OUR 27TH YEAR!

EPARA BEACON

VOL. 7, NUMBER 4 THE OFFICIAL NEWSLETTER OF THE EASTERN PENNSYLVANIA AMATEUR RADIO ASSOCIATION APRIL 2023

NEXT CLUB MEETING: APRIL 13TH

Monroe County Public Safety Center, 100 Gypsum Rd Stroudsburg, PA 18360

Welcome to the EPARA Beacon! This newsletter is published monthly and is the official newsletter of the Eastern Pennsylvania Amateur Radio Association. EPARA has served the amateur radio community in the Pocono Mountains for over 25 years. We have been an ARRL affiliated club since 1995. We offer opportunities for learning and the advancement of skills in the radio art for hams and non-hams alike. EPARA supports Monroe County ARES/RACES in their mission of providing emergency communications for served agencies in Monroe County. Feel free to join us at one of our meetings or operating events during the year. The club meets on the second Thursday of every month, at the Monroe County 911 Emergency Control Center. The business meeting starts at 7:30 P.M. Anyone interested is invited to participate in our meetings and activities.

ZOOM Meeting Info: Meetings begin at 7:30PM!

https://us02web.zoom.us/j/85463346031?pwd=bU1KcVZ0aVZiVEUvdjRsUXlNNHZkZz09

Meeting ID: 854 6334 6031 Password: 244632

From The President

Spring is in the air, well sort of anyway. It's still a little cold for my blood but that's me. I started some overdue antenna work at home, and we have some antenna work to do at the 911 center. The coax for the 911 center antenna has been ordered and we will schedule the repair work at the next meeting. I have been having a hard time getting things done with work and family obligations as well as some health issues.

The Saint Patrick's Day Parade was a great event and I think quite successful. We did some great community outreach. I want to thank all who helped make it possible and I especially want to thank Ruth Ann W9FBO for organizing this. She is a great asset serving as the EPARA PIO. I have some additional news about the West End Fair that will be announced at the meeting.

We have some Field Day planning and Hamfest planning to do, these events are coming fast so time to get going. We also have some developments to discuss concerning our EME and Sat COMM efforts. So, there are some very important things to handle in the coming months, your input and participation is very important. This club is for you and is nothing without you.

Well, that's it for now.
Our next meeting will be on April 13th, hope to see you then.

