD9BGA on 902.1 MHz using a handheld transceiver connected to his 432 MHz Yagi at 150 kilometers and duplex with 10 GHz.

Here and There

Ken Kucera, KAØY, recently became a Silent Key. Ken was a pioneer in 432 MHz EME with a 12.8-meter dish antenna from Iowa. In May of 1979, Ken earned his 2-meter Worked All States award (#9).

Kari Leino, OH2BC, installed the world's largest cross-polarized 6-meter array consisting of eight long Yagis.

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!

Jan. 9 – Feb. 14, 0001Z – 2359Z, N4DAB, Daytona Beach, FL. Daytona Beach CERT ART. **2021 Daytona 500/Speedweeks**. 14.255 14.070 7.255 7.070; phone, CW, and digital. Certificate & QSL. DB CERT ART/Steve Szabo, WB4OMM, License Trustee, 536 Central Park Blvd., Port Orange, FL 32127-1136. *See website for QSL and certificate information. Operating hours dependent on propagation and availability.* **www.n4dab.com**

Jan. 15 – Feb. 15, 0000Z – 2359Z, KL7RST, various cities, 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. *Participating call signs: KL7RST, KL7RST/KL7, VY1RST/KL7, VE8RST/KL7, and VY0RST/KL7. Certificate by email for working any three stations when you QSL.* **www.qrz.com/db/k7ice**

Jan. 23, 1700Z — 2100Z, various call signs, various cities, TX. Deep East Texas Amateur Radio Club Inc. **1st Annual Lone Star Frozen POTA Event**. All modes, all bands. QSL. Dayton Jones, KG5TKF, email or see website for information. **www.parksontheair.com** *or* **kg5tkg.radio@gmail.com**

Feb. 1 – Feb. 28, 0000Z – 2359Z, N9SES, Lake Station, IN. Arab QRZ Club. **JY1 Special Event Memorial Station 2021**. 14.250 14.030 7.185 7.030; HF/VHF/UHF, all modes. QSL. Ayman Azar, 2861 Decatur St., Lake Station, IN 46405. *See website for participating stations from other countries.* HamSphere *users can also participate in the event.* **www.n9ses.com/?page_id=18**

Feb. 6, 0900Z – 1500Z, K3HWJ, Punxsutawney, PA. Punxsutawney Amateur Radio Club. **Ground Hog Day Special Event**. All bands, all modes. Certificate. Stephen Waltman, KB3FPN, 37 Clark St., Brookville, PA 15825. **www.punxyclub.com**

Feb. 6 – Feb. 7, 1400Z – 2359Z, K5C, Nacogdoches, TX. Nacogdoches Amateur Radio Club. **Shuttle *Columbia* Special Event**. 28.350 21.350 14.260 7.216. QSL. Army Curtis, 167 CR 2093, Nacogdoches, TX 75965. *All contacts will be confirmed via LoTW.* **www.w5nac.com**

Feb. 6 – Feb. 27, 1800Z – 2359Z, W6UW, San Jose, CA. Santa Clara County Amateur Radio Association. **100th Anniversary**. 21.320 14.250 7.250. Certificate. Don Village, K6PBQ, 3290 Woody Ln., San Jose, CA 95132. **w6uw@arrl.net** or **www.qsl.net/sccara**

Feb. 7, 1200Z – 2359Z, KD2FSI, Randolph, NJ, KD2FSI. **Commemorating Howard E. Anthony, Father of Heathkit**. 21.300 14.300 7.300 3.900. QSL. David R. Hackett, 3 High Ridge Rd., Randolph, NJ 07869. *We will operate using a variety of vintage Heathkit gear to commemorate the life and legacy of Howard E. Anthony, father of the Heathkit brand of electronic kits. Check Facebook operating schedule.* **davehackett@cs.com** or **https://www.facebook.com/dave.hackett.9085**

Feb. 13, 1400Z – 2000Z, W4B, Fredericksburg, VA. Stafford Amateur Radio Association. **George Washington's Birthday at his Boyhood Home, Ferry Farm**. 14.225 7.195 447.275. QSL. Stafford Amateur Radio Association, P.O. Box 6331, Fredericksburg, VA 22403. **www.ws4va.org**

Feb. 13 – Feb. 15, 1400Z – 2355Z, W0JH, Stillwater, MN. Stillwater (MN) Amateur Radio Association. **Ice-olation Station W0JH**. 21.360 14.260 7.260 3.860. Certificate. Via email only: **Ice2021@radioham.org**. *We will have multiple stations simultaneously operating on different bands and different modes. In keeping with COVID-19 social distancing protocols, we will operate from our individual QTHs this year.* **www.radioham.org** *or* **www.qrz.com/db/w0jh**

Feb. 13 – Feb. 21, 0000Z – 2359Z, W7P, Flagstaff, AZ. Northern Arizona DX Association. **I ♥ Pluto Special Event**. 14.290 21.290 7.290 14.090. Certificate & QSL. W7P — I ♥ Pluto Special Event, Bob Wertz, NF7E, 6315 Townsend Winona Rd., Flagstaff, AZ 86004-1493. *This will be an annual countdown special event to the 100th anniversary of the discovery of Pluto, held every February, up to and including 2030.* **www.nadxa.com**

Feb. 20 – Feb. 22, 2000Z – 2000Z, WS7G, George, WA. Columbia Basin DX Club. **George Washington's Birthday**. 14.322 14.255 7.222 7.260 3.960 3.855. QSL. Brian Nielson, 11650 Road 1 SE, Moses Lake, WA 98837. *Commemorating George Washington's birthday from the city of George, in the state of Washington.* **cbn.homestead.com/WS7G.HTML**

Feb. 27, 1400Z – 2200Z, W0EBB, Leavenworth, KS. Kickapoo QRP Amateur Radio Club. **17th Annual Freeze Your Keys Winter Operating Event**. 14.325 14.058 7.240 7.035. QSL. Gary Auchard, 34058 167th St., Leavenworth, KS 66048. **w0mna74@gmail.com** *or* **www.qrz.com/db/w0ebb**

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 **May** *QST* would have to be received by **March 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**.

Convention and Hamfest Calendar

A = AUCTION
D = DEALERS / VENDORS
F = FLEA MARKET
H = HANDICAP ACCESS
Q = FIELD CHECKING OF QSL CARDS
R = REFRESHMENTS
S = SEMINARS / PRESENTATIONS
T = TAILGATING
V = VE SESSIONS

Abbreviations

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

Florida (Brooksville) — Feb. 20 D H R T V
8 AM – 4 PM. *Spr:* Hernando County ARA. Sand Hill Scout Reservation, 11210 Cortez Blvd. (Hwy. 50). *TI:* 146.715. *Adm:* $6, $5 with coupon. **www.hcara.org**

Florida (Punta Gorda) — Mar. 6 F H R T
7:30 AM – 1 PM. *Spr:* Peace River Radio Assn. Punta Gorda Boat Club, 802 W. Retta Esplanade. *TI:* 147.255. *Adm:* $6. **www.prra.club**

7th ANNUAL TECHCON
February 26 – 27, Winter Haven, FL
Fri. 1 – 5 PM, Sat. 9 AM – 5 PM. *Spr:* ARRL West Central Florida Section. Polk County Emergency Operations Center, 1890 Jim Keene Blvd. *TI:* 146.985, 443.9, 444.625, 444.95 (127.3 Hz). *Adm:* Free. **www.arrlwcf.org/wcf-special-events/wcftechconference**

Georgia (Dalton) — Feb. 27 D F H R S T V
8 AM – 2 PM. *Spr:* Dalton ARC. North Georgia Agricultural Fairgrounds, 500 Legion Dr. *TI:* 145.230 (PL 141.3 Hz). *Adm:* $5. **www.facebook.com/events/624779201744768**

Kentucky (Cave City) — Mar. 6 D F H Q R T V
7:30 AM – 3 PM. *Spr:* Mammoth Cave ARC. Cave City Convention Center, 502 Mammoth Cave St. *TI:* 146.94. *Adm:* $6. **www.ky4x.org**

Minnesota (St. Cloud) — Feb. 13 D H R S V
9 AM – 1 PM. *Spr:* St. Cloud ARC. Eagles Aerie #662, 730 41st Ave. N. *TI:* 147.015 (100 Hz). *Adm:* $10. **www.w0sv.club/hamfest**

Ohio (Elyria) — Mar. 7 D H R
8 AM – noon. *Spr:* Northern Ohio ARS. Lorain County Community College, 1005 N. Abbe Rd. *TI:* 146.7 (110.9 Hz). *Adm:* $7.

Oklahoma (Elk City) — Mar. 6 D F H V
8:30 AM. *Spr:* West Central OK ARC. Gathering Place, 916 S. Main St. *TI:* 146.76 (88.5 Hz). *Adm:* $5. **www.sites.google.com/view/wcoarc**

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

Strays

ARRL Centurion Award

Elizabeth "Betty" Oakberg, N4LZL, recently received the ARRL Centurion Award at the age of 102. She started in radio as a shortwave listener (SWL) and then earned her Novice-class license in the late 1970s when she neared retirement as an elementary school teacher in Oak Ridge, Tennessee. Within 5 years, she upgraded to an Amateur Extra-class license. During her more active hamming years, she earned a Worked All States Award, made the DXCC Honor Roll, received the Austrian OE-100 Award, and contacted the MIR space station, among other achievements.

As a longtime member of the Oak Ridge Amateur Radio Club, she served as an officer for several years and regularly participated in ARRL Field Day. She was also a frequent check-in with the American Foreign Service Net and really enjoyed that aspect of ham radio.

The ARRL Centurion Award plaque was given to her in November 2020. Once pandemic restrictions ease up, a formal presentation will be arranged.

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.

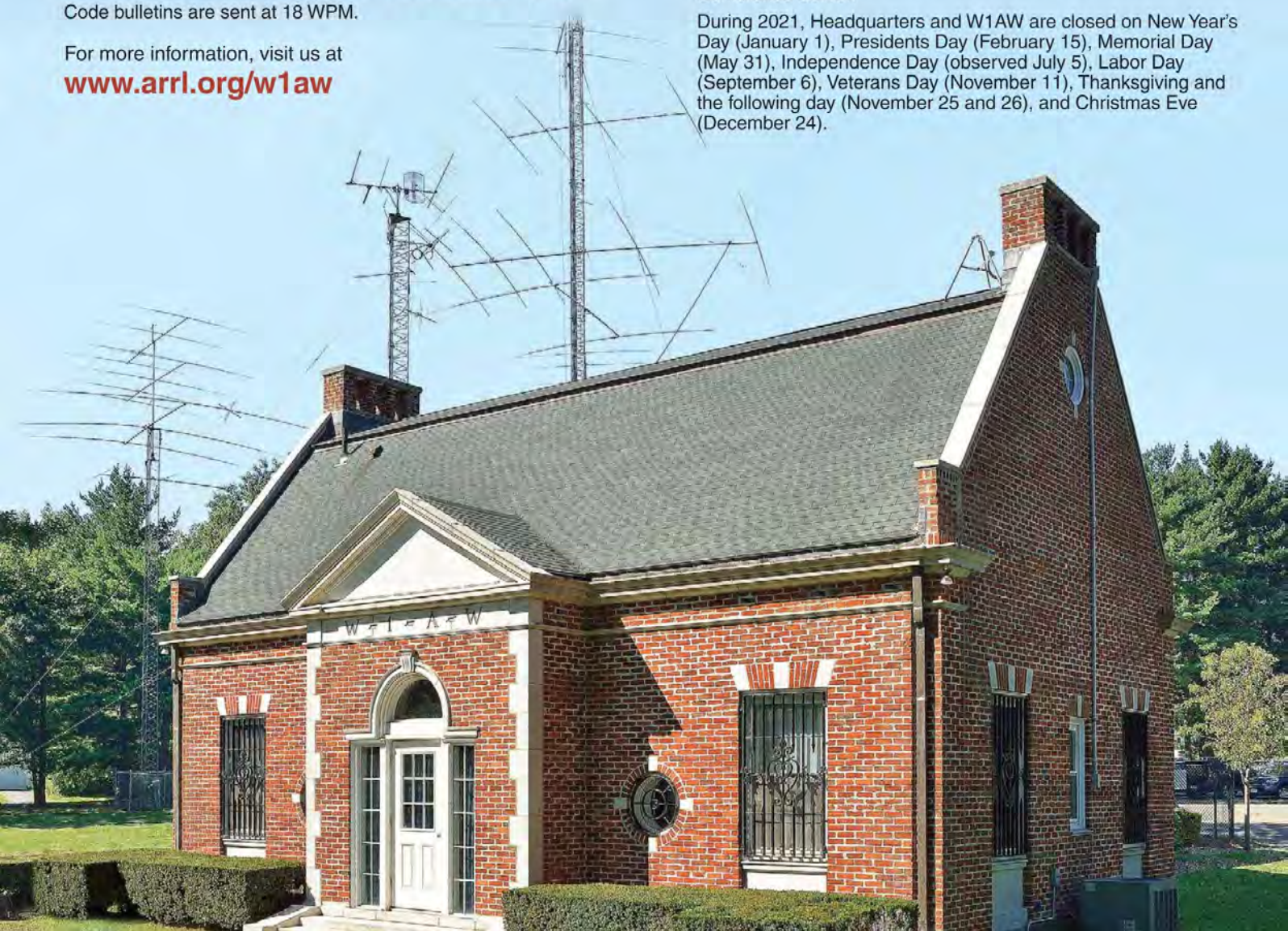
Keplerian elements for many amateur satellites will be sent on the regular digital frequencies on Tuesdays and Fridays at 6:30 PM Eastern time using Baudot and PSK31.

♦ 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.