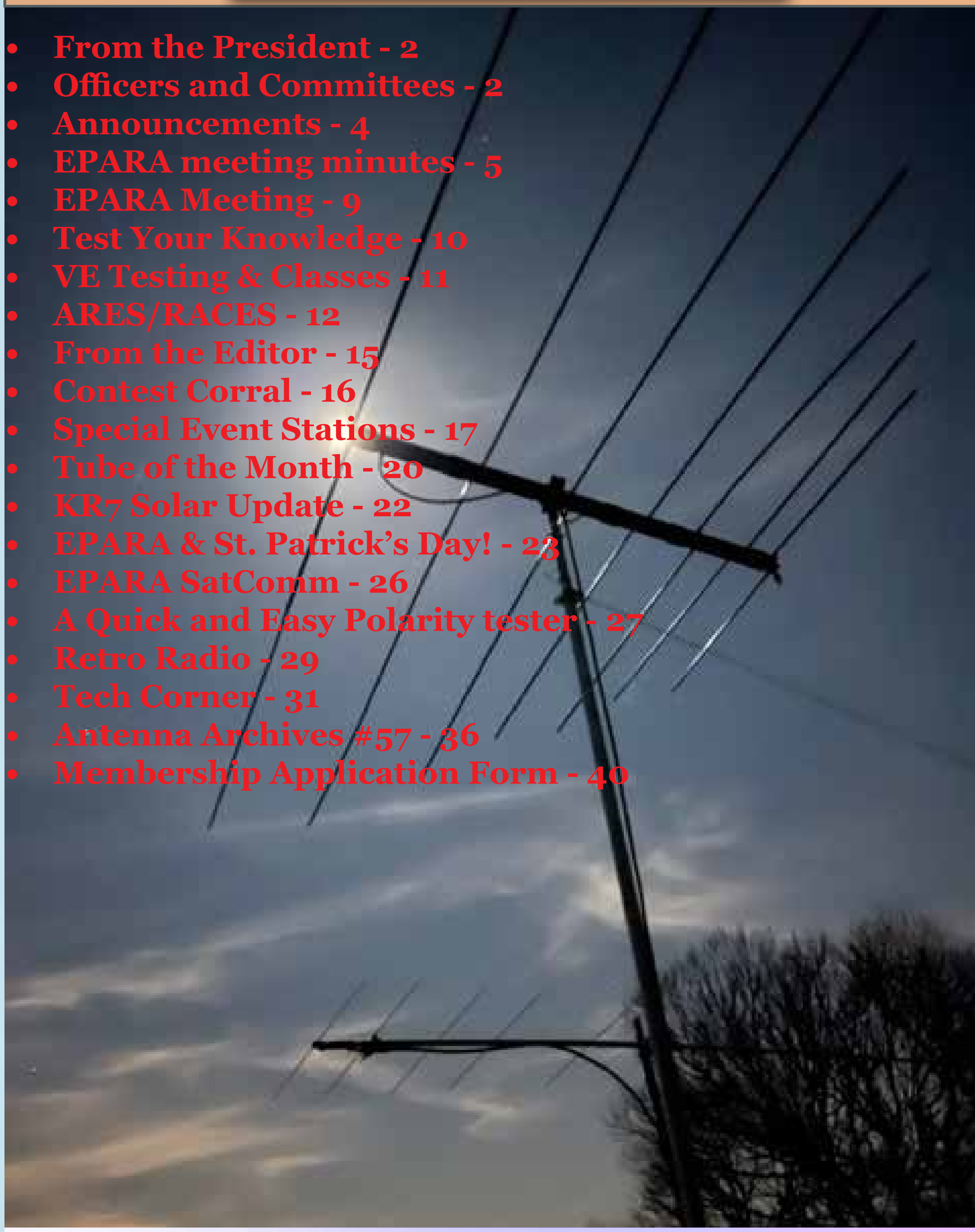
Chris, AJ3C

CONTACT INFORMATION

President Chris Saunders AJ3C: aj3c@gmx.com	Vice President Bob Matychak W3BMM: w3bmmqth@gmail.com
Secretary Kevin Forest W3KCF: w3kcf@outlook.com	Treasurer Scott Phelan KC3IAO: kc3iao@hobbyguild.com
Member at Large Eric Weis N3SWR: n3swr@ptd.net	ARES EC Charles Borger KB3JUF KB3JUF@gmail.com

Postal Address:	Web Site:	Send dues to:	Newsletter submissions to:
EPARA	https://www.qsl.net/n3is/	EPARA	Eric Weis, N3SWR Editor
PO Box 521	Email:	PO Box 521	EPARAnewsletter@ptd.net
Sciota, PA 18354	N3IS@qsl.net	Sciota, PA 18354	

What's INSIDE this ISSUE



EPARA Net list

Monroe county ARES-RACES – Sunday's 8:30 PM, 146.865 MHz, PL -100 Hz

The Monday Night Pimple Hill repeater 8:30 PM (Repeater freq = 447.275 with a - 5MHz offset) DMR TECH Net on TG314273* Time Slot 2

SPARK Information/Swap Net – Tuesday's 8:30 PM, 147.045 MHz, PL 131.8 Hz

The Wednesday Night EPARA Hot Spot DMR Rag Chew net at 8:30 PM, TG 3149822* Time Slot 2 (N3IS Talk Group)

EPARA Tech Net – Friday's 8:30 PM, 147.045 MHz, PL +131.8 Hz

*TG = Talk Group

President
Chris Saunders AJ3C

Vice President
Bob Matychak W3BMM

Secretary
Kevin Forest W3KCF

Treasurer
Scott Phelan KC3IAO

Member at Large
Eric Weis N3SWR

****

ARES EC
Charles Borger KB3JUF

Assistant EC
Chris Saunders AJ3C
Len Lavenda KC3OND

Field Day Coordinator
Chris Saunders AJ3

Quartermaster
TBD

Membership Coordinator
Al Brizzi KB3OVB

Newsletter Editor
Eric Weis N3SWR

Photographer
Eric Weis N3SWR

Public Information
Ruth Ann W9FBO

Social Media
Chris Saunders AJ3C
Eric Weis N3SWR

Hamfest Coordinator
Bill Connely W3MJ
Walter Koras W3FNZ

Technical Program Coordinator
Bill Carpenter AB3ME

Lead VE
Chris Saunders AJ3C

Webmaster
Chris Saunders AJ3C

Announcements
AND UPCOMING EVENTS

EPARA Club Dues!

Club dues are now past due. Contact Scott KC3IAO via his email: KC3IAO@hobbyguild.com and you can send him a check or pay via PayPal.

Rookie Roundup

Rookie Roundup is a contest aimed at Amateurs licensed for three years or less. This six-hour event is held three times per year (April, August and December). Rookies can contact anybody, while "Old Timers" make contact with only Rookies. Mentoring is a big part of this event!

All events run for 6 hours (from 1800 to 2359 UTC) on the dates shown below.
- Sunday, April 16, 2023, using SSB.
- Sunday, August 20, 2023, using RTTY.
- Sunday, December 17, 2023, using CW

2023 ARRL Field Day is June 24-25

Field Day is ham radio's open house. Every June, more than 40,000 hams throughout North America set up temporary transmitting stations in public places to demonstrate ham radio's science, skill and service to our communities and our nation. It combines public service, emergency preparedness, community outreach, and technical skills all in a single event. Field Day has been an annual event since 1933, and remains the most popular event in ham radio.

Tornado Season and Amateur Radio

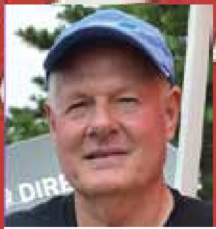
Tornado season is fast approaching, and amateur radio operators will again play a key role in helping the National Weather Service (NWS) issue accurate and timely warnings. In fact, March through May is considered the most active period for tornadoes to develop.

The SKYWARN® (weather.gov) Storm Spotter Program is available to anyone interested in helping the NWS track and report potentially dangerous weather. Anyone can become a SKYWARN weather spotter, and the information is available at the SKYWARN website. Most states have amateur radio networks that are activated during severe weather. Trained volunteers use their radios to report rapidly changing activity and share the information with local weather offices. A list of the states that have scheduled special weather awareness activities can be found at the NWS Awareness and Preparedness Calendar (weather.gov).

Significant solar flare erupts from sun

The sun emitted a significant solar flare on March 30, 2022, peaking at 1:35 p.m. EST. This flare is classified as an X-Class flare. X-class denotes the most intense flares, while the number provides more information about its strength. An X2 is twice as intense as an X1, an X3 is three times as intense, etc.

Rule #1 of Amateur Radio, it is a hobby, unless you figured out a way to fashion a living out of it.
Rule #2 of Amateur Radio, life is not a hobby and typically carries heavy responsibilities of everything that is not a hobby.
Rule #3 of Amateur Radio, never give up a LIFE event for a Ham event. You may make some great memories at the Ham event, but the guilt you may carry missing a LIFE event can be a terribly heavy millstone.
Rule #4 of Amateur Radio, as technology moves forward, so does Ham Radio - do what makes you happiest, experiment with other elements of Ham Radio as LIFE allows.
Rule #5 of Amateur Radio, it is only Ham Radio, when confused always refer to Rule #1 through #4.