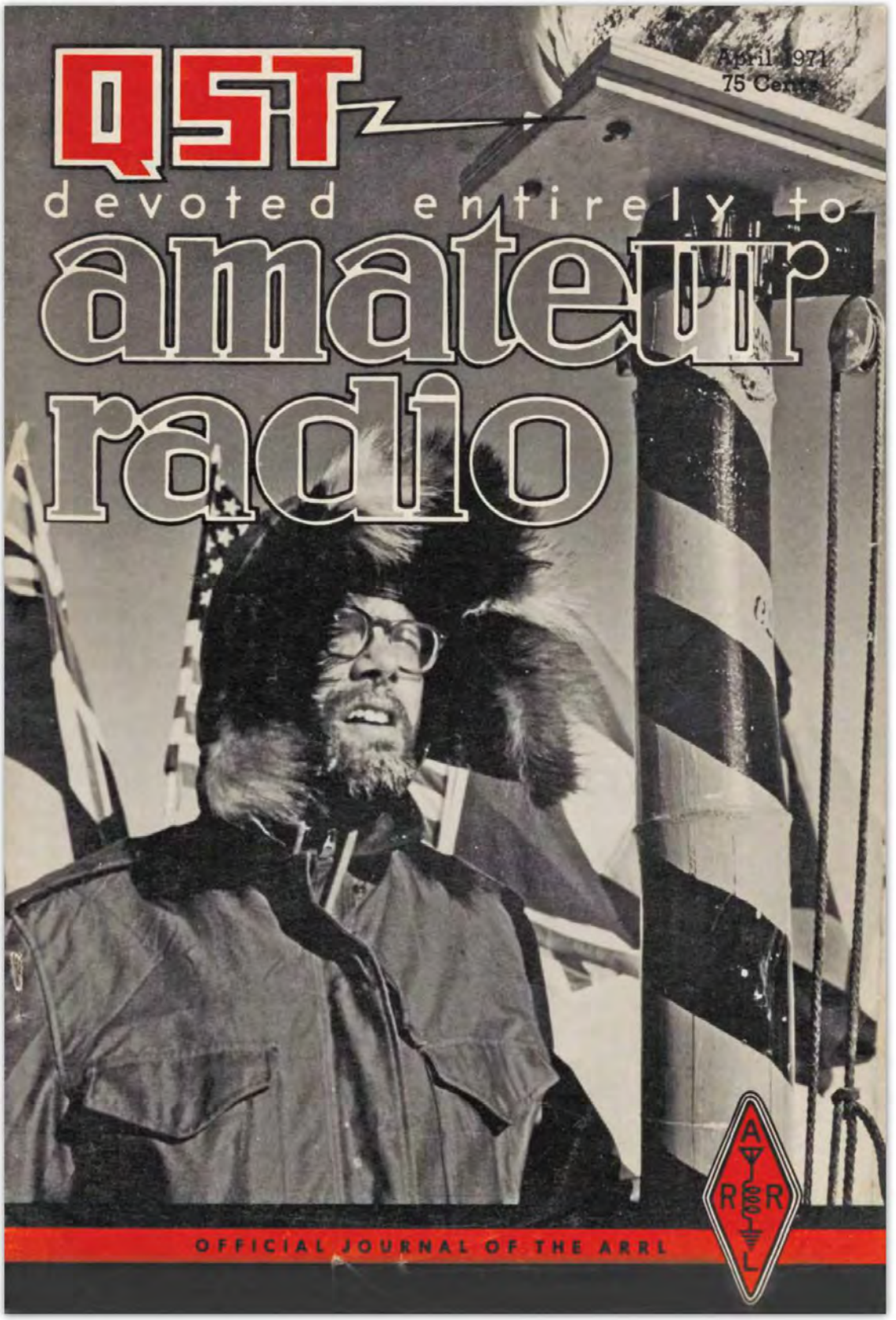
♦ Notes: On Fridays, UTC, a DX bulletin replaces the regular bulletins. W1AW is open to visitors 10 AM to noon and 1 PM to 3:45 PM Monday through Friday. FCC-licensed amateurs may operate the station during that time. Be sure to bring a reference copy of your current FCC amateur license. In a communication emergency, monitor W1AW for special bulletins as follows: voice on the hour, teleprinter at 15 minutes past the hour, and CW on the half hour.

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

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



A Look Back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A R R L

The Two-Meter Eggbeater

Omnidirectional Horizontal Antenna of Simple Design

BY DAVE THORNBURG,* WA2KZV/WA1MJD AND LES KRAMER,** WA2PTS/WA1JWN

WHEN OPERATING 2-meter mobile in the East the problem of antenna polarization is encountered frequently. The simple whip is vertically polarized, and most home station antennas not used for fm are horizontal. An omnidirectional horizontally-polarized antenna is desirable. Current 2-meter designs widely used include halos, turnstiles, and Big Wheels. WA2KZV, who had been experimenting with antennas for several years, decided to try a variation of the full-wave loop. The result described here provides the desired radiation pattern, and it is fairly easy to construct. It has performed very well.

Electrical Description

The antenna is basically two circular full-wave loops, fed 90 degrees apart electrically, and placed at right angles mechanically. Each has two current maxima. With each loop oriented in a vertical plane and fed at the bottom, the polarization of the antenna is horizontal and the current maxima are at the top and bottom. This gives gain toward the horizon, as when separate antennas are stacked. The 90-degree phasing and right-angle placement of the elements give rise to the desired omnidirectional pattern.

The feed impedance of a full-wave loop is approximately 100 ohms. The two loops must be fed equal power, at 90 degrees out of phase, to produce the omnidirectional pattern. A convenient way to meet these requirements is to join the loops with a balanced line a quarter-wavelength long, of the same impedance as that of the loops, and feed one of the loops directly. A 100-ohm balanced line can be made of two pieces of 50-ohm coax, joining the braids at each end and feeding the inner conductors. With this arrangement, the impedance seen at either loop is then approximately half that of either one.

The balanced load must be converted to unbalanced, for feeding with coax. This may be done with a 1:1 balun, or another 100-ohm quarter-wave line may be used as a Q section to transform the 50 ohms to 200, and this fed through 50-ohm line and a conventional half-wave balun. This is the method we have used, as shown in Fig. 1.

Construction

A photograph of a complete "Eggbeater" is included, but details may be clearer from the drawings. The top insulator is optional, as the top is the voltage node of each loop. The insulating mount is a convenient way of supporting the elements, and it may help to prevent noise resulting from imperfect electrical grounding that might come from a metal mounting at the top. The feed points are supported on simple plastic blocks.

The loops were made from 3/16-inch diameter 1100-H alloy aluminum, 81 1/2 inches long. After these were passed through the top support the ends were flattened and drilled for the connections. The top support is 1 1/4-inch diameter polystyrene rod. Lengths of the Q section, phasing section and balun loop given in Fig. 1 are nominal values, assuming that the propagation factor of the coaxial line used is 0.66.[1] Even if the line used is rated as having this propagation factor, it can vary considerably, and dipping the sections for resonance in the band is recommended. A quarter-wave section of line is shorted with a small loop at one end, and left open at the other. Couple to the loop with the dipper coil to check the resonant frequency. Be sure to check the frequency calibration of your dipper. Some are far off in the vhf range.

All coax used in the Eggbeater construction was RG-58/U. The supporting mast was made from three telescoping sections of 6061-T6 alloy, 3/4, 7/8, and 1-inch diameter, .058-inch wall thickness.

*3 Elm Street, Natick, MA 01760
**133 Winthrop Street, Apt. 8, Framingham, MA 01701

[1]If foam-filled coax line is used, the velocity factor will be 0.81. EDITOR.

The "Eggbeater" uses two full-wave loops oriented and fed 90 degrees apart. Its pattern is essentially omnidirectional, with slight bulges perpendicular to the plane of each loop. Polarization is horizontal.

QST for

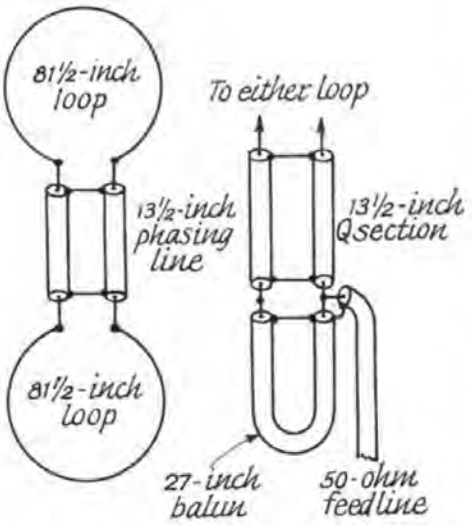

Fig. 1 — The two loops of the Eggbeater are fed 90 degrees apart, through a quarter-wave balanced phasing section. The 50-ohm feed system, right, includes a 4:1 balun and a quarter-wave *Q* section.

Connections and exposed ends of the coax were covered with RTV silicone rubber, sold in stores as bathtub caulk, for water-proofing. Finally, the entire antenna was painted, to help resist corrosion caused by salt spread on New England roads in winter.

Eggbeaters of this type have been built and used by WA2KZV, WA2PTS, and K1DRB, all with very encouraging results. In comparisons with a halo and a reference dipole on two occasions, on different paths, the Eggbeater was superior to the halo, and equal to the dipole when the latter was oriented for maximum signal. In mobile communication, it shows less flutter than the halo.

All three Eggbeaters show low SWR; less than 1.5:1 over the range of 144 to 146 MHz. The frequency response is broad, which is characteristic of full-wave loops. In addition to its excellent performance in mobile work, the Eggbeater should be a good choice for fixed-station service, where uncritical operation and omnidirectional pattern are desired, with horizontal polarization.

For inspiration and help in making measurements, we would like to thank WA1MFY, several operators at W1MX, and K9AQP/1. And last, but not least, Lew Collins, K4GGI/1 deserves credit for the name, "Eggbeater," which reduced the time required for on-the-air explanations of the antenna from a half hour to a half minute.

Some Observations with the Eggbeater

Never one to pass up a new or different idea for vhf mobile antennas, the undersigned built and tested several versions of the Eggbeater. Our loops were 1/8-inch hard aluminum wire, which just happened to come in coils about 2 feet in diameter. This expanded easily to the 27-inch diameter required, and maintained its shape well. A piece of fiber glass rod left over from another project was pressed into service as part of the vertical support. This kept metal out of the core of the loops, and simplified assembly. Half-inch aluminum fitted into the bottom end made up the rest of the support, and also was tried as part of a 1:1 balun, as explained later.

About Lengths

Loops 81 1/2 inches in length, recommended by the authors, worked well, but the impedance was high and the SWR was 2:1 or more, showing the lowest value at the high end of the band. This suggested too-short elements, so 83 inches was tried. The SWR was lower, but still was dropping at the high end — so we started digging for information on full-wave loops.

Perhaps the best available is given by Lindsay,[2] in a classic article on quads. He cites work done in Japan years ago, substantiated in much amateur work with quads and other full-wave loops, which gives the length in feet as

$$L = \frac{1005}{Freq.(MHz)}$$

[2]Lindsay, "Quads and Yagis," May, 1968, *QST*, Fig. II-6.

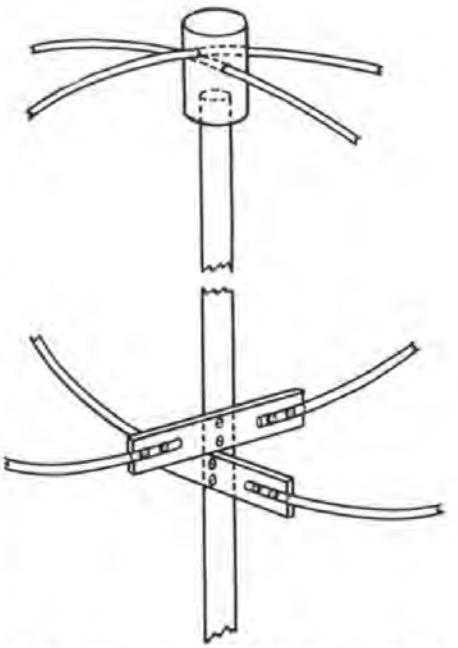

Fig. 2 — Principal details of the support for the mobile antenna. The top insulator and the blocks for fastening the element ends are of polystyrene. The main support is aluminum tubing.

This is for hf loops. In vhf service the ratio of loop circumference to conductor diameter becomes important. First we convert the formula to inches, using

$$L = \frac{12060}{Freq.(MHz)}$$

Then we multiply by the "shape factor," which for our dimensions is 1.04

$$L\ (inches) = \frac{12060}{145\ (MHz)} \times 1.04 = 86.5$$

Accordingly, we made two 86 1/2-inch loops, threading the ends so that 8-32 nuts could be used on each to hold lugs for connecting the feed system.

As suggested, we dipped the coaxial phasing, matching and balancing sections. The authors' recommendations of 13 1/2 and 27 inches are correct for coax of the propagation factor that RG-58/U is supposed to have, but it is well to check for sure. Two samples of RG-58/U from different manufacturers had to be cut to between 12 and 12 1/2 inches for the quarter-wave sections, and 24 to 25 inches for the balun, for resonance at 145 MHz.

First, a single 86 1/2-inch loop was fed through a 4:1 balun and 50-ohm line. It showed an SWR of 1.7+ across the band, indicating an impedance of about 115 ohms. This is close to the value for a full-wave loop given by Kraus.[3] Two loops at right angles, phased and fed as in Fig. 1, showed 1.5:1 across the band, as reported by the authors.

The very broad frequency response of the Eggbeater is reminiscent of experience years ago with the first Big Wheels. Both antennas are so broad that anyone who has worked with parasitic arrays extensively is almost convinced that these full-wave systems can't be working. As far as SWR checks are concerned, they might well be mistaken for dummy loads! In such antennas, small changes in element length make little observable difference in results.

[3]Kraus, *Antennas*, Fig. 6-12. McGraw-Hill, 1950.

Baluns

Our antennas were fed at first with the system shown in Fig. 1. Later the 1:1 balun idea was tried. The metal support, the top of which is just below the feedpoint of the loops, was used as one side of the balun. The outer sheath of the RG-58/U was cut at 19 inches down from the loops. A short length of No. 20 wire was wrapped around the outer conductor, and soldered in place. This was then soldered to a lug bolted to the aluminum support. Checks for rf on the outside of the coax showed that this balun was doing its job reasonably well.

The effective length of such a quarter-wave balun depends on how it is made. If the coax is taped to the metal support the length will have to be determined by experiment. If the coax and the support are separated, and held at a constant spacing with a minimum of insulation between them, the balun will be approximately a full quarter-wavelength. In view of the variables involved in the 1:1 balun, the authors' method (Fig. 1) seems the better choice.

Another and neater 1:1 balun, not tried in this instance but used with turnstiles in the past, involves running the coax inside a metal support. A self-tapping screw with a sharp point can be run through the support, at a point a quarter-wavelength down from the top, far enough to puncture the coax insulation and contact the braided outer conductor.

None of these baluns is particularly critical, nor does use or nonuse of them make a large difference in the performance of most mobile antennas. Too many fudge factors enter into typical amateur mobile installations to make the effect of such fine points very apparent. Especially with an antenna as uncritical as these full-wave loops, and with the short lines used in mobile setups, almost anything goes. – *W1HDQ*

Strays

After a recent showing of "Ham's Wide World" to members of the Theodore Roosevelt ARC, club sponsor and science department chairman, W8MPD, arranged to show the film to some of the English and communications classes. One teacher then made the assignment to his students to write an essay about the film. Here are some excerpts from their papers: If I had to rate this movie, 1 being bad, and 10 being good, I would rate it 2. First of all because it had no relevance to our English class and secondly, because I have no interest in ham radio. What's wrong with the telephone? . . . One of the faults of the movie was that there was too much beep-beep-beeping. This took away from watching the movie and was distracting. . . . Although I would not want to spend every Saturday with a ham set as some loyal hams do, this is definitely a hobby to look into. . . . It was a great movie with a lot of fast-moving speakers. The only bad part was that all of the actors in the movie were real hams. . . . Anyone who didn't know very much about hams certainly would after watching it. . . . When it first started, I didn't know what they were talking about. But by the end of the film I did. . . . There were two parts that I really enjoyed, they were when the young boys went out on a Saturday morning and tried to reach other people. The other part was when they were explaining about the cards. . . . It is good that schools have a radio club because then the students will be aware of the usefulness and the fun they can have using ham radio.

– . . . –

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Celebrating Our Legacy

50 Years of Radio

I earned my first license in 1964, at the age of 14. Before finishing high school I worked a lot of DX, thanks to the stellar sunspot conditions at the time. I had a Galaxy V transceiver connected to a TA-33 JR triband antenna on a 33-foot tower. I was always building new projects in the basement. I homebrewed a 500 W linear and a typewriter-style Morse code keyer built with early RTL logic.

Courtney Krehbiel, KD6X, 50 years after earning his ham radio license.

A career in electrical engineering was an easy choice due to my love for electronics. My first job was designing microwave frequency synthesizers that were used in defense industry advanced receiver systems. I was the interface between the digital miniature computers controlling the systems and the RF world.

With the progression of my career, marriage, and kids, my ham radio days slowed down, but I kept my license current. I missed being hands-on with the hardware and software. By the early 2000s, I wanted to get back into technical stuff and ham radio was right there waiting for me. I started building an Elecraft K2 transceiver and haven't looked back since. I'm now happily retired and have six grandchildren. Ham radio has been very good to me!

Courtney Krehbiel, KD6X
Carlsbad, California

A Career on the Air

I earned my Novice-class license just before turning 16. A year later, I earned my General-class license. I bought a new radio with money earned from working at McDonalds for $1.35 an hour.

In high school, I would stay up at night working DX instead of studying. Even in medical school studying to become a podiatric surgeon, I couldn't stay away from electromagnetic propagation. I taught television production at KVCR TV in San Bernardino, California, before becoming a traffic reporter in Los Angeles on KABC-AM, with "Dr. Roadmap" as my radio name.

While moving between a dozen different cities in California, I brought several radios along for the ride: a Heathkit HW-101, Swan 350, Heathkit SB-102, Yaesu FT-101, and a Kenwood TS-820. I currently work in IT as a database patching coordinator for an electric company in Phoenix, Arizona. I still use my first call sign and my original brass straight key!

David Rizzo, WB6WFV
Phoenix, Arizona

An Active Retirement

I earned my first ham radio license in 1970. I was in Navy electronics school near Virginia Beach, Virginia, and the base I was stationed at had a club station, K4NCP, nicknamed "Navy Coffee Pot." I'd been interested in amateur radio since I was about 12 years old.

After leaving electronics school, I was assigned to the Naval Submarine School (NSS) in Groton, Connecticut. I worked at the club station there, WA1DIU, nicknamed "Dummies in Uniform." When I was assigned to a nuclear submarine, I wasn't able to participate in amateur radio activities. I purchased a TEN-TEC CW transceiver to use when ashore, but because I lived in apartments, I wasn't able to install a usable antenna.

When my license expired I became inactive until 1984, when I earned my Technician-class license. Within the next few years, I earned my Advanced- and Amateur Extra-class licenses. I retired in 2016, and now live in Florida, where I belong to two very active clubs — Clearwater Amateur Radio Society (CARS) and Upper Pinellas Amateur Radio Club (UPARC). I have a modest HF/VHF/UHF station at home. As the sunspot cycle improves, I plan on becoming more active on HF.

There is no doubt in my mind that my early interest in amateur radio led me to a wonderful career in electronics, spending the last 25 years of my career in Silicon Valley as a computer systems engineer.

Gerry Pollack, WR6N
Palm Harbor, Florida

Naval Radio Operation

My radio journey began around the time I graduated from the US Navy Mass Communication Specialist class "A" school in Pensacola, Florida. I was stationed at Royal Air Force (RAF) Edzell in Scotland, with the Naval Security Group (NAVSECGRU) doing high-frequency direction finding. While in Scotland, I obtained a reciprocal license and operated CW and SSB from the base as GM5ASI from 1970 until 1972.

Daniel Flanagan operating with the call sign GM5ASI, in the early 1970s.

My present call sign, W3DF, was the call sign of FCC Commissioner George Sterling when he was a resident of Maryland. I've been active the past 52 years, aside from when my wife and I were raising our children. I've been continuously active on HF since 1997, operating mostly CW.

Daniel Flanagan, W3DF
Westminster, Maryland
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.

Dennis Lazar, W4DNN, w4dnn@arrl.net

Classic Radio

The Heathkit DX-40 and Hallicrafters S-38: Faithful Old Friends

The Heathkit DX-40

The DX-40 transmitter first appeared in Heathkit advertising in 1958. It sold as a kit for $64.95. That would be $574.56 in today's dollars. It was the perfect transmitter for a beginner because it included an AM phone modulator. It featured 75 W of input power with three switch-selected crystal positions. Later, after earning a General-class license, I added a VFO to operate on AM phone.

The circuitry of this transmitter was a combination of cost- and complexity-saving innovations. It consisted of a power supply, three RF stages, two dual-triode audio stages, and an RCA-6146 amplifier. An antenna tuner wasn't necessary because the Pi network output coupling could match a range of antenna impedance from 50 to 1,000 Ω. Later, I purchased a Heathkit SWR bridge to make tuning more accurate and convenient.

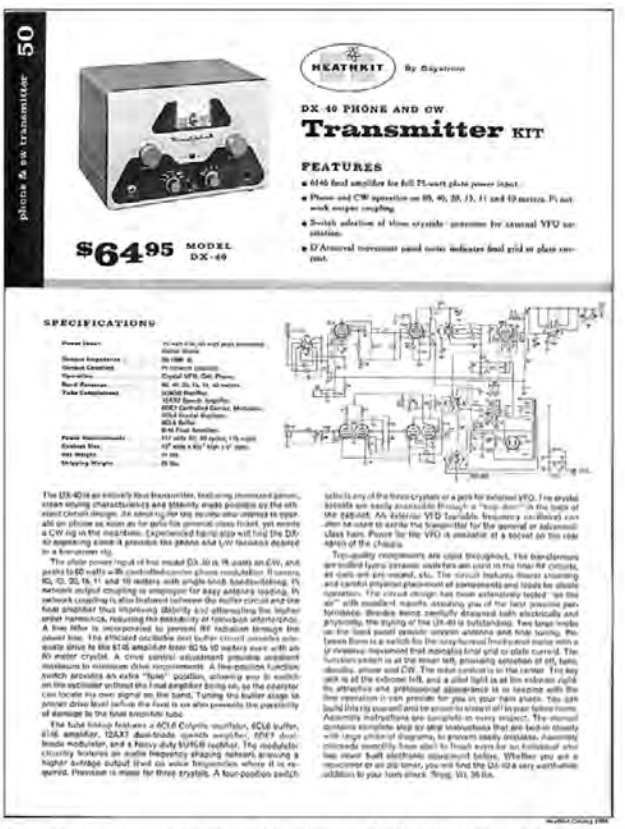
Controls were similar for all transmitters of that era. There was a key jack, a function switch, a band switch, grid drive control, a pilot light, final amplifier tuning, antenna tuning, and a meter switch. The microphone connector, crystal switch, output connector, VFO input, and auxiliary power socket were on the rear chassis apron.

Always seeking ways to make use of inexpensive components and less complex circuits, the engineers at Heathkit came up with some very clever and unusual designs. One was to run the 5U4GB full-wave rectifier above its maximum-rated plate voltage. Heathkit had tested this, and there weren't any problems. Also, power to the oscillator and buffer circuits were run in series directly from the 600 V supply, thus making a low-voltage supply unnecessary.

Heathkit took into consideration that these kits would be built by beginners. The manual stated, "The step-by-step instructions in this manual have been covered in considerable detail. Read each step completely through and be sure it is understood before proceeding. This will assure that a complicated step is performed in the proper sequence."

This advice helped me throughout my ham career as I built Heathkits ranging from the venerable 6-meter Benton Harbor Lunchbox to the HW8 QRP transceiver, the SB-200 600 W RF amplifier, and a very complex dual-

Dennis, W4DNN, operates this vintage station with the addition of the Vibroplex Bug.



HEATHKIT

DX-40 PHONE AND CW

Transmitter KIT

FEATURES

$64.95 MODEL DX-40

SPECIFICATIONS

An advertisement for the DX-40 in a 1958 Heathkit catalog.

trace oscilloscope. It was so sad to see this great resource bite the dust.

The Hallicrafters S-38

For many hams, the S-38 was their first introduction to the magic of the shortwave bands, foreign broadcasting, and then ham radio. When it first made its appearance in advertising in 1946, it was priced at $47.50 ($655.69 in today's dollars). I purchased mine for about $25.

This entry-level receiver was an ac/dc radio, which was very common at the time. That makes it a dangerous radio to mess with because there is no transformer to isolate the metal chassis from the power line. The S-38's six tubes function as a converter, an IF amplifier, a combination detector/AVC/AF, a BFO/ANL, an audio output, and a rectifier.

The S-38 could receive the AM broadcast band, shortwave, and amateur radio (with a band-spread dial to make tuning easier). It could receive CW with a fixed-frequency BFO (beat frequency oscillator), which was activated by a switch on the left side of the panel. Audio was heard from either a built-in speaker or plug-in headphones. The receiver could be silenced with the **RECEIVE/STANDBY** switch on the left side of the panel.

A very obvious downside to trying to navigate today's bands with an entry-level vintage receiver is lack of selectivity. While not as evident during the bottom of the solar cycle, the bands can be packed with signals during good conditions. An outboard DSP or audio filter is a must.

A 1947 Hallicrafters receiver ad.

An ad for the RCA-6146 amplifier tubes.

Operating a Vintage Station

To operate my vintage station today, I use the transmitter, receiver, and an antenna T/R relay. An old Dow Key relay toggles the antenna between transmitter and receiver, and it also has contacts that can put the receiver into standby mode during transmission. The receiver audio provides a side-tone to hear my transmit keying. The relay grounds the antenna during transmit, and before transmitting, I manually turn down the gain.

To use crystal control, I call CQ on one of my crystal frequencies and listen for a reply, or I listen and wait to transmit when I hear a nearby station. Adding the VFO is a game changer. If I hear a station calling CQ, I only need to switch the VFO to **TUNE**, and rotate the dial to zero beat his frequency. If the transmitter is tuned for this part of the band, I just hit the key and transmit.

Tuning a Vintage Transmitter

If the transmitter is not set up for the band I want to work or is not close to my desired frequency, I need to switch the transmitter from **STANDBY** to **TUNE**, switch the meter to **GRID**, and adjust grid current for maximum. Then I switch the meter to **PLATE CURRENT**, and adjust the final tuning control to minimum plate current. This adjusts the final tank circuit to resonance. I then increase the antenna tuning or loading control. The plate current will rise. I dip the plate control again to minimum plate current. I repeat this two-handed operation until any further increase in the antenna loading control can no longer be dipped, around 125 mA. Now the transmitter is ready to go. With practice, this whole procedure can be done in a few seconds. It sure makes an old ham appreciate today's carefree transceivers.

Trying the Classics

Getting on the air with a vintage station can be a rewarding challenge, especially when using gear that is older than you. Many old transmitters and receivers are worth trying out, especially the old Heathkits that come at a modest cost. Ham radio is never boring. There is always something new to try. In this case, something new can be something old.

Al Brogdon, W1AB

100, 50, and 25 Years Ago

February 1921

- The cover art shows a female operator making an on-air contact as she stares at the photo of a young man on her desk, with a large red heart as the backdrop.
- The editorial discusses the privileges of being able to operate amateur stations.
- L. Spangenberg presents the details on "2ZM's Radiophone and C.W. Transmitter," complete with photos and schematics.
- P. J. Furlong, 1FF, writes about "An Electrolytic Rectifier for C.W."
- "The Washington's Birthday Relay" reports how 9XE, in cooperation with ARRL's Operating Department, arranged for a 30-word message from President-Elect Warren G. Harding to be relayed by hams to all state governors and town mayors in the country.
- The Editor addresses the "Transatlantic Sending Tests" that took place during the first week of February, with US stations transmitting and British stations listening, following prearranged schedules.
- In "Some Whys, and Speculation as to Some Possible Wherefores," M. B. West looks into some of the mysteries of radio.

February 1971

- The cover is a die photo of a monolithic integrated circuit.
- The editorial points out that Headquarters has a lot of information packages available, such as a script for a 30-minute presentation to non-hams, tips on organizing a radio club, etc.
- Colonel John H. Parrott, Jr., W4FRU, compares a "Quad vs Triband Yagi." He concludes that a quad will outperform a Yagi, and wide spacing of the quad elements will give even better performance.
- Doug DeMaw, W1CER, describes "Quick-and-Easy Portable/Mobile Reception" using his solid-state converter (including a beat frequency oscillator) feeding an AM broadcast-band receiver.
- In Part 2 of "Receiving FM," Douglas Blakeslee, W1KLK, talks about basic principles and new circuits.
- Thomas F. McMullen, Jr., W1QVF, and Edward P. Tilton, W1HDQ, share some "New Ideas for the 2-Meter Kilowatt."
- William J. Hall, K1RPB, presents Part 1 of "The ATTR-166 — A Homemade Transceiver for the 160- to 6-Meter Bands."

February 1996

- The cover photo shows the Flat Top repeater site near Bozeman, Montana, with lots of snow and solar panels keeping things going.
- The editorial, "Managing the Morse Issue," discusses whether or not you need to pass a Morse code test to get a ham license.
- "The *Illa Tiki* Expedition," by John Haslett, KC5KHA, reports on how ham radio helped during the voyage by a sailing vessel of antique construction, recreating a long-ago voyage from Ecuador to Hawaii.
- James D. Cain, K1TN, gives a rundown on "VE1ZZ: A 'Ham's Ham'" who assembled a powerful station by using his ingenuity and careful scrounging.
- Dave Hershberger, W9GR, shares how to make hamming easier using digital signal processing, in "DSP — An Intuitive Approach."
- Richard Q. Marris, G2BZQ, says hams can use a little wood, some wire, and a handful of components to fashion "An In-Room, 80-Meter Transmitting Multiturn Loop Antenna."
- In "Studying for My License," 11-year-old General-class licensee Sarah Murphy, KBØNZR, talks about her experience.
- Guenter Thoss, DF5OL, shares a handful of examples to show that "It's a Small World for Hams."
- Kirk Kleinschmidt, NTØZ, tries to get hams out of the RST-QTH-name rut in their contacts, in "On-Air Conversations: Go Beyond the Basics."