EPARA GENERAL MEMBERSHIP MEETING AGENDA

EPARA Membership Meeting Minutes
March 9th *2023*

General Membership Meeting 7:30Pm

<u>Open meeting:</u>

Meeting called to order at 7:30 pm on March 9th, 2023 by Chris AJ3C

Declaration of Quorum.
Total attending **30**. Present at 911Center **21**. Present on Zoom **9**. Visitors present **2**

<u>Pledge of Allegiance / Moment of silence:</u>

<u>Membership Meeting – Minutes Feb 9 th|2023</u>
Secretary - W3KCF:

Meeting minutes for Feb 9th 2023 were posted on the EPARA website. Chris – AJ3C asked members if they had seen and read the minutes from our previous meeting. He then asked if there were any questions or objections to the minutes as they were presented. With no objections, Chris asked for a motion to accept the minutes as presented:

Motion to accept minutes as read: By Alex – KD2FTA 2nd by Martin – KC3TOE Motion Passed

<u>Treasurer's report:</u>

Treasurer's report: For March 2023
Read by Chris – AJ3C

Bank Account 2/28/23 statement Opening Balance.: $5310.40.

Income:
Interest: $0.20.

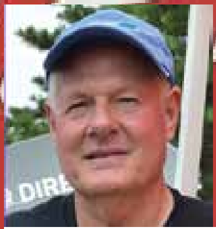
Expenses:
Chk #169 $50.00 St Pat's parade permit.

Closing Balance: $5260.60.

Un-deposited Funds: $140.00
Dues: (KC3NAO, AA2CQ & wife, KD2FTA, W3WWP, KE2KY)
50/50: ($45.00) Winner – Brett

Our PayPal Account: 2/28/23 statement opening balance: $224.70

Income:
Dues: $65.00 (KA2TSM, KC3SMF, KO3Q, KC3BZJ)



Expenses
PayPal Fee: $3.26

Closing Balance: $286.44.

Motion to accept by Ruth Ann – W9FBO   Seconded by Dan – KC3JCE   Motion Passed

Correspondence: None

Reports of officers and committee's:

Bill AB3ME – Program Committee

Alex KD2FTA is scheduled to make a presentation on software-defined radios (SDR) after the Meeting.

Chris -AJ3C stated that those interested in giving a presentation, please contact him or Bill – AB3ME.

Charlie KB3JUF – ARES/RACES:

Charlie - KB3JUF spoke about the new equipment in the radio room. Very thankful for the donation.

Charlie reiterated that all involved in ARES need to be motivated. Make sure you attend our meetings on the 4th Friday of the month and keep your Task Books up to date. Complete any and all training required and stay enthused. Charlie also stated, please check in on the Sunday Night ARES Net.

Charlie also mentioned we are in the recruitment stage. We are looking for volunteers to increase membership in our ARES group.

Ruth Ann, W9FBO – PIO:

EPARA will participate on Sunday March 19th, in the St. Patrick's Day parade in Stroudsburg. Mike – W3MIK volunteered his truck/trailer. Brad KF6FOK volunteered portable HF rig, speakers and power. RuthAnn asked if everyone could be there between 9 and 10 that morning to get setup.

Chris AJ3C -- Instruction and Training:

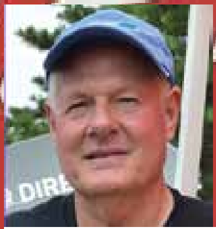
VE sessions have started again on the 4th Friday each month at 6:00pm. Training classes will be postponed until after field day, as Chris will be out of town.

Chris AJ3C – Website:
No Update

Bob W3BMM – Social Media:

New EPARA Groups.IO -- the club's new bulletin board on the cloud and group email service -- has been well received and active. Members are welcome to post any and all amateur radio-related questions and topics.

Bob said, "**please like the site**", and send him as many pictures of the parade as possible.



EPARA GENERAL MEMBERSHIP MEETING AGENDA

Al, KB3OVB: Membership:

As of the start of tonight's meeting, forty-one (41) members have paid their 2023 dues. Annual dues are now due.

Eric N3SWR – Newsletter:

Eric wanted us to know that everything is well with the newsletter. Keep sharing content with him. He plans to have audio links and additional pages in the next addition.

Sat-Com / EME Group:

Alex KD2FTA stated that a calendar with the best EME date was forthcoming. He also said he was working to fine tune the process for all our satellite work.

Old business:

Radio Room – Update:

The radio room is setup and ready to use. We are just waiting on the antenna repairs and it will be fully operational. We appreciate the donations made by John and the work he put into making sure everything was up and working. We'd also like to thank Martin, Len and Charlie, who were there to lend a helping hand.

Again John, thank you for the equipment you provided to the club. It will be a benefit to all our members and those in the community that receive our help.

911 Center Antenna:

We are looking to purchase 500 feet of RG 8/U at a cost of just under $500, to repair the damaged cable at the 911 center. Chris said we'd like to make repairs as soon as the weather cooperates.

Motion to accept* by *Chris – AJ3C and 2nd by Brad* – KF6FOK. *Motion Passed

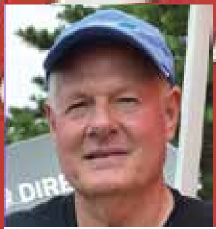
New business:

Net Controllers:

Alex KD2FDA noted that additional volunteer net controllers for non-MCARES EPARA nets would be beneficial. Ruth Ann W9FBO volunteered to be added to the NC rotation for the non-MCARES EPARA nets, but said she would initially need help running the net with technical questions that may be asked.