Silent Keys

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

K1DQV **Miner**, Roger S., Fulton, MD
• KA1FYL **Patz**, Jonathan, Dover, DE
WA1GHU **Drown**, Richard B., Weymouth, MA
KL1KU **Fischer**, Thomas B., Pahrump, NV
♦K1SG **Gilbert**, Stephen M., Salem, MA
WA1TGN **Kravitz**, Robert A., Hudson, NH
WE1X **Tankin**, Harry J., Yardley, PA
KX2F **David**, Abel, Jr., Warsaw, IN
W2GPK **Kennedy**, Gerard P., Bushnell, FL
N2JDN **Levis**, John M. "Milt," Rochester, NY
N2KNL **Kretschmer**, William A., Harwich, MA
KE2T **Parker**, Delmer G., Kent, OH
♦WB2ZZB **Napfel**, Hans F., Sarasota, FL
W3CKU **Doyle**, Jim, Chambersburg, PA
KI3K **Cruise**, Barry O., Green Valley, AZ
N3RAV **Hively**, Steven L., Greenville, PA
• AA3RT **Audley**, Arthur R., La Plata, MD
K3SDS **Nitz**, Eliot R., Silver Spring, MD
W4BIV **Eddlemon**, Charles O., Memphis, TN
N4BUF **Rohm**, Rickey D., Dallas, NC
KG4BYN **Harold**, Benjamin S., Kingston, TN
N4CR **Barnett**, Phillip R., Apopka, FL
W4DHF **Pitcock**, John R., Louisville, KY
KB4EDM **Brell**, James A., Jr., Maysville, KY
KF4EKA **Bowen**, Sandra R., Stephens City, VA
KI4JMJ **Hammontree**, Derek A., Fairmount, IN
K4KBB **McCoy**, John P., Greenville, NC
♦N4QEA **Moyers**, John W., Knoxville, TN
N4RBJ **Jordan**, Robert B., III, "Rob," Limestone, TN
KD4SFI **Creech**, John S., Sumter, SC
♦WA4SUH **Strosnider**, Robert K. "Bob," Winchester, KY
• KJ4UEK **Newton**, William, Honaker, VA
N4WGK **Beyer**, Denise M., Manitwoc, WI
KC5AK **Morris**, Gregory R., Lufkin, TX
KD5BUH **Gaulke**, Gerald E., Sanger, TX
♦WB5CMB **Armstrong**, Noel, North Chesterfield, VA
KG5HMB **Blankinship**, William C., Rusk, TX
WD5JTA **Chambers**, Sherril R. "Ray," Duncan, OK
N5LHO **West**, John D., Clovis, NM
W5NDK **Cowan**, Paul J., Denton, TX
KG5ORY **Cowley**, Robert A., Garland, TX
♦KJ6DNB **Doyal**, Lynn, Markleeville, CA
WD6DPE **Olsten**, Robert E., Santa Rosa, CA
♦WB6JAD **Milldrum**, Gordon J., Jr., Reno, NV
♦K6JAT **Tiemstra**, James Allan, Oakland, CA
N6NIX **Kaliczak**, Michael, Chico, CA
W6NNH **Weilbrenner**, C. Bernal, Jr., Choctaw, OK
WA6QJW **Zukerman**, Mitsue K. "Mitzi," Fountain Valley, CA
KQ6QX **Webb**, Hiram J., Umatilla, OR
N6RNP **Padgett**, Alan W., Chico, CA
AH6RQ **Bommarito**, Joseph, Jr., "Joe," Wailuku, HI
♦K6RV **Schliesser**, Donald L., Cedar Park, TX
♦W6SQN **Crouch**, Leon H., Bandon, OR
• N6ZGA **Ellison**, Bishop L., Fleming Island, FL
K7AQ **Cox**, Charles W., Peoria, AZ
WW7DD **Frees**, James W., Addy, WA
KL7HLF **Linnen**, Donald L., Syracuse, UT
K7MGB **Riemenschneider**, David R., Yakima, WA
NU7P **Baranski**, Zbigniew, Queen Creek, AZ
W7RAW **Whaley**, Ruskin A., Vancouver, WA
KA7RMS **Emden**, Albert C., Yuma, AZ
WB7SNJ **Nielsen**, Bennett F., Orem, UT
KB8AOG **Fournier**, Barbara A., Cuyahoga Falls, OH
K8ERV **Lamb**, John T., Montrose, CO
K8IHR **Flinn**, Robert W., Blytheville, AR
KB8RSZ **Dusich**, Mark M., Jr., Temperance, MI
WA8VRS **Martin**, Franklin G. "Frank," Cartersville, GA
WO8W **Walker**, David D., Danville, WV
W8WWP **Stuben**, David, Saint Clair, MI
KA8ZGY **Rinehart**, Louise Ann, South Charleston, WV
AB9AA **Wallace**, John A., Tipton, IN
W9BNI **Beachy**, Claude R., Paoli, IN
K9FSE **Webb**, William G., Helenville, WI
N9GK **Keller**, Victor L., Fort Wayne, IN
• W9KOE **Zajac**, Richard P., Portage, IN
• KK9L **Wright**, Jay H., Danville, IN
WB9L **Martin**, Michael D., Knox, IN
KD9LWJ **Lawson**, Roger A., North Liberty, IN
• W9MTE **Whiles**, Kenneth W., Knox, IN
• WB9UAE **Stevenson**, Phyllis B., Lexington, MA
N9UWK **Cleaver**, Joan C., Joliet, IL
K0BOY **Halbert**, Douglas D., Omaha, NE
KA0FZR **Gregoire**, Maurice R., Lyndon, KS
♦W0MZN **Davis**, William E., III, Winona, MN
KB0NEE **Mann**, David C., Marshfield, MO
WD0O **Conklin**, John D., Topeka, KS
• KC0OX **Breitwisch**, Ronald L., Marion, IA
K0RGT **Tost**, Ronald G. "Ron," Ava, MO
W0ROB **Baker**, Robert C. "Rob," Sartell, MN
K0TGB **Blankenship**, Thomas G., Sr., Blue Spruce, MO
K0UAA **Bellinger**, Michael C., Kansas City, MO
KB0UJW **Smith**, Nancy J., Lake Leelanau, MI
W0ZTL **Muggli**, Alexander J. "Alex," Glen Ullin, ND
VE4ADS **Gowron**, John A. T., Dugald, Manitoba, Canada
♦ON4UN **Devoldere**, John, Merelbeke, Belgium
♦DL9SH **Bergmann**, Horst, Beindersheim, Germany
WK6O **Gaude**, Michael W., Leon, Nicaragua

♦ 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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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*

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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
Control Cable Conductors	**8**
Shipping Weight	26 lbs.
Effective Moment (in tower)	**2800 ft.-lbs**

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Brake Power	**9000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**Triple race/138 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
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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**
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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**
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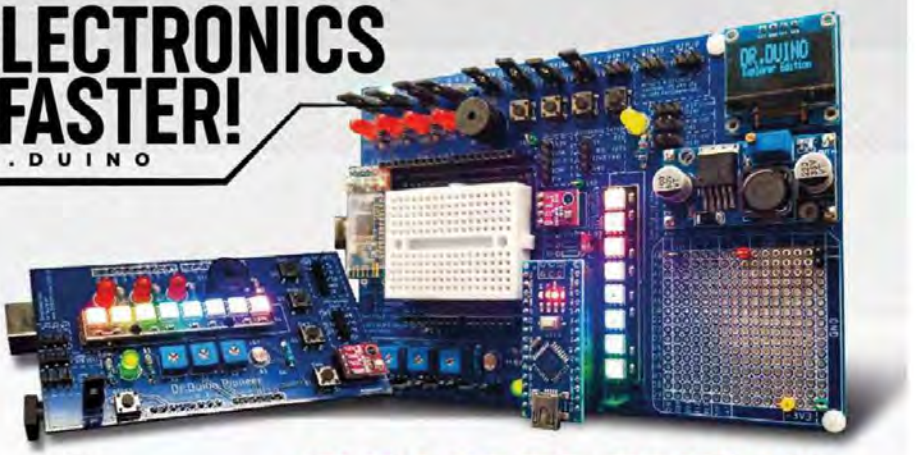

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Got Noise?!

MFJ has answers

Noise-Cancellers Wipe Out Interference

Null out all types of noise!!! Severe power line noise from arcing transformers and insulators, fluorescent lamps, dimmers, touch controlled lamps, computers, TV birdies, lightning, garage door openers, electric drills, motors, industrial processes. It's much more effective than a noise blanker because interference much stronger than a desired signal can be completely removed without affecting the desired signal. All modes -- SSB, AM, CW, FM, frequences from BCB to lower VHF.

Null out strong QRM on top of weak rare DX ! Null out a strong local ham or AM broadcast station to prevent your expensive receiver from overloading.

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

MFJ-1026
$239.95

MFJ-1026 simply plugs between your transmitting antenna and your transceiver. To null, you adjust the amplitude and phase potentiometer controls for a minimum S-meter reading or low noise. To peak, push reverse.

Use built-in active or external antenna. *Constant Amplitude Phase Control*™ makes nulling super easy -- snag that rare DX you have missed.

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

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

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

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

MFJ-5008
$199.95

MFJ Power Line Noise Finder

MFJ-852
$139.95

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

MFJ-1767, $99.95. Adds 3-element beam to MFJ-852.

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

MFJ Low-Noise Receiving Mag Loop

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

MFJ-1886
$289.95
Receive Loop with Biastee

Reduce Harmonics, Avoid TVI with MFJ Low Pass Filters

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

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

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

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

MFJ-854
$139.95

MFJ Clamp-on RF Ammeters

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

MFJ-853, $69.95. Like MFJ-854, Ranges: 0.3, 1, 3 A. Mini size.

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

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

MFJ-1164B
$89.95

MFJ AC Line Filter/Protector

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

Ferrite RFI Suppression Chokes

MFJ-700A4, $14.95. .275" diameter 4-Pack
MFJ-700B4, $15.95. .402" diameter. 4-Pack
MFJ-700C4, $24.95. .528" diameter 4-Pack
MFJ-700D4, $29.95. .750" diameter 4-Pack

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MFJ-1708B-SDR
$119.95

If you want to know where the activity is, who's generating splatter, what's in the DX window, how wide your audio is or what frequencies are clear, it's all right there! While receiving on your transceiver, MFJ-1708B-SDR switches your SDR to your antenna showing the entire band. On transmit your SDR is switched out and grounded to protect your SDR. PTT and a failsafe RF sense switches MFJ-1708B-SDR. For HF/VHF/UHF. Monitor multiple bands with multiple SDRs and a multi-coupler.

MFJ-1708B-SDR-S, $129.95. SMA connector for your SDR.

MFJ-1708SDR, $99.95. Original model for HF/VHF.

New B series improvements...
The original MFJ-1708 series used one relay and wires to connect the SO-239s. The new B-series uses four relays and connectors on a *single* pc board. This gives you > 50 dB isolation at 300 MHz and > 68 dB at 50 MHz. SWR < 1.16:1 at 50 MHz and < 1.75:1 at 450 MHz at the transmit port. Mute output is a selectable short or open to ground. Use "boat anchors" or modern receivers or key a linear amplifier. Receiver input protection prevents overload from nearby high power signals and from receive to transmit. A hybrid splitter on SDR models reduces loading effect and gives > 15 dB isolation between the SDR REC and XCVR ports to reduce interference. The original MFJ-1708 series is still available.

MFJ Low Noise VLF/HF Receiving Loop

Pull weak signals out of static crashes, atmospheric, man-made and power line noise!

Hear signals 500 KHz to 30 MHz cleaner, quieter than ever before! Power line noise disappears. Rotate its figure 8 pattern and its extremely deep null to completely eliminate an interfering signal or greatly peak a desired one. Fully protected state of-the-art Gali MMICs in push-pull gives you a preamp with extremely high dynamic range, low IMD and 25 dB of low noise gain. Excellent performance on strong and weak signals without overload. 36-inch dia. loop. 1-in. OD 6061 aluminum.

MFJ *wideband* SDR *Discone* Antenna

Receives 25-1300 MHz

MFJ ultra wide-band *Discone* Antenna receives 25-1300 MHz. Perfect for all band SDR reception. Covers 10, 6, 2 Meters, 220 and 440 MHz and 33/23 CM ham bands and everything in between. It is excellent for monitoring multiple bands simultaneously using multiple SDRs and a multi-coupler. Also test any transmitter 50-1300 MHz using a single discone and single coax. Handles 200W. Includes 50 feet coax, stainless steel elements and mounting hardware.

MFJ-1866, $59.95. Like MFJ-1868 but transmits 144-1290 MHz. Coax and mounting hardware not included.

Tuned Indoor SDR Active Antenna

MFJ-1020C
$119.95

Make your SDR receiver come alive with HF signals, .3-40 MHz, while rejecting interference with MFJ-1020C *tunable* indoor active antenna! Gain control, telescoping whip.

Untuned Indoor SDR Active Antenna

MFJ-1022, $79.95. Hear weak, noisy VLF to UHF signals. Noise-less feedback gives excellent low noise reception. Handles strong signals.

Active Outdoor Antenna

MFJ-1024
$179.95

World Radio TV Handbook says "MFJ-1024 is a *first rate, easy-to-operate active antenna, quiet, excellent dynamic range, good gain, very low noise factor, broad frequency coverage, excellent choice...*" **Outdoor** mounted 54-inch whip/pre-amp gives maximum signal and minimum noise. Covers .05-30 MHz. **Indoor** unit: 20 dB attenuator, gain control, 2 receiver and 2 antenna switches.

HF SDR Preselector

MFJ-1040C
$139.95

Tuneable MFJ-1040C lets you copy weak, noisy SDR signals from 1.8 to 54 MHz. Greatly tunes out and reject out-of-band interference. Up to 20 dB gain. Has gain control. Cascode FET/bipolar transistor gives low noise, high gain without overloading. Switches for 2 antennas and 2 receivers. SO-239s. Has 20 dB attenuator. Automatically bypasses when transmitting or use PTT. 6½W x 2½H x 4D inches.

MFJ LW/MW/SW SDR Preselector/Tuner

MFJ-956
$79.95

Highly rated series-tuned MFJ-956 boosts your desired signals while greatly rejecting interference and preventing serious overload. **Greatly** improves reception 0.15 to 30 MHz. Incredibly effective below 2 MHz. **Super** easy to operate, select band and tune! **Bypass** tuner and ground receiver switch positions. **Compact** 2 x 3 x 4 inches. SO-239 connectors.

MFJ-1708B, $119.95.

MFJ RF Sense Transmit/Receive Switch

Switches your antenna from receiver to transmitter using a relay. Shorts your receiver to ground during transmit. Use RF sensing with adjustable delay or PTT line. Has selectable open/short mute.

MFJ-1707B, $119.95.

Auto switch XCVR between 2 antennas

Switches switches separate transmit and receive antennas on transceivers with only one antenna port. *Example*: Efficient 75M dipole for XMIT and MFJ-1708B low noise MFJ loop for receive -- *no static crashes*!