West End Fair:

Charlie has an appointment next week and is meeting with Peanut, to see about getting a booth again this year at the fair.



EPARA GENERAL MEMBERSHIP MEETING AGENDA

Votes/New Members:

Chris- KC3VIO and Joseph – KC3VQT are our newest members. Congratulations!

Announcements:

Club dues for 2023 are now due. If you would like to pay your 2023 EPARA dues using PayPal, please email Scott and Include your Call Sign, Name, and Age. Scott will send you a PayPal Invoice you can use to pay your dues.

KC3IAO@hobbyguild.com

Any Additional Announcements None

Tonight's 50/50 Raffle was won by Brett, who received $46

Adjournment…

Meeting was adjourned at 2030*:*

Motion to close by RuthAnn – W9FBO and 2nd by Charlie -KB3JUF Motion Passed.

Secretary
Kevin Forrest
W3KCF

MARCH 1976
$1.50

AMATEUR RADIO

EPARA MEETING

"Ain't nuthin' wrong with us, Doc!"

TEST YOUR KNOWLEDGE!

How many states does a 3-bit binary counter have?

A. 3
B. 6
C. 8
D. 16

Last months answer was C. The formula to compute the power loss in decibels (dB) is:
dB=10 × log10 (Pf / Pi).
The power change is given as a loss of 1 dB, which we can plug into our equation:
-1 dB=10 × log10 (Pf / Pi)

What is Digital Mobile Radio (DMR)?

- A European Telecommunications Standards Institute (ETSI) standard first ratified in 2005 and is the standard for "professional mobile radio" (PMR) users. Motorola designed their MotoTrbo line of radios based upon the DMR standards
- Meets 12.5kHz channel spacing and 6.25kHz regulatory equivalency standards
- Two slot Time Division Multiple Access (TDMA)
- 4 level FSK modulation
- Cutting edge Forward Error Correction (FEC)
- Commercial ETSI/TIA specs mean rugged performance and excellent service in RF congested urban environments (no intermod and other RF "hash")
- Equipment interoperability is certified by the DMR Association

DMR
DIGITAL MOBILE RADIO

The EPARA HOT SPOT Wednesday night DMR rag chew is here!

Wednesday evenings at 8:30 PM local, 0:30 UTC!

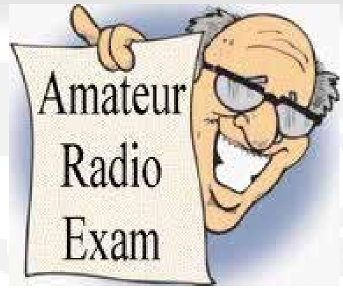
Tune your DMR radios to Talk Group 3149822 TS2 to join the

N3IS EPARA Hot Spot rag chew DMR net.

Listen to the Tech Net Friday nights on the 147.045 repeater to learn more about joining this net and for upcoming ZOOM meetings announcements to learn more about programing your radios and hot spots!

VE Testing & Classes

Anyone looking to take an exam is encouraged to contact Chris AJ3C to preregister at least one (1) week in advance of the test date. If you have any questions or to register, Chris can be reached via email AJ3C@GMX.COM. VE sessions are being held the 4th Friday of each month at 6pm at the Monroe County 911 training center. Seating is limited for the time being so we can follow the health guidelines set forth by the county and state.



VE sessions are back - contact Chris AJ3C for further information!

AMATEUR RADIO CLASSES

ARES/RACES meetings are now being held on the fourth Friday of each month at 7PM. The meetings are once again being held at the 911 call center. These meetings will serve as training sessions covering several aspects of amateur radio emergency communications. We will start with traffic handling and the use of Radiograms and the ICS 213 general message form. Future sessions will cover the use of several ICS forms and the setup and use of digital communication modes including Winlink, Packet Radio, APRS, and the FLDIGI software program. Meeting are open to all, you do not need to be an ARES/RACES team member to attend.

Want to Put Your Ham Radio Skills to Good Use? Get Involved in

EmComm!

One of the missions of the Amateur Radio Service is for amateur radio operators to provide public service and emergency communications (EmComm) when needed. We act as a voluntary noncommercial communication service and pitch in to help our communities and first responders.

So, what organizations are out there for community-minded amateur radio operators and what can we do to help?

Join In

One good entry point into public service and emergency communications is to join SkyWarn, a volunteer program run by the National Weather Service (NWS) with more than 290,000 trained severe weather spotters. These volunteers help keep their local communities safe by providing timely and accurate reports of severe weather to the NWS.

Not all of these weather spotters are amateur radio operators, but many are. Amateur radio communications can report severe weather in real time. When severe weather is imminent, SkyWarn spotters are deployed to the areas where severe weather is expected. A net is activated on a local repeater and SkyWarn spotters who are Hams check into that net. The net control advises the spotters when they might expect to see severe weather, and the spotters report conditions such as horizontal winds, large hail, rotating clouds, and even tornadoes.

To become a SkyWarn spotter, you must attend a class that teaches you the basics of severe weather, how to identify potentially severe weather features, and how to report them. The classes are free and typically last about two hours. Check your local NWS website for class schedules.

ARES/RACES/CERT

Another way Hams can become involved in public service and emergency communication is to join an ARES or RACES group. Technically, these are two separate services—the Amateur Radio Emergency Service (ARES) is run by the ARRL, while the Radio Amateur Civil Emergency Service (RACES) is a function of the Federal Emergency Management Agency (FEMA). Amateur radio operators who typically take part in one also take part in the other.

To participate in RACES, you'll need to take some self-study FEMA courses in emergency preparedness and emergency-response protocols. Classes may or may not be required to participate in ARES. These requirements are set by each individual ARES group. To get involved with either ARES or RACES, ask your local club members when they meet. You can also contact the Section Manager or Emergency Coordinator for your ARRL section. To contact them, click here and find the section that you live in.

Amateur radio operators belonging to ARES (and its predecessor, the Amateur Radio Emergency Corps) have responded to local and regional disasters since the 1930s, including the 9/11 attacks, and Hurricane Katrina and Hurricane Michael, among others.

The Community Emergency Response Team (CERT) program trains volunteers—both Hams and non-hams—how to be prepared for disasters that may impact their area. They provide basic disaster response skills, such as fire safety, light search and rescue, team organization, and disaster medical operations. CERT offers a nationwide approach to volunteer training and organization that first responders can rely on during disaster situations, allowing them to focus on more complex tasks.

What Gear Do You Need?

For most local needs, a 5-watt VHF/UHF handheld transceiver is sufficient for utilizing local repeaters to relay messages and report on conditions as they exist. Replacing the radio's stock antenna with a higher gain antenna or connecting it to a magnetic mount on a vehicle will increase range significantly.

Even better is a VHF/UHF mobile radio installed in your vehicle with 25 or more watts output and a good mobile antenna. In the event the repeater loses power, you can talk over a considerably larger area in simplex mode with the extra power and a good mobile antenna.

If you work with an ARES or RACES group, you may be asked to act as a county control station. In this capacity, you'd need both HF and VHF transceivers in a fixed location, such as your house, with a good antenna system and emergency power capabilities like a generator or batteries. This allows you to make contacts within your state and throughout the U.S.

Helping Hams

Ham radio can play a key role in emergency situations. Here are a few examples:

- Ham radio connected firefighters and police departments, Red Cross workers, and other emergency personnel during the 2003 blackout that affected the northeast United States.
- In 2017, fifty amateur radio operators were dispatched to Puerto Rico to provide communications services in the wake of Hurricane Maria.
- Amateur radio operators provided communications in the aftermath of the Boston Marathon bombing when cellphone systems became overloaded.

- During Hurricane Katrina, more than one thousand ARES volunteers assisted in the aftermath and provided communications for the American Red Cross.
- During the devastating Oklahoma tornado outbreak that began in May 1999, amateur radio operators—giving timely ground-truth reports of severe weather—played a critical role in the warning and decision-making processes at the NWS Weather Forecast Office in Norman, Oklahoma.

Credit: https://www.onallbands.com/want-to-put-your-ham-radio-skills-to-good-use-get-involved-in-emcomm/

From the Editor

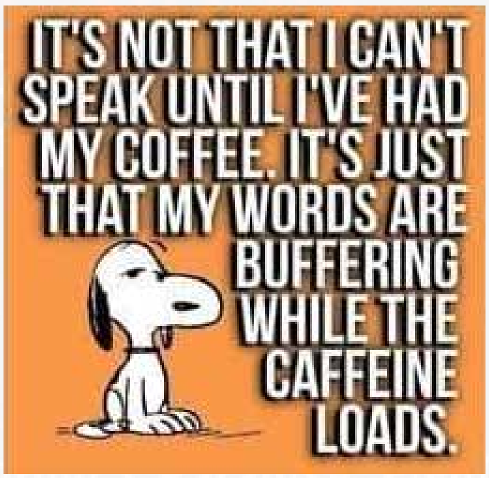
Eric, N3SWR

April Fools is once again upon us, but then again so is spring, but somehow I lost that somewhere along the way. It's too cold out there it seems. But I found time to make it to the rifle and pistol range. That seemed to have cured me for now haha. Walking around the "public" range in Tobyhanna I found ten live rounds just laying around. You know - the things that make you go Hmmm... :)

We I have to admit, it is almost 70 degrees outside and I need to catch some fresh air before this storm hits later today. It's on the radar and headed this way. Should be an interesting evening. Tomorrow we head back to the cold days for a spell.

That's it for now, catch you all next month!

Eric N3SWR, 73



NEW ITEMS ON THE MARKET

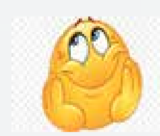
Electric Outlet Tester Cord

This simple device affords a simple, yet foolproof method for testing wall receptacles to find out whether current if flowing out or not. Available from "Hotline Industries, Inc." Dept. Bzzt, Black Hand, South Dakota. $2.95

"Here's all you have to know about men and women: Women are crazy, men are stupid.
And the main reason women are crazy is that men are stupid."
—George Carlin

Topics of Interest

Have an idea you would like to share with your fellow hams? Interested in one of the new exotic digital modes and would like to get others interested in it too? Found a blog somewhere that you think others would find interesting? Members are encouraged to submit items of interest for publication. Submitted articles (are suggested) to be no more than a page or two in length and may be edited for content and grammar. The EPARA officers and newsletter editor reserve the right to determine which items will be included in The Beacon. The deadline for publication is the 15th of the month. The publication date will be at the end of each month. Copyrights are the property of their respective owners and their use is strictly non-profit/educational and intended to foster the spirit of amateur radio.



If you've taken pictures at an event and would like to submit them for possible inclusion in the newsletter, forward them to the newsletter editor. Please send action shots, if possible. Faces are often preferable over the backs of heads. Many hams may be way too overweight, so please consider using a wide-angled lens.

Disclaimer

The Beacon is not representative of the views or opinions of the whole organization, and such views and opinions expressed herein are of the individual author(s).