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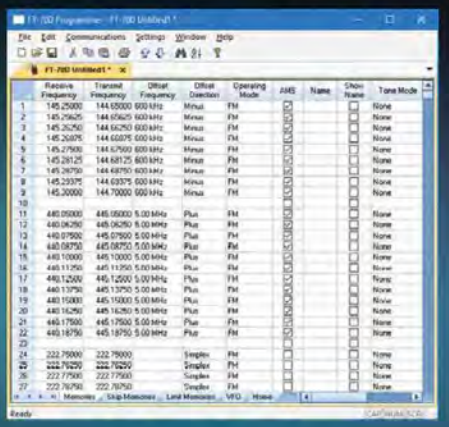

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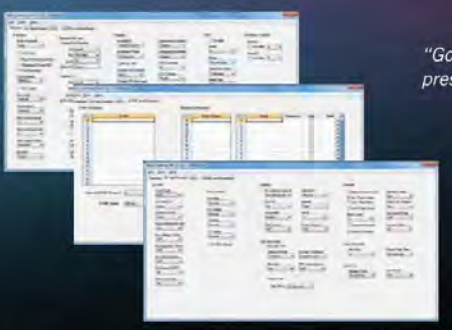

"God is our refuge and strength, a very present help in trouble." – **Psalms 46:1**

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

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MFJ-1778, $69.95. 80-10M. 102 feet long.
MFJ-1778M, $59.95. 40-10M. 52 feet long.

End Fed Half Waves

Operate 80-10 or 40-10M with one support/no tuner.
80-10 Meters, 132 feet:
MFJ-1982HP, $109.95. 800 Watts.
MFJ-1982MP, $79.95. 300 Watts.
MFJ-1982LP, $59.95. 30 Watts.
40-10 Meters, 66 feet:
MFJ-1984HP, $89.95. 800 Watts.
MFJ-1984MP, $69.95. 300 Watts.
MFJ-1984LP, $49.95. 30 Watts.

Off Center Fed Dipoles

Lightweight, virtually invisible. Gives you directivity and gain (*see MFJ website*).
MFJ-2012, $89.95, 40/20/10/6 Meters, 1500 Watts. 67 ft.
MFJ-2010, $69.95. 40/20/10/6 Meters, 300 Watts. 67 ft.
MFJ-2014, $119.95. 75/40 Meters, 1500 Watts. 122 ft.
MFJ-2016, $149.95. 160/75/40 Meters, 1500 Watts. 240 ft.
MFJ-2013, $89.95. 60/30 Meters, 300 Watts. 86 ft.

Dual Band 80/40 or 40/20 Dipoles, 1.5 kW

MFJ-17758, $109.95. 80/40 Meters, 95 feet long, ultra-efficient end-loading on 80 Meters. No tuner needed. Super-strong center insulator, built-in SO239, hanghole.
MFJ-17754, $69.95. 40/20M, 42 ft.

MFJ All Band Doublet

MFJ-1777, $79.95.102 foot, 160-6 Meters with tuner/balun. *Extremely low feedline loss.* Super strong fiberglass center insulator provides stress relief for included 100 feet ladder line. *Ceramic* end insulators. 1500 Watts SSB/CW/Digital.

MFJ 1.5 kW Dipoles

7-strand, 14-ga. copper wire.*Ceramic* insulators. Center insulator with SO-239
MFJ-1779C, $39.95. 20-6M, 35 feet.
MFJ-1779B, $59.95. 80-40M,135 feet.
MFJ-1779A, $79.95. 160M, 265 feet.

20M Extended Double Zepp

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

80M End-Fed Zepp

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

MFJ Vertical Mounted Antennas

MFJ 6-Band Cobweb Antenna

MFJ-1836H, $299.95. Six-bands: 20/17/15/12/10/6 Meters, 1.5 kW. *Perfect for restricted space.* Nearly invisible. 9x9x1/2 feet, 8 lbs. Outstand-ing performance! Horizontally polarized gives less noise, more gain over verticals. Omni-directional. No radials needed! Works great at low heights. Low SWR.
MFJ-1836, $269.95. Like MFJ-1836H, but 300 Watts.

MFJ *4-Band* Dipole Octopus Antenna

***Octopus** antenna hub turns hamsticks into four balanced* HF/VHF/UHF *dipoles!* Rotate for maximum signal, minimum QRM/noise. Mount low for local NVIS, high for DX. Perfect for portable, limited space, HOAs, camping, ARES. Balun. No tuner needed.
MFJ-2104, $289.95. Includes 8 hamsticks for 75/40/20/15 M.
MFJ-2100, $119.95. Hub only. Use eight hamsticks.

MFJ Multi-Band Verticals, no radials needed!

Low angle radiation lets you easily work far-away, rare DX!
Efficient end loading gives maximum radiated power.
1500 Watts SSB/CW/Digital. Low SWR. Omni-directional. No radials or antenna tuner needed.
Low profiles blend into any surroundings. Mount them anywhere ground level, roof tops, apartments, houses, small lots.
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MFJ-1797LP, $339.95. Like MFJ-1797, but only 9 feet tall. Narrower bandwidth on 40 Meters.
MFJ-1799, $449.95.10 bands: 80/40/30/20/17/15/12/10/6/2M. 20 ft.
MFJ-1799X, $399.95. Like MFJ-1799, but less 80M.

MFJ 43-foot Vertical, 160-6 Meter

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

BigStick ™ Vertical

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

BigEAR ™ Dipole

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

MFJ-915, $39.95 RFI Isolator

Prevents unwanted RF from traveling on your coax shield into your expensive transceiver. Prevents painful RF "bites" and erratic operation. 1.5 kW. 1.8-30 MHz.

MFJ-918, $39.95 4:1 Balun

True 1:1 current balun/center insulator. High-permeability ferrite beads on RG-303 *Teflon*(R) coax. 2" dia.x6" long. 14 gauge 7-strand copper wire. 1.5 kW 1.8-30 MHz.

MFJ-913, $39.95, 300W MFJ-919, $69.95, 1.5 kW

True 4:1 current baluns/antenna center insulators transform 200 ohms to 50 ohms, 1.8-30 MHz. Transmission line transformer, low permeability ferrite cores, SO-239, stainless steel hardware with direct 14 gauge stranded copper wire to antenna.

Lightning surge protectors

MFJ-270, $24.95. 400W.
MFJ-272, $39.95. 1500W. Gas discharge tube shunts 5000 amps peak.< 0.1 dB loss. 1 GHz. SO-239s.

2-Position Antenna Switch

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

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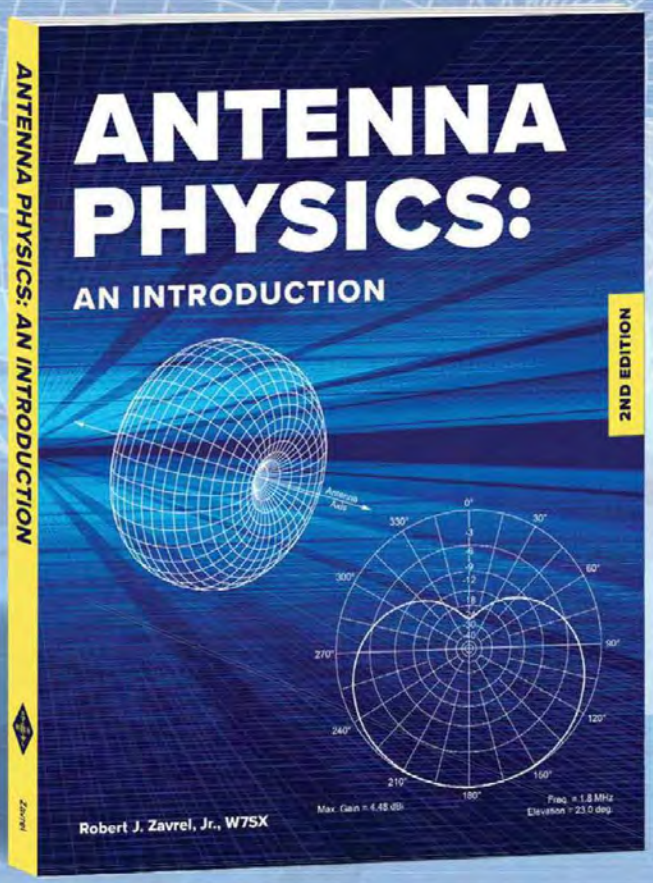

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For quick put-up and take-down, light-duty models have Twist & Lock sections and heavy-duty thick wall models use military style *QuickClamps*™ or stainless steel hose clamps.

Use them for traveling, camping, at hotels, hamfests, field day, DX-peditions. Put up full size full performance inverted Vee, dipole or vertical antenna in minutes at heights that will snag you real DX.

Use multiple telescoping masts to make loops, quads, rotatable dipoles even beams.

← *Light Duty Lightweight Fiberglass Masts*

So lightweight you can take them anywhere!

MFJ's most popular MFJ-1910 is 33 feet long, 3.3 lbs.

MFJ-1910, $99.95. 33 ft., light duty w/top tie ring.
MFJ-1911, $109.95. 20 ft., light duty w/top tie ring.
MFJ-1913, $109.95. 28 ft., lightweight w/top tie ring.
MFJ-1915, $159.95. 25 ft., for heavier duty use.
MFJ-1916, $179.95. 34 ft., for heavier duty use.
MFJ-1917, $189.95. 43 ft., heavier duty w/top tie ring.

Super-strong .125" Thick-Wall Fiberglass Masts

Use for temporary or permanent wire antennas, small beams or verticals. **Best seller** is 50 ft. long, just 26 lbs.

Heavy Duty Models: All have QuickClamps™ →

MFJ-1908HD, $289.95 is 48 ext., 7.75-ft. collapsed, has 2 1/2" OD bottom, 1" OD top, seven 7.75-ft. sections, 24 lbs.
MFJ-1906HD, $249.95 is 38' extended, 6 feet collapsed, has 2 1/2" OD bottom, 1" OD top, seven 6-foot sections, 24 lbs.
MFJ-1904HD, $179.95 is 25' extended, 4 feet collapsed, has 2 1/2" OD bottom, 1" OD top, seven 4-foot sections, 14 lbs.
MFJ-1904H, $159.95. 22' ext., 5' collapsed, 9 lbs. 2 1/2" OD.
MFJ-1902H, $139.95, 10' ext., 38" collapsed, 5 lbs. 2 1/2" OD

Standard Models: H models have QuickClamps™

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

Mast Accessories

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

Mast Guy Ring Sets

Fits masts 3/4" to 1 1/4" dia OD. **MFJ-2830X, $9.95,** *fiberglass*; **MFJ-2840X, $12.95**, *aluminum.*

Left: *Stainless Steel Hose Clamps* recommended for permanent installations. Fiberglass is slotted.

Right: UV protected Military grade *QuickClamps*.Guy 2 levels when fully extended.

18' Telescopic Mast & Tripod

MFJ-1919EX, $179.95.
Put your antennas up high anywhere with this super-strong* 18 foot telescoping fiberglass mast and MFJ-1919 heavy duty steel tripod.** ***QuickClamps™ lower mast to 5 feet. Mast has thick 1/8 in. wall, .75" top, 1.5" bottom dia. 15 lbs. Steel tripod has braced triangle base, non-skid feet, mast lock.

MFJ-1918EX, $109.95.
MFJ-1918 tripod has super strong 9.5 foot telescoping fiberglass mast. 3.8 feet collapsed. *QuickClamps*™. Thick 1/8 inch wall, .75" top, 1" bottom diameters. 6.5 lbs.

Tripods Only

MFJ-1921, $199.95, Giant tripod base spreads to 8 feet! Supports massive antennas. Adjustable length non-skid legs accommodates uneven ground surfaces. Optional foot anchors **MFJ-1905, $34.95**, see **Tripod Anchors** bottom right. 5.75Hx7D feet collapsed. 14 lbs.

MFJ-1919, $109.95, *Large tripod* base spreads to 4.8 feet. Supports 100 pounds. 7.8 feet, 1.4 inch diameter mast. 4.5H x .5D feet collapsed. 9.75 lbs.

MFJ-1918, $69.95, Smaller tripod base spreads to 2.75 ft. Support 66 lbs. 6 foot, 1" dia. mast. 3.2H x .3D ft. collapsed. 6.75 lbs.

80-6 Meter Antenna

3.8 foot fiberglass mast telescopes to a 31 foot self-supporting high performance 80-6 Meter vertical antenna in minutes!

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$115.95
40-6 Meters

MFJ-2982
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80-6 Meters

Quarter wave performance on 40 Meters, halfwave on 20M. High-Q air wound loading coil. Use antenna tuner for 30, 20, 15, 12, 10, 6 Meters. 600 Watts SSB/CW.

Use as temporary, portable or permanent antenna for home, RVs, camping, field day, hamfest, DX-pedition.

Includes four 12 foot radials. Current balun reduces feedline radiation and pattern distortion.

MFJ "HamStick" Isolated Dipole

Build your own 80-6 Meter *mini*-dipole using two HF mobile whips! Only MFJ-347 mount *isolates* dipole elements and lets you use a balun to give a true *balanced dipole*. Prevents pattern distortion, noise pickup and RFI radiation from RF on coax shield. Solid aluminum. Use mast up to 1 1/4" OD.

MFJ-347
$24.95

3/8-24 Hamstick

MFJ-342T
$15.95

Mount 3/8-24 HF/VHF hamsticks vertically or horizontally on masts up to 1 inch. Built-in SO239 connector.

MFJ Balcony Mount

MFJ-1907
$49.95

Mount *multiple* HF/VHF hamsticks, verticals, dipoles vertically and/or horizontally on your apartment/condo balcony. High-strength aircraft aluminum extends out 14". Two U-bolts mount up to 1 1/2" diameter.

Tripod Anchors

MFJ-1905
$34.95

Securely anchor tripod to ground with these 3 stainless steel foot braces and your stakes. For high winds, unlevel ground, tall antennas. Fits legs to 1 1/2"OD.

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Dummy Loads

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MFJ-260C $49.95

Dry 1.5 kW HF/VHF/UHF Dummy Load

Ham radio's most versatile 1.5 kW 50 ohm *dry* dummy load covers DC through 650 MHz. SWR 1.1:1 to 30 MHz and 1.3:1 to 650 MHz. Handles 1500 Watts for ten seconds, 100 Watts for 10 minutes. 3W x 3H x 9D in. SO-239 connector. **MFJ-264N, $109.95.** With type "N" connector.

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Run 1kW CW or 2 kW PEP for 10 minutes. Run *continuous duty* with 200 Watts CW or 400W PEP. Transformer oil included. SWR 1.2:1 to 30 MHz. Low SWR to 400 MHz. SO-239 connector. Safety vent with cap, carrying handle. 7½H x 6⅝D in. **MFJ-250X, $69.95.** No transformer oil.