Contest Corral

April 2023

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 Date-Time		Finish Date-Time		Bands	Contest Name	Mode	Exchange	Sponsor's Website
1	0800	1	2000	1.8-28	RSGB FT4 International Activity Day	Dig	Signal report, 4-char grid	www.rsgbcc.org/hf/
1	1000	2	0400	14	PODXS 070 Club PSK 31 Flavors Contest	Dig	SPC, mbr or name	www.podxs070.com
1	1200	2	1200	3.5-28	EA RTTY Contest	Dig	RSQ, province or serial	concursos.ure.es/en/eartty/bases
1	1400	2	0200	1.8-28,50, 144	Louisiana QSO Party	CW Ph Dig	RS(T), LA parish or SPC	laqp.louisianacontestclub.org
1	1400	2	0200	1.8-28,50, 144	Mississippi QSO Party	CW Ph Dig	RS(T), MS county or SPC	www.arrlmiss.org
1	1400	2	2000	1.8-28, V/UHF	Missouri QSO Party	CW Ph Dig	RS(T), MO county or SPC	www.w0ma.org
1	1400	2	2200	3.5-28	Florida State Parks on the Air	CW Ph Dig	Park ID or SPC	flspota.org/rules
1	1500	2	1500	1.8-28	SP DX Contest	CW Ph	RS(T), SP province or serial	spdxcontest.pzk.org.pl/2023
3	1900	3	2030	3.5	RSGB 80m Club Champ, CW	CW	RST, serial	www.rsgbcc.org/hf/
4	0100	4	0300	3.5-28	ARS Spartan Sprint	CW	RST, SPC, pwr	arsqrp.blogspot.com
5	2000	5	2100	3.5	UKEICC 80m Contest	Ph	6-char grid	www.ukeicc.com/80m-rules.php
6	0000	7	0300	7	Walk for the Bacon QRP Contest	CW	Max 13 WPM; RST, SPC, name, mbr or pwr	qrpcontest.com/pigwalk40
8	0000	8	0600	1.8-28	QRP ARCI Spring QSO Party	CW	RS, SPC, mbr or pwr	qrparci.org
8	0700	9	1300	1.8-28	JIDX CW Contest	CW	RST, JS prefecture or CQ one	www.jidx.org/jidxrule-e.html
8	1200	9	1100	3.5-28	DIG QSO Party, CW	CW	RST, mbr or RST	diplom-interessen-gruppe.info
8	1200	9	1200	1.8-28	OK/OM DX Contest, SSB	Ph	RS, OK/MO county code or serial	okomdx.crk.cz
8	1200	9	1800	3.5-28	IG-RY World Wide RTTY Contest	Dig	RST, 4-dig yr first licensed	www.ig-ry.de/ig-ry-ww-contest
8	1400	9	0200	1.8-28,50, 144	New Mexico QSO Party	CW Ph Dig	Name, NM county or SPC	www.newmexicoqsoparty.org
8	1800	9	2359	1.8-28,50	Georgia QSO Party	CW Ph	RST, GA county or SPC	gaqsoparty.com
8	2100	9	2100	1.8-28,Sat	Yuri Gagarin Int'l DX Contest	CW	RST, ITU zone	gc.qst.ru/en/section/32
9	1000	9	2100	3.5-14	WAB 3.5/7/14 MHz Data Modes	Dig	RS, serial, WAB square or country	wab.intermip.net/Contests.php
10	0000	10	0200	1.8-28	4 States QRP Group 2nd Sun Sprint	CW Ph	RS(T), SPC, mbr or pwr	www.4sqrp.com
10	1500	10	1730	3.5,7	DARC Easter Contest	CW Ph	RS(T), DOK or serial	www.darc.de/der-club/referate/conteste
10	1900	10	2300	144	144 MHz Spring Sprint	CW Ph Dig	4-char grid	sites.google.com/site/springvhf upsprints
12	0030	12	0230	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or pwr	naqcc.info
14	2100	15	2059	3.5-28	Holyland DX Contest	CW Ph	RS(T), 4X area or serial	www.iarc.org
15	0600	16	0559	3.5-28	Worked All Provinces of China	Ph	RS(T), BY province or serial	www.mulandxc.com
15	0700	16	0659	3.5-28	YU DX Contest	CW Ph	RS(T), YU/YT county or serial	www.yudx.yu1srs.org.rs
15	0700	15	1900	1.8-28	Dutch PACCdigi Contest	FT8 Dig	RST, 4-char grid	www.veron.nl
15	0900	16	2359	3.5-28	CQMM DX Contest	CW	RST, continent abbrev	www.cqmmdx.com/rules
15	1300	16	2200	1.8-28, V/UHF	Nebraska QSO Party	CW Ph Dig	NE county or SPC (FT8: grid)	nebraskaqsoparty.com
15	1400	16	2000	No WARC	Texas State Parks on the Air	CW Ph Dig	RST, park ID or SPC	www.tspota.org
15	1600	16	0400	3.5-28	Michigan QSO Party	CW Ph	RST, MI county or SPC	miqp.org/index.php/rules
15	1700	16	1200	3.5-28	EA-QRP CW Contest	CW	RST, category, "M" if mbr	www.eaqrp.com
15	1800	16	1800	1.8-28,50, 144	Ontario QSO Party	CW Ph	RS(T), ON county or SPC	www.va3cco.com/oqp/rules.htm
15	1800	16	1800	1.8-28,50, 144	North Dakota QSO Party	CW Ph Dig	RS(T), ND county or SPC	www.ndarrlsection.com
16	1200	16	2000	1.8-28,50, 144	Quebec QSO Party	CW Ph	RS(T), QC zone or SPC	wp1.quebecqsoparty.org
16	1800	16	2359	3.5-28	ARRL Rookie Roundup, SSB	Ph	Name, 2-dig yr first licensed, state/province/XE area/DX	www.arrl.org/rookie-roundup
18	1900	18	2300	222	222 MHz Spring Sprint	CW Ph Dig	4-char grid	sites.google.com/site/springvhf upsprints
19	1900	19	2030	3.5	RSGB 80m Club Champ, SSB	Ph	RS, serial	www.rsgbcc.org/hf/
22	0800	22	1800	3.5-28	QRP to the Field	CW Ph	RST, SPC, name/SOTA	www.zianet.com/qrp/qrpttf/pg.html
22	1200	23	1200	3.5-28	SP DX RTTY Contest	Dig	RST, SP 2-letter province or serial	www.pkrvg.org
23	0000	23	0400	3.5-14	North American SSB Sprint Contest	Ph	Other's call, your call, serial, name, SPC	ssbsprint.com/rules
23	1700	23	2059	3.5-28	BARTG Sprint 75	Dig	Serial	bartg.org.uk
24	1900	24	2030	3.5-14	RSGB FT4 Contest	FT4	4-char grid, signal report	www.rsgbcc.org/hf/
26	1900	26	2300	432	432 MHz Spring Sprint	CW Ph Dig	4-char grid	sites.google.com/site/springvhf upsprints
27	1900	27	2030	3.5	RSGB 80m Club Champ, Data	Dig	RST, serial	www.rsgbcc.org/hf/
29	0001	30	2359	28	10-10 Int'l Spring Contest, Digital	Dig	Name, mbr or "0," SPC	www.ten-ten.org
29	1200	30	1200	3.5-28	UK/EI DX Contest, CW	CW	RST, serial, UK/EI district code, serial	www.ukeicc.com/dx-contest-rules.php
29	1300	30	1259	1.8-28	Helvetia Contest	CW Ph Dig	RS(T), HB canton or serial	www.uska.ch/contest
29	1600	30	2159	7,14,21,28	Florida QSO Party	CW Ph	RS(T), FL county or SPC	floridaqsoparty.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 and times 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.*

AMATEUR RADIO SPECIAL EVENT STATIONS!

03/31/2023 | 165th Annual Tater Day Festival - Yam It Up!

Mar 31-Apr 3, 0000Z-2359Z, KI4HUS, Benton, KY. Marshall County Amateur Radio Association. 3.820 7.250 14.325 28.350. QSL. Steve French, KM4JZJ, 3640 Olive Hamlett Rd., Benton, KY 42025. For a QSL card, send your card along with an SASE to Steve French - KM4JZJ www.facebook.com/groups/861322314291904

04/02/2023 | The Popcorn Net 3rd Anniversary

Apr 2-Apr 3, 1200Z-1400Z, W4P, Ellijay, GA. Popcorn Net. 7.271 7.272. Certificate & QSL. Popcorn Net, 216 Mount Pleasant Dr., Ellijay, GA 30540. wt2t@popcornnet.net

04/04/2023 | WE7GV Vintage Radio Special Event

Apr 4, 1700Z-2200Z, WE7GV, Sahuarita, AZ. Green Valley Amateur Radio Club. 14.242 14.245 14.248. Certificate & QSL. Tom Lang, 1085 W. El Toro Rd, Sahuarita, AZ 85629. WE7GV will be using the 1963 Discone antenna at the Titan Missile Museum along with vintage Hallicrafter, Heathkit, and Kenwood radios. we7gv1@gmail.com

04/08/2023 | Battle Of New Bern Adventure Day Special Event

Apr 8, 1500Z-2000Z, N4B, New Bern, NC. New Bern Amateur Radio Club. 14.328 7.116. QSL. John Riley, 980 Dry Monia Rd., New Bern, NC 28562.

04/08/2023 | Commemorating Operation Frequent Wind; evacuation of Saigon in 1975

Apr 8, 1600Z-2300Z, NI6IW, San Diego, CA. USS Midway Museum Ship. 14.320 7.250 14.070 PSK31 DSTAR on Papa system repeaters. QSL. USS Midway Museum Ship COMEDTRA, 910 N Harbor Drive, San Diego, CA 92101. www.qrz.com/db/ni6iw

04/11/2023 | Kamikaze Attack Remembrance

Apr 11, 1500Z-2030Z, W5KID, Baton Rouge, LA. Baton Rouge Amateur Radio Club. 7.040 7.250 14.040 14.250. QSL. USS Kidd Amateur Radio Club, 305 S. River Rd., Baton Rouge, LA 70802. CW, SSB, FT8 Operation aboard the USS Kidd (DD-661), a World War II Fletcher-class destroyer. www.qrz.com/db/w5kid

04/14/2023 | Whiskey 4 Moonshine

Apr 14-Apr 29, 0000Z-2359Z, W4M, Boones Mill, VA. AA4SS. 7 Mhz 14 Mhz 15 Mhz. QSL. Timothy Boyd, 2201 Green Level Rd, Boones Mill, VA 24065. W4M ("Whiskey 4 MOONSHINE") will operate from April 14 through April 29 2023 on ALL HF bands (depending upon volunteers preferences and equipment) using phone, digital, cw and Satellite modes. Operations will take place in Franklin and surrounding counties with one remote operation planned in conjunction with a local Moonshine Heritage Car Show at Ferrum College and a few POTA activations. QSL info on QRZ.com https://whiskey4moonshine.wordpress.com

04/15/2023 | 100th Anniversary of the Garland, Texas power company, Garland Power and Light

Apr 15, 1400Z-2200Z, K5G, Garland, TX. Garland Amateur Radio Club. 14.260. Certificate. Garland Amateur Radio Club, 1027B Austin St., Garland, TX 75040. PDF certificates will be emailed to all after the event. info@k5qhd.org