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500 MHz, 100 Watt Dummy Load

Connects directly with built-in PL-259. Finned aluminum air-cooled heatsink. 15 Watts continuous, 100W peak. SWR <1.5:1, DC-500 MHz. 15/8 inch round by 3 inches long. **MFJ-262B, $69.95.** PL-259. 35 Watts continuous, 200W for 5-seconds. SWR< 1.2;1 DC-1 GHz.

MFJ-261 $34.95 *with PL-259* DC to 500 MHz

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MFJ's 2500 Watt *fan cooled* load handles legal limit amps, 2500W average one minute on, ten minutes off, 300W continuous. DC- 6 Meters. SWR <1.25, 30 MHz; <1.4, 30-60 MHz. Detailed power curve. 12 VDC or 110 VAC. 8¼W x 4H x 9½D in. SO-239s. 5 pounds.

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Select 16.6, 25, 50, 100, 150 Ohm dummy loads. Test/calibrate your wattmeters, SWR accuracy. At 50 Ohms it handles 300 Watts for 30 seconds with SWR < 1.1, 60 MHz. SO-239. 4½W x 2¼H x 6½D in. Optional 12 VDC/110 VAC adaptor, **MFJ-1312D, $19.95**.

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New high-tech metal film resistor on large heavy-duty air-cooled heatsink. 300 Watts for ten seconds and 125W continuously. SWR < 1.1, 1 GHz; <1.2, 1.5 GHz; <1.5, 3 GHz. N-connector. 10¾W x 2¼H x 5¼D inches.

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MFJ-267 $179.95

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Compact Cross-Needle SWR/Wattmeters

Large 3-inch lighted Cross-Needle meter covers 1.8-200 MHz in 30/300W power ranges. Read forward, reflected power, SWR *simultaneously*. 3¼W x 3¼H x 3¼D in. SO-239 connectors. **MFJ-842, $69.95.** 140-525 MHz, 15/150W.

MFJ-822 $69.95

High-accuracy 1.8-60 MHz Digital SWR/Wattmeter

Highly accurate! Auto-ranging select 25W, 250W, 1500W ranges with *full 10-bit* resolution. Frequency compensated data insures highest accuracy. *True peak*/average forward/reflected power, SWR and frequency are *simultaneously* displayed on backlit LCD and large 3-inch lighted cross needle meter. Peak hold. LED, buzzer, amplifier-by-pass alerts and protects your amplifier when SWR is high and toggles extra relay. 6½W x 2⅝H x 6D". **MFJ-826B, $199.95.** No meter, ampr bypass, control relay.

MFJ-828 $269.95

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GrandMaster™ SWR/Power Meters are the *Cadillacs of ham radio!* Large 3¼ x 1¼ inch precision illuminated meter gives easy wide-angle viewing of SWR, forward or reflected power. 7½W x 3⅛H x 4¼D in. SO-239s. **MFJ-870, $89.95.** 1.6-60 MHz. 30/300/3000 Watt ranges. **MFJ-874, $129.95.** 1.8-525 MHz. 5/20/200 Watt ranges.

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VHF SWR/Wattmeter plus Field Strength

World's most popular – and most affordable – VHF SWR/Wattmeter. Read SWR, forward and reflected power over 144-220 MHz in two ranges, 30/300W. Built-in field strength meter for 1-220 MHz. 4½W x 2¼H x 3D".

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Displays forward, refelected power, SWR (1.6-60 MHz) and battery *all in a single glance!* Large ½" forward power digits and 5/8" reflected/SWR digits! 0-200W. Power/backlight on/off. SO-239s. **MFJ-847, $114.95.** 125-525 MHz, 0-120W. **MFJ-849, $189.95.** Large 3.5" bright orange LCD displays SWR, forward/reflected power. 1.5-525 MHz, 200W, HF/VHF-UHF switch.

MFJ-845 $114.95

MFJ-849 $189.95

MFJ HF *QRP* SWR/Wattmeter

Read forward, reflected power 1.8- 50 MHz, 0-5W. Also reads SWR, relative power 100 mW to 50W. SO-239s. 4½W x 2¼ H x 3D in.

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Super easy-to-use!

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World famous MFJ-259D gives you a complete picture of your antenna's SWR and Complex Impedance.

MFJ-259D is a complete ham radio test station including – frequency counter, RF signal generator, *SWR Analyzer*™, RF Resistance/Reactance Analyzer, Coax Analyzer, Capacitance/Inductance Meter and more!

You can read Complex Impedance as series resistance and reactance (R+jX) or as magnitude (Z) and phase (degrees).

Determine velocity factor, coax cable loss in dB, length of coax and distance to short/open.

You can read SWR, return loss and reflection coefficient at any frequency simultaneously.

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Every MFJ Analyzer is protected by MFJ's famous one year **No Matter What**™ limited warranty. We will repair or replace your MFJ analyzer (at our option) for a full year.

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Large easy-to-read two line LCD screen and side-by-side meters clearly display your information.

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280 KHz - 230 MHz *plus* 415-470 MHz, 280-230 MHz plus 2200Meters!

MFJ-269D
$419.95

MFJ-269D is a *super* MFJ-259D that adds 415-470 MHz and 12-bit A/D converter that gives you much better accuracy. *Complex Impedance Analyzer* reads series/*parallel* equivalents and magnitude/phase *CoaxCalculator*™ gives line length from electrical degrees and vice-versa for any frequency, Velocity Factor, coax loss in dB. Use any characteristic impedance 10-600 Ohms. Has LCD log SWR bargraph, N-connector.

MFJ-223

1-60 MHz Color Graphic VNA Analyzer

MFJ-223
$339.95

This *pocket-sized* wonder breaks the mold for analyzer design with user-friendly convenience, top notch accuracy, and a vivid TFT multi-color display. Don't let the size fool you, MFJ-223 is packed with all the VNA features and performance you need!

- **Single-frequency** and *swept-frequency* operating modes
- **Truly accurate** SWR, R, X, and Z measurements
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- **Powerful +5-dBm** stimulus generator overrides local interference
- **Field-strength meter** measures local signals, detects potential interference
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- **Vivid 1600-pixel/inch** color graphics on a 2x2 inch non-glare TFT screen

MFJ-225

1.5-180 MHz *continuous* Two-Port Graphic Analyzer

Out in the field, MFJ-225 is a compact completely *self-contained handheld graphing analyzer*. On the bench it becomes a full-fledged two-port (S21) desktop machine when teamed up with your PC. Using powerful IG-miniVNA freeware, you'll run detailed data analysis and print out stunning color-graphic plots to document your work!

MFJ-225
$339.95

Built-in back-lighted *3-inch LCD graphic* display. Make fine adjustments using fullscreen easy-to-view SWR bargraph, capture vivid swept displays for SWR, impedance, return loss, phase angle, more. DDS generator.

MFJ-269DPRO™ Analyzer

MFJ-269DPro, $459.95

Like MFJ-269D, but UHF range covers ***430 to 520 MHz*** to include commercial and industrial frequencies. Rugged protective shell protects knobs, switches, meters, digital display for commercial, industrial and lab work.

MFJ VNA Antenna Analyzer

MFJ VNA Antenna Analyzer covers 1 to 230 MHz, 1Hz resolution.

- ***Frequency sweep plots:*** *SWR, Impedance, Resistance, Reactance, Phase Angle, Complex Return Loss, Smith Chart*
- ***Sign of reactance*** positively identifies inductive or capacitive reactance
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MFJ-226
$359.95

MFJ SWR Analyzer Accessories

- **A. MFJ-29D/MFJ-39D, $39.95.** Carrying Pouch for MFJ-259D/269D.
- **B. MFJ-92AA10, $39.95.** 10-Pack 2500 mAh Ni-MH Supercells.
- **C. MFJ-66C, $39.95.** Dip coils, set of two covers 1.8-230 MHz.
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- **E. MFJ-917, $39.95.** 1:1 Current balun for SWR Analyzers to test balanced line antennas, other loads.
- **F. MFJ-5510, $15.95.** 12VDC cigarette lighter adapter.
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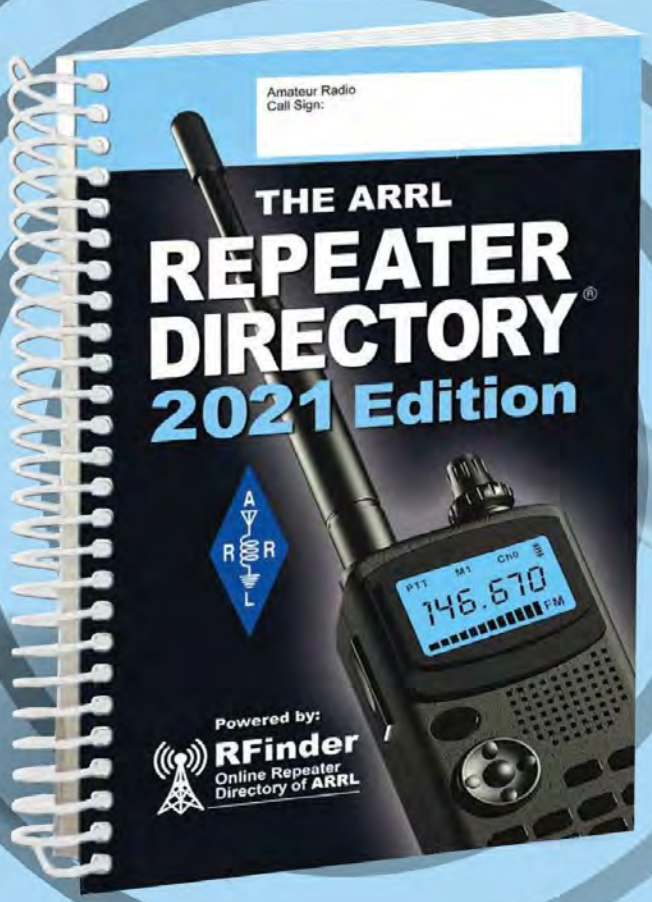

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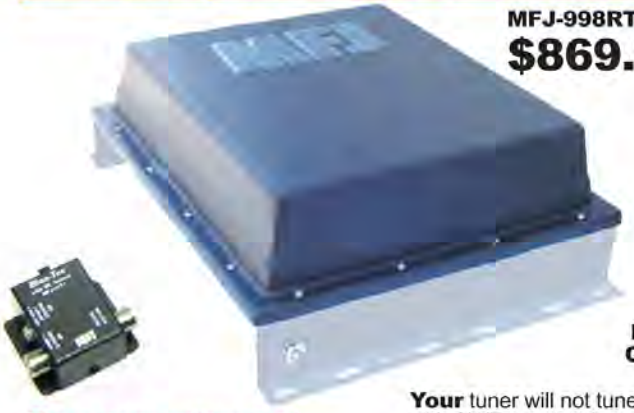

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Bottom Chassis

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Tune your antenna at your antenna

Get greatly reduced losses and high efficiencies with long coax runs and high SWR antennas with this new MFJ-998RT 1.5 kW Remote Antenna Tuner.

Weather-Sealed

A tough, durable weather-sealed ABS cabinet with over-lapping lips, sealing gasket and stainless steel chassis protects the MFJ-998RT from all kinds of weather.

No Power Cable Needed!

No power cable needed – remotely powered through coax. Includes MFJ-4117 Bias-Tee with on/off switch for station end of coax. Has 12 VDC jack for power cable, if desired.

Fully Protected

MFJ exclusive algorithms protect your tuner, radio and RF power amplifier from damage.

Automatic inductor and capacitor limiting prevents tuning extreme loads which can destroy your tuner.

Your tuner will not tune if more than 75 Watts with SWR greater than 3:1 is applied or if more than 125 Watts is applied.

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MFJ exclusive StickyTune™

Very high SWR can fold back transmitter power and prevent tuning caused by extreme differences in loads (example: changing bands and other conditions).

But MFJ exclusive StickyTune™ always tunes with a simple on/off power cycle and re-transmit.

Tunes Coax fed and Wire Antennas

Tunes both coax fed and wire antennas. Has ceramic feed-through insulator for wire antennas. 2 kV Teflon® insulated SO-239 – prevents arcing from high SWR.

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A highly efficient L-network matches 6-1600 Ohms at full 1500 Watts legal limit SSB/CW and Digital, 1.8 to 30 MHz with Hi-Q Ls, Cs.

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As you operate, the MFJ-998RT automatically tunes for minimum SWR and remembers your frequency and tuner settings. The next time you operate on that frequency and antenna, its tuner solution is restored in milliseconds and you're ready to operate!

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MFJ InstantRecall™ recalls stored tuning solutions from 10,000 memories. For new frequencies, MFJ Intelli-Tune™ measures your antenna impedance and instantly determines the correct matching components. If antenna impedances cannot be measured, MFJ AdaptiveSearch™ searches only the relevant components that can match your antenna giving you ultra-fast tuning.

Field upgradeable firmware. Requires 12-15 VDC at 1.4 Amps maximum or 110 VAC with optional **MFJ-1316, $29.95**. Weighs 9.5 lbs. 13 1/4W x 6 3/4H x 17 1/2D inches.

600W Remote IntelliTuner™

MFJ-994BRT – perfect for 600 Watt SSB/CW amplifiers like Ameritron's AL-811/ ALS-600/ALS-500M. Matches 12-800 Ohms. Coax/wire antennas, 1.8-30 MHz. Fully weather-sealed for outdoor use. Remotely powered through coax. Tough, durable, built-to-last cabinet, 9 1/4W x 3H x 14 1/4D inches, 4 lbs. Includes MFJ-4117 BiasTee Power Injector.

MFJ-994BRT
$459.95

200W Remote IntelliTuner™

MFJ-926B, 200 Watts SSB/CW/Digital, 6-1600 Ohms, Coax/wire antennas, 1.8-30 MHz. Includes BiasTee.

MFJ-926B **$329.95**

300W Remote IntelliTuner™

MFJ-993BRT handles 300 Watts SSB/CW and digital.Has extra-wide 6-1600 Ohm impedances. Coax/ wire antennas, 1.8-30 MHz. Fully weather-sealed for remote outdoor or marine use. Remotely powered through coax. Tough, durable, built-to-last cabinet measures 9 1/4W x 3H x 14 1/4D inches. Weighs just 4 pounds. Includes MFJ-4117 BiasTee Power Injector.

MFJ-993BRT
$339.95

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160-6 Meters 43 foot Vertical Antenna

Operate all bands 160-6 Meters at full 1500 Watts with this self-supporting, 43 foot high performance vertical! Assembles in less than an hour. Low profile blends in with sky and trees -- barely see it. Entire length radiates. Exceptional low angle DX performance on 160-20 Meters and very good performance on 17-6 Meters. Telescope it shorter for more effective low angle radiation on 17-6 M if desired. One of these wide range MFJ automatic tuners at the antenna easily matches all bands 160-6 Meters. There's no physical tuning adjustments on the antenna -- you simply put it up! Requires ground system, at least one radial, more the better. Includes balun and base mount. **MFJ-1932, $44.95**. All band ground radial system.

MFJ-2990
$399.95

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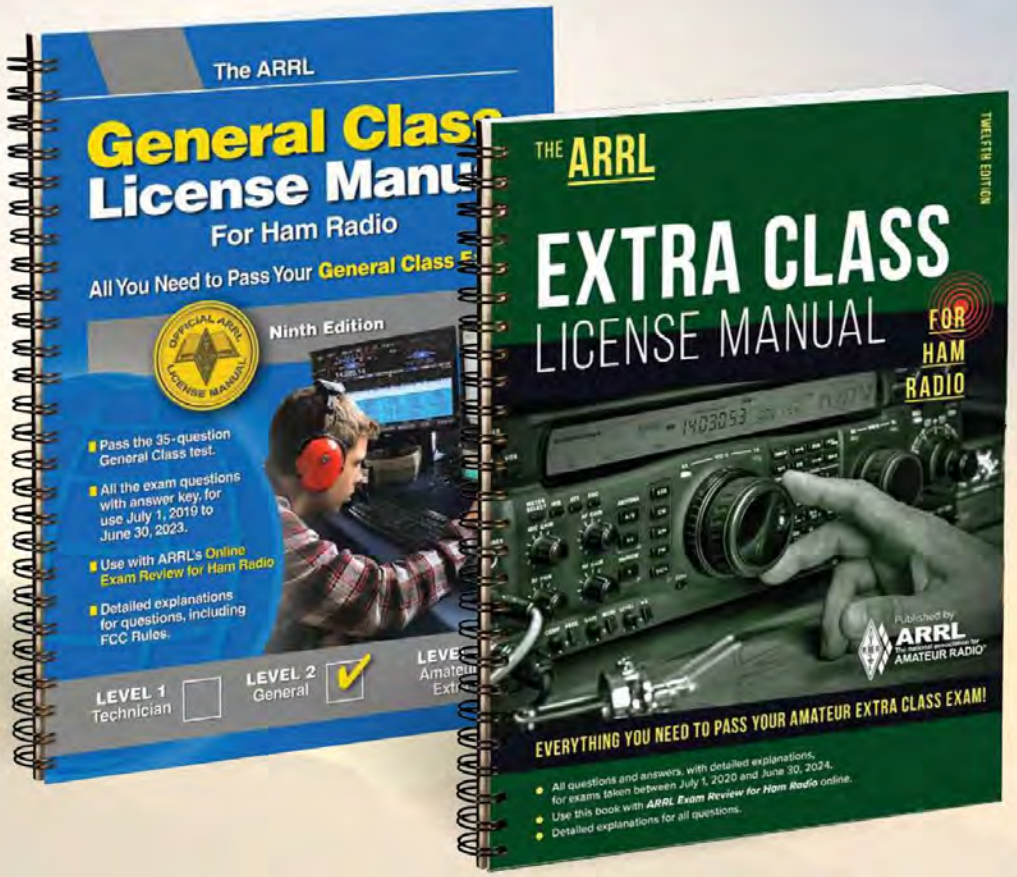

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MFJ Tuners

Ham Radio's Most Popular 300 Watt Antenna Tuner

MFJ-949E $219.95

More hams use MFJ-949s than any other antenna tuner in the world!

Why? Because the world's leading tuner has earned a worldwide reputation for being able to match just about anything.

Full 1.8-30 MHz Operation

Tune your antenna for minimum SWR! Works 1.8-30 MHz on dipoles, verticals, inverted vees, random wires, beams, mobile whips, shortwave receiving antennas...Use coax, random wire, balanced lines. Has heavy-duty 4:1 balun for balanced lines.

Custom inductor switch

Custom designed inductor switch, 1000 volt tuning capacitors, Teflon® insulating washers and proper L/C ratio gives you arc-free no worries operation up to 300 Watts PEP transceiver input power.

The MFJ-949E inductor switch was custom designed to withstand the extremely high RF voltages and currents that are developed in your tuner.

8-Position Antenna switch

Antenna switch lets you select two coax fed antennas, random wire/balanced line or dummy load through your MFJ-949E or direct to your transceiver.

Lighted Cross-Needle Meter

Full size 3-inch lighted Cross-Needle Meter. Lets you easily read SWR, peak or average forward and reflected power simultaneously. Has 300 Watt or 30 Watt ranges.

QRM-Free PreTune™

MFJ's QRM-Free PreTune™ lets you pre-tune your MFJ-949E off-the-air into its built-in dummy load! Makes tuning your actual antenna faster and easier.

Plus Much More!

Full size built-in non-inductive 50 Ohm dummy load, scratch-proof Lexan multi-colored front panel, $10^5/_8$ x $3^1/_2$ x 7 inches. Superior cabinet construction and more!

MFJ-948, $189.95. Econo version MFJ-949E. Has all features except for dummy load.

No Matter What™ Warranty

Every MFJ tuner is protected by MFJ's famous one year **No Matter What™** limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

More hams use MFJ tuners than all other tuners in the world!

MFJ-989D Legal Limit Tuner

MFJ-989D $469.95

New, improved MFJ- 989D legal limit antenna tuner gives you better efficiency, lower losses and a new true peak reading meter. Easily handles full 1500 Watts SSB/CW, 1.8-30 MHz, including MARS/WARC bands. Six position antenna switch, dummy load. New 500 pF air variable capacitors. New improved AirCore™ Roller Inductor. New high voltage current balun. New crank knob. $12^7/_8$W x 6H x $11^5/_8$D inches.

MFJ-986 Two knob Differential-T™

MFJ-986 $419.95

Two knob tuning (differential capacitor and AirCore™ roller inductor) makes tuning foolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 KW PEP SSB amplifier input power (1.5 KW output). Gear-driven turns counter, lighted peak/average Cross- Needle SWR/Wattmeter, antenna switch, balun. 1.8 to 30 MHz. $10^3/_4$W x $4^1/_2$H x 15 in.

MFJ-962D Compact kW Tuner

MFJ-962D $359.95

A few more dollars steps you up to a KW tuner for an amp later. Handles 1.5 KW PEP SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H! AirCore™ roller inductor, gear-driven turns counter, pk/avg lighted Cross-Needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8-30MHz. $10^3/_4$ x $4^1/_2$ x $10^7/_8$ in.

MFJ-969 300W Roller Inductor Tuner

Superb, AirCore™ Roller Inductor tuning. Covers 6 Meters thru 160 Meters! 300 Watts PEP SSB. Active true peak reading lighted Cross-Needle SWR Wattmeter, QRM-Free PreTune™, antenna switch, dummy load, 4:1 balun, Lexan front panel. $10^1/_2$W x $3^1/_2$H x $9^1/_2$D inches.

MFJ-969 $259.95

MFJ-941E Super Value Tuner

Most for your money! 300 Watts PEP, 1.8-30 MHZ, lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, 4:1 balun, 1000 volt capacitors, Lexan front panel. $10^1/_2$W x $2^1/_2$H x 7D in. **MFJ-941EK, $149.95.** Tuner Kit -- Build your own!

MFJ-941E $169.95

MFJ-945E HF/6M Mobile Tuner

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8 x 2 x 6 in. Lighted Cross-Needle SWR/Wattmeter. Lamp and bypass switches. Covers 1.8-30 MHz and 6 Meters. 300 Watts PEP. **MFJ-20, $9.95**, mobile mount.

MFJ-945E $159.95

MFJ-971 Portable/QRP Tuner

Tunes coax, balanced lines, random wire 1.8-30 MHz. Cross-Needle Meter. SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ transceivers. Tiny 6 x $6^1/_2$ x $2^1/_2$ in.

MFJ-971 $149.95

MFJ-901B Smallest Versa Tuner

MFJ's smallest (5 x 2 x 6 in.) and most affordable wide range 200 Watt PEP Versa tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-901B $119.95

MFJ-902B Tiny Travel Tuner

Tiny $4^1/_2$ x $2^1/_4$ x 3 inches, full 150 Watts, 80-6 Meters, has tuner bypass switch, for coax/random wire. **MFJ-904H, $169.95**. Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. $7^1/_4$ x $2^1/_4$ x $2^3/_4$ inches.

MFJ-902B $129.95

MFJ-16010 Random Wire Tuner

Operate all bands anywhere with MFJ's reversible L-network. Turns random wire into powerful transmitting antenna. 1.8-30 MHz. 200 Watts PEP. Tiny 2 x 3 x 4 in.

MFJ-16010 $79.95

MFJ-9201 QRPocket™ Tuner

80-10 Meters, 25 Watts. 12 position inductor, tune/bypass switch, wide-range T-network, BNCs. 4W x $2^5/_8$H x $1^1/_2$D inches. **MFJ-9201, $59.95**

MFJ-9201 $59.95

MFJ-921/924 VHF/UHF Tuners

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8 x $2^1/_2$ x 3 in.

MFJ-921/924 $109.95

MFJ-931 Artificial RF Ground

Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. Creates artificial RF ground or electrically places far away RF ground directly at rig. **MFJ-934, $249.95**, Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

MFJ-931 $129.95

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Comet's primary tool for any antenna adjustment or diagnostic project...

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!

Manual band-sweep function:
Select the band, select the center frequency, and select the bandwidth. Manually sweep the chosen frequency range and display the SWR graph.

Multiple Manual Band-Sweeps
Manually graph the user defined bandwidth multiple times and see the results overlaid in 5 selectable colors! Make antenna length, position, height above ground, gamma match adjustments, etc...and graph each adjustment in seconds, in a new color, without losing the previous graph!

The perfect combination of analog and graphic information, designed in particular for antenna diagnostics and adjustments while on the roof, tower or in the field!

Features:
Operates on 8-16VDC external power, 6 AA Alkaline or NiMH rechargeable cells • Trickle charger built in (only when using NiMH batteries) • Typical battery life: 9 hours of continuous operation • Battery level indicator • Selectable auto power-off time limit preserves battery capacity • SO-239 connector for 1.8-300MHz range • N-female connector for 300-500MHz range • Optional soft carry case sold separately: CAA-5SC

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New! Ver. 2.0 MFJ-1234B . . . Remotely operate your transceiver from anywhere in the world!

MFJ-1234B has RigPi version 2 software with new powerful Raspberry Pi 4B with 2 GB RAM. Loaded with 30 new features and updates and provides remote CW keying over the internet, support for over 27 new radios, PTT and frequency control knob from the Contour Shuttle controller and Flic Bluetooth PTT switch, antenna switching, power amp control and much more!

New!

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Apple iPhone operating your rig remotely from anywhere in the world!

Remotely operate your station! Use any web browser on your mobile phone, iPad, tablet, laptop, desk-top even a Kindle!

Use nearly any transceiver with CAT control, old or new. Operate all modes SSB, CW, FM, digital. WSJT-X, Fldigi are installed.

Control from anywhere via the internet using any browser -- radio, rotor, CW keying, VoIP, digital modes, logging, spot monitoring, callbook lookups, more.

Look-up calls using included FCC database or optional QRZ subscription. Monitor DX spots for un-worked or unconfirmed calls.

Design, maintain multiple logs. Upload ADIF logs to ARRL LoTW server. Send CW from a mobile device, keyboard or paddle.

32 programmable macros.

Two or more hams from different locations can operate different radios at the same time using one MFJ-1234.

Single-click updating, I/Q Input for SDR radios, onboard VoIP server gives outstanding 2-way audio.

Includes email, word processing, spreadsheet programs, 1000's of Linux programs, including many for ham radio. Modify, program RigPi Station Server features using a text editor.

HARDWARE

RSS is a Raspberry Pi™ computer running Linux and RigPi Keyer and Audio boards. RigPi Keyer uses K1EL WinKeyer3 integrated circuit for keyboard/paddle input. RigPi Audio is used for VoIP for remote, digital modes and I/Q spectral display (Panadaptor).

OPTIONS

MFJ-1305RP, $24.95. 5V, 3A Pwr Supl.
MFJ-1234BSD,$59.95. RigPi 2.0 software on SD Card only.
MFJ-1234BOS, $29.95. Rig Pi Version 2.0 software download.
MFJ-1234AB, $79.95. Audio Board.
MFJ-1234KB, $79.95. Keyer Board.
MFJ-1234BC, $29.95. Metal cabinet for Raspberry Pi 4B, audio, keyer boards.

TECH HELP

- RigPi forum is *https://rigpi.groups.io*
- RigPi website is *https://rigpi.net*

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MFJ CW Reader and Keyer Combination

Plug MFJ's CW Reader with Keyer into your transceiver's phone jack and key jack.

Now you're ready to compete with the world's best hi-speed CW operators -- and *they won't even know you're still learning the code!* Sends and reads 5-99 WPM.

Automatic speed tracking. Large 2-line LCD shows send/receive messages. Use paddle or computer keyboard.

Easy menu operation. Front panel speed, volume controls. 4 message memories, type ahead buffer, read again buffer, adjustable weight/sidetone, speaker. RFI proof.

MFJ-551, $39.95. RFI suppressed keyboard, a must to avoid RFI problems.

MFJ-464

$239.95

(Keyboard, paddle not included.)

MFJ Pocket-Size CW Reader™ and Code Tutor

MFJ-461, $109.95. Place this tiny pocket size MFJ Morse Code Reader near your receiver's speaker and watch CW turn into solid text messages as they scroll across an easy-to-read LCD. No cables to hook-up, no computer, no interface, nothing else needed! Practice by copying along with the MFJ-461. Learn the code and increase your speed as you instantly see if you're right or wrong. Eavesdrop on interesting Morse QSOs from hams all over the world. MFJ's *AutoTrak*™ automatically locks on, tracks and displays CW to 99 WPM. Serial port lets you display full screen CW text on your computer monitor with your computer and terminal program. Tiny 2¼x3¼x1", 5½ oz. Fits in your shirt pocket, take it anywhere. Use 9 Volt battery.

MFJ-418, $109.95. Morse Code Tutor. Learn Morse code anywhere! Copy letters, numbers, prosigns or any combination or words or QSOs. ARRL/VEC format. Go from zero code speed to a high speed *CW Pro!* High contrast LCD, built-in speaker.

Plug & Play FT-8 and all Digital Modes!

MFJ-1204, $119.95. *Plug&Play* all digital modes! Specify your radio when ordering and just plug USB cable into your computer. Download *free* software from internet and operate: FT-8, JT4, JT-65, JT6M, FSK441, WSPR, PSK-31, EchoLink, APRS, CW, RTTY, packet, Amtor, more. Easy-to-set transmit/receive levels. Transformer isolated audio, PTT sensing eliminates adjustments. Universal, never obsolete.

MFJ-407E Deluxe CW Keyer $119.95

MFJ Curtis-Keyer has all modes, dot-dash memories, jam-proof spacing, weight, sidetone, built-in speaker. Speed, weight and tone controls and tune, semi-auto and on/off are on front panel.

MFJ-557 Code Oscillator/Key $49.95

Practice sending Morse code. Telegraph key, code oscillator, speaker on heavy non-skid steel base. Volume/tone controls. Use 9V battery.

MFJ-550, $19.95. Key only.

MFJ-561 Tiny Iambic paddle $34.95

Tiny *Iambic paddle* is just 1¾Wx¾Hx1¾D", just 2½ oz. Precision paddle formed from phosphorous bronze, rugged metal base, non-skid rubber feet, wired.

MFJ-401E *Econo* CW Keyer $94.95

Front-panel volume/speed controls (8-50 wpm), tune switch. Internally adjust weight/tone. Solid state keying. Tiny 4x2x3½ inches.

MFJ-564 Iambic Paddles $109.95

Deluxe Iambic paddles. Tension/contact spacing adjustments, steel bearings, precision frame, non-skid feet. Crome (MFJ-564) or Black (MFJ-564B).

MFJ-422E *Keyer/Paddle* $229.95

MFJ *CW keyer and Iambic Paddle* combo lets you send smooth, easy CW. Front panel volume/speed (8-50 WPM), built-in dot-dash memories, speaker, sidetone.

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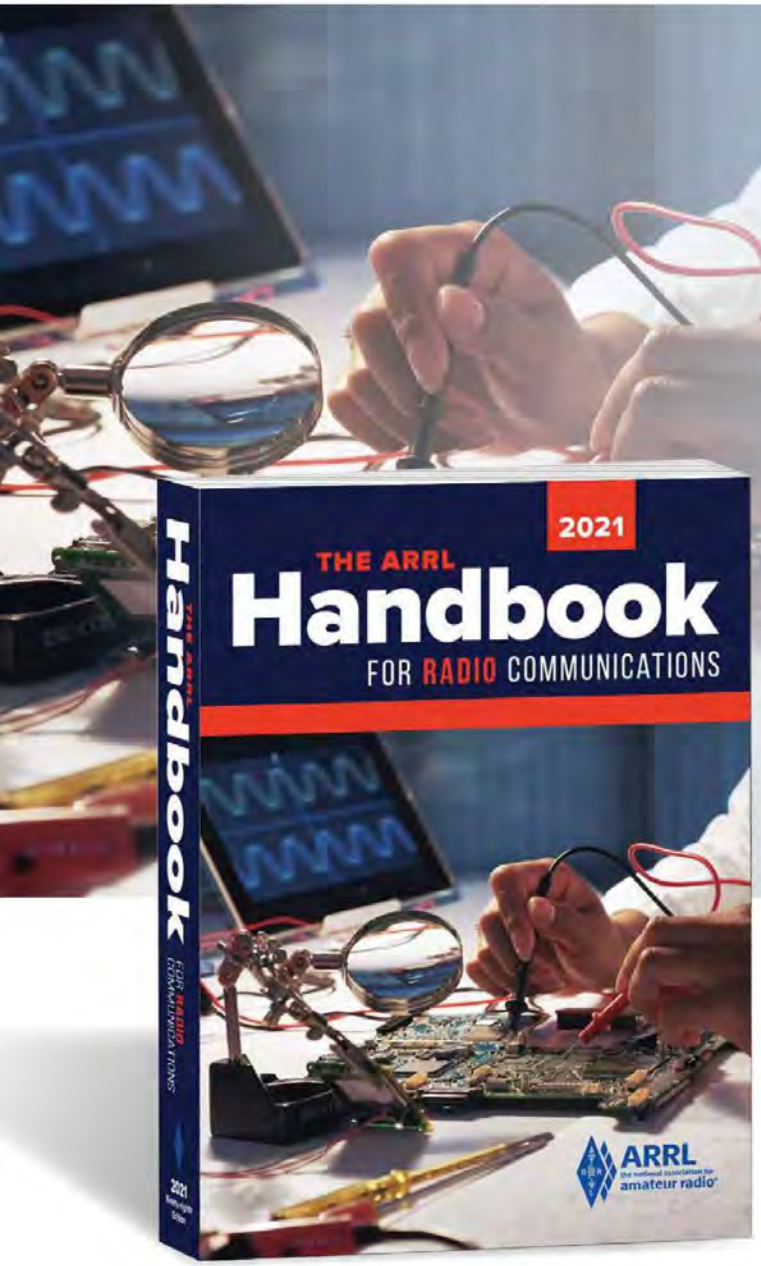

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MFJ Mobile Antennas!

Dual Band Mag Mount Antennas

MFJ-1724B

2-Meter/440 MHz

MFJ-1724B **$34.95**

This antenna is perfect for your dual band mobile or HT. Powerful 3 1/2 inch magnet holds firm at highway speeds, rubber guard, 19" black stainless steel whip, low SWR, excellent gain, 300 Watts PEP, 12 feet coax with PL-259. Free BNC adapter.

MFJ-281 **$15.95**

MFJ-281

Clearest speech you ever heard!
3" speaker, 8W, 8 Ohms, 6' cord, 3.5 mm plug.

MFJ-1729

Power*Gain™

MFJ-1729 **$49.95**

Ham Radio's most powerful dual band antenna gives whopping gain on 440 MHz and 2-Meters! Low SWR. 27 1/2" stainless steel Slimline™ radiator minimizes wind vibration for less SWR flutter for longer range, better readability. 12' coax, PL-259, Heavy duty magnet mount.

MFJ-1728B

5/8 Wave 2/6 Meter Mobile

MFJ-1728B **$34.95**

Full 50-inch 5/8 Wave gives you maximum possible gain of any single element antenna on 2-Meters. On 6-Meter "magic band" you get a powerful signal with its high-performance low SWR full 1/4 Wave. 300 Watts PEP, heavy duty magnet, 12 feet coax, stainless steel radiator.

MFJ Super-Strong Magnet Mounts with Coax/PL-259

MFJ 5-inch Magnet

Best Seller!
These jetblack 5-inch super strong magnet mounts have 17' coaxial line terminated with PL-259 connectors. SO-239 (BS) or NMO (BM) for your VHF/UHF antennas or 3/8-24 threaded (BT) for your HF hamstick antennas with a 3/8-24 threaded connector.

$19.95 Each

MFJ-335BS – SO-239
MFJ-335BM – NMO
MFJ-335BT – 3/8 - 24 For HF sticks

MFJ 3-inch Magnet

3-inch Black Magnet Antenna Mounts
17-foot coax is terminated with PL-259 connector. Choose SO-239 (BS) or NMO (BM). For VHF/UHF lightweight antennas.
MFJ-333BS Pictured

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MFJ SMA/BNC Cables

Release strain on your HT's antenna connector! 3 ft. flexible, mini coax with SO-239 connector.

$19.95 Each

A. **MFJ-5612S** SMA Male.
B. **MFJ-5612SF** SMA Female Wouxun/Baofeng.
C. **MFJ-5612B** BNC Male.

MFJ Triple 5-inch Magnets

Goliath™ – Ultimate Strength Magnet
Three super-strong 5-Inch Magnets make up this MFJ Goliath™ Tri-Magnet Mount. 1/4" thick steel triangle base. 17' coax. Select SO-239, NMO, 3/8-24 antennas. **Caution:** once on, it's difficult to get off!

$44.95 Each

MFJ-336S – SO-239
MFJ-336M – NMO
MFJ-336T – 3/8 x 24

HF/VHF/UHF 200 Watt Duplexers

MFJ-916B **$34.95**

Use separate HF/VHF and 440 MHz UHF antennas with single transceiver OR use two separate HF/VHF and 440 MHz UHF transceivers with a single HF/VHF/UHF antenna. Heavy-duty diecast enclosure houses low/high pass networks that separate/combine HF/VHF/UHF signals. Low loss SO-239s. 50 Ohm ports. **MFJ-916BC, $59.95** 3 ft. coax pigtails on 2-port side.

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Compact 1.8-200 MHz SWR/Wattmeter has HUGE 3" Cross-Needle meter. Read forward/reflected power and SWR simultaneously. Perfect for mobile/portable. 30/300 Watt ranges. Built-in meter light. SO-239s. 3 1/4W x 3 1/4H x 3 1/4D". **MFJ-842, $69.95** covers 140-525 MHz, 15/150 Watts.

MFJ-822 **1.8-200 MHz $69.95**
MFJ-842 140-525

VHF/UHF Hi-Gain Antennas

A. MFJ-1402, $39.95.
VHF/UHF RuffRiderJunior™. Premium, short 16 1/2" antenna fits in any garage on any auto. 1/4 Wave on 2 Meters, 1/2 Wave, gain on 440 MHz. 100W. No foldover. B or C.

B. MFJ-1412, $39.95.
VHF/UHF RuffRider High Power™. Just 40" long handles full 200 Watts. Great for high power mobile amp. 1/2 Wave, gain on 2 Meters, 5/8 Wave, great gain on 440 MHz. Black or chrome.

C. MFJ-1422, $44.95.
VHF/UHF RuffRider High Gain™. 41 1/2 inch long antenna gives extra gain with little height increase. Handles 150 Watts. 1/2 wave with good gain on 2 Meters, 5/8 wave, excellent gain on 440 MHz. Black or chrome.

D. MFJ-1432, $64.95.
VHF/UHF RuffRider Hyper Gain™. 62 1/2" brute gives whopping gain on 7/8 Wave 2-Meters, 5/8 Wave and a MONSTER gain on 440 MHz. MFJ will rock your ham radio world! 150 Watts. Use tri-magnet. Black or Chrome.

MFJ Mobile HF Ham Sticks

Each is ruggedly constructed. A heavy duty 4 foot, 3/8 inch diameter fiberglass rod; a nearly indestructible .125 inch diameter PH-17-7 stainless steel whip and chrome plated brass fittings will give you years of service. It's sleek, low profile construction has low wind loading and its semi-rigid fiberglass eliminates the need for springs or guys.

Black anti-static jacket protects loading coil, blends with any vehicle. Stainless steel whip is adjustable for lowest SWR. Push it down to park in the garage or fully extend it for maximum efficiency during mobile operation.

Includes allen wrench and complete tuning and matching instructions. Handle 250 Watts PEP. Whips are 7 feet fully extended, and collapse to about 4 feet for easy storage.

Simply screws into any 3/8 x 24 female mount for quick bandchanging. Get them all for great band coverage!

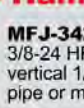
MFJ-1675T - 75 Meters
MFJ-1660T - 60 Meters
MFJ-1640T - 40 Meters
MFJ-1630T - 30 Meters
MFJ-1620T - 20 Meters
MFJ-1617T - 17 Meters
MFJ-1615T - 15 Meters
MFJ-1612T - 12 Meters
MFJ-1610T - 10 Meters
MFJ-1606T - 6 Meters

$19.95 -$21.95 Each

60-75 Meters $29.95 each

— 3/8-24 Ham Stick Mounts —

MFJ-343, $15.95. Tough 3/8-24 hard mount for permanent installation.



MFJ-342T, $15.95. 3/8-24 HF horizontal or vertical 1/4 or 1/2 inch pipe or mirror mount.

MFJ-344, $15.95. Like MFJ-342T, but horizontal pipe mount.

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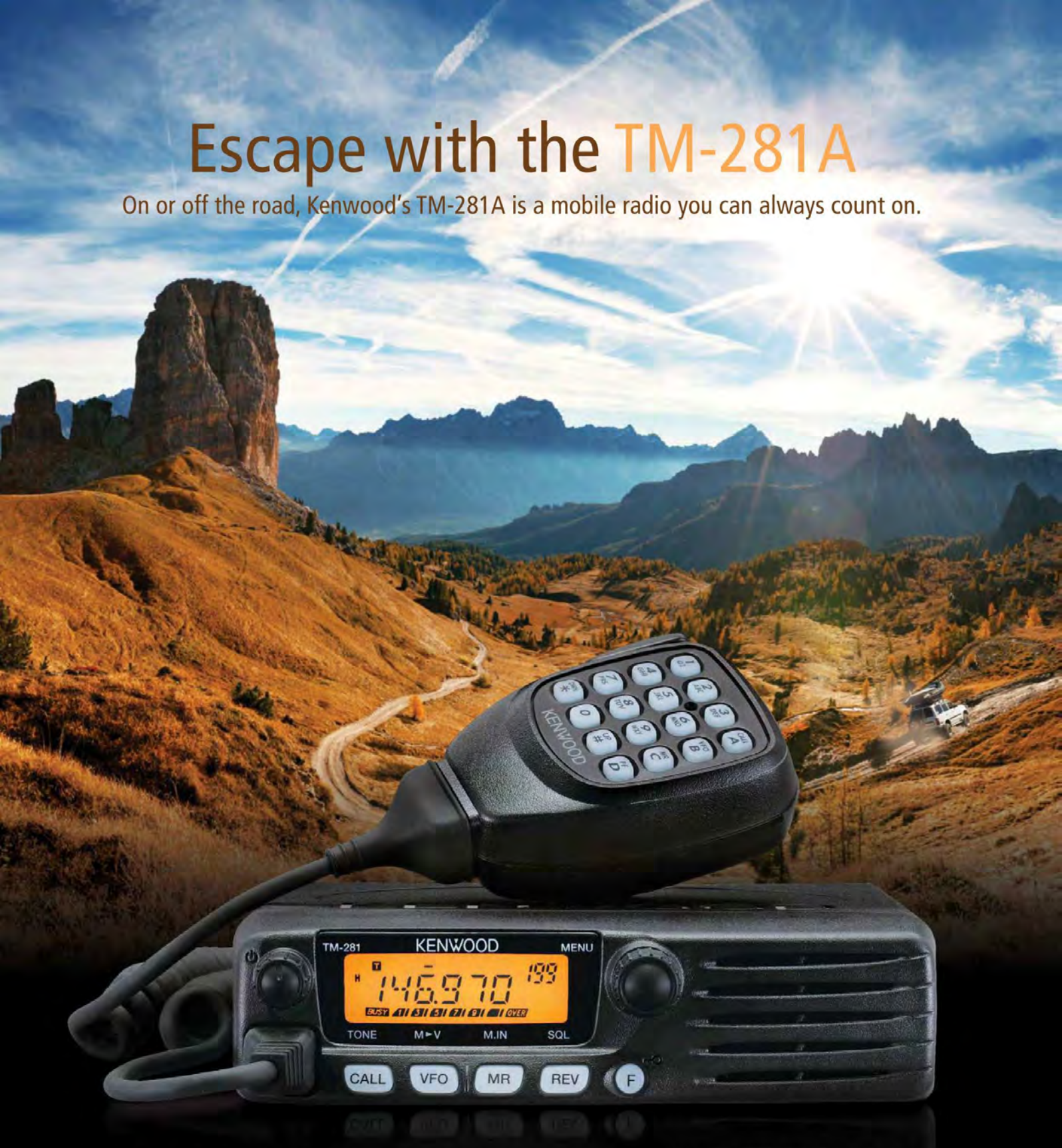

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