04/15/2023 | 40th Anniversary of the Voyage of the Abegweit

Apr 15-Apr 17, 1400Z-0200Z, K9CYC, Chicago, IL. Columbia Yacht Club Amateur Radio Society. 14.238 29.000. Certificate & QSL. K9CYC Columbia Yacht Club Amateur Radio Society, 111 N. Lake Shore Dr., Chicago, IL 60601. www.qrz.com/db/K9CYC

04/15/2023 | Beaver Valley ARA 100th Anniversary

Apr 15-Apr 22, 1300Z-2100Z, W3S, Beaver Falls, PA. Beaver Valley Amateur Radio Association. 7.270 14.270 28.470 145.310 (-600kHz PL 131.8). Certificate & QSL. BVARA, PO Box 424, South Heights, PA 15081. QSL direct with SASE, stations making contact on two or more bands or modes may request a PDF certificate that will be e-mailed. www.w3sgj.org

04/15/2023 | Texas State Parks on the Air to Commemorate Tom King, WK5DX, the Texas Event's Founder

Apr 15-Apr 16, 1400Z-0200Z, K5LRK, The Colony, TX. Lake Area Amateur Radio Klub. 7.040 7.215 14.040 14.265. QSL. Ken Rainey, AC5EZ, 529 Kenilworth Ave, Oak Point, TX 75068. CW-Bottom of band +40kHz ; Phone-General Segment +40kHZ and 28.350; VHF 50.200 & 144.200 MHz. 4/15 14:00 to 4/16 02:00 and:4/16 14:00 to 4/16 20:00. https://www.tspota.org/home

04/17/2023 | World Amateur Radio Day 2023

Apr 17-Apr 18, 1700Z-2300Z, W2W, Rochester, NY. Roc-Ham Radio Network. EchoLink ROCH-HAM CONFERENCE/531091 EchoLink - FREESTAR CONFRENCE EchoLink - WALES CONFERENCE 20m 14.313. Certificate & QSL. John Derycke, W2JLD, 85 Amherst St. Apt. 2, Rochester, NY 14607. Join us for the 8th annual World Amateur Radio Day 2023. For more information, check out the website www.roc-ham.net

04/22/2023 | Earth Day Celebration

Apr 22-Apr 23, 1500Z-2000Z, W8PRC, Cleveland, OH. Parma Radio Club. 7.195 mHz 14.245 mHz 145.410 2m repeater pl 110.9. QSL. Parma Radio Club, 7811 Dogwood Lane, Cleveland, OH 44130. The PRC's 9th Earth Day Celebration, operating on power from Ol' Sol. W8PRC will be operating from Stearns Farm (FB: Stearns Homestead historical farm) www.parmaradioclub.com

04/22/2023 | Venice Shark's Tooth Festival

Apr 22-Apr 23, 1400Z-1900Z, K4S, Venice, FL. Tamiami ARC. 14.320 Mhz SSB 18.085 MHz CW 80-10 m FT8. QSL. Tamiami ARC, PO Box 976, Nokomis, FL 34275. Back on the air again after a three-year COVID hiatus. Venice Florida is considered the Shark's tooth capital of the world. Send a SASE with your QSL card and we'll reply with our card and a genuine, prehistoric shark's tooth fossil for you. tamiamiarc.org

04/28/2023 | National Library Week

Apr 28-Apr 30, 1700Z-1700Z, K8L, Youngstown, OH. WF8U, KC3GFU. 14.074 7.074 14.240 7.240. QSL. K8L, 239 Elvira Ct., Mc Donald, OH 44437. Join us in celebrating National Library Week. K8L will be on air Friday, Apr 28th (1700 UTC) - Sunday, Apr 30th (1700 UTC). We will be operating both SSB & FT8 modes. QSL available upon request. Please send your QSL/request to K8L, 239 Elvira Ct., McDonald, OH 44437. *Please include postage stamp & return address label. More information available on www.qrz.com/db/WF8U

04/29/2023 | 30th Anniversary

Apr 29, 1400Z-2300Z, N5BVA, Springdale, AR. Bella Vista Radio Club. 7.190 14.260. QSL. Don Banta, 3407 Diana St., Springdale, AR 72764. See QRZ.com for QSL info. bellavistaradioclub.org

04/29/2023 | Anniversary of the Birth of Radio Astronomy

Apr 29-Apr 30, 1400Z-2359Z, W9GFZ, Virginia and New Mexico. National Radio Astronomy Observatory. 3.800-4.000; 7.175-7.300; 14.225-14.350; 21.275-21.450; 28.300-29.700. Certificate & QSL. Kevin Shoemaker, 1180 Boxwood Estate Rd., Charlottesville, VA 22903. kshoemak@nrao.edu

04/29/2023 | Hams for PanCAN

Apr 29, 1400Z-1900Z, N4P, Altamonte Springs, FL. Lake Monroe Amateur Radio Society. 40 20 15 10 meters. Certificate & QSL. Lake Monroe ARS, 7747 Danu Dr., Orlando, FL 32822. SASE please. From Cranes Roost Park. Multiple N#P Stations across the country will be located in each of the ten ARRL sections -All stations will be on SSB. This nationwide Special Event's aim is raising awareness of pancreatic cancer research and support by the PanCAN (Pancreatic Cancer Network) during its national Purple Stride event. Each station will highlight any ham operator, or friends and family members who are diagnosed with pancreatic cancer located in that Section. Also, we'll provide access to how PanCAN helps patients with support and funding of research projects. Event Bonus stations will be located at Purple Stride locations and will offer special QSL cards. Each N#P station web page on the ARRL Special Event tab will provide QSL submission information. A Clean Sweep Certificate will be awarded for contacting all section stations. QSL card requests need SASE. For a Clean Sweep certificate, include $1 please. rybar1949@gmail.com https://www.lmars.org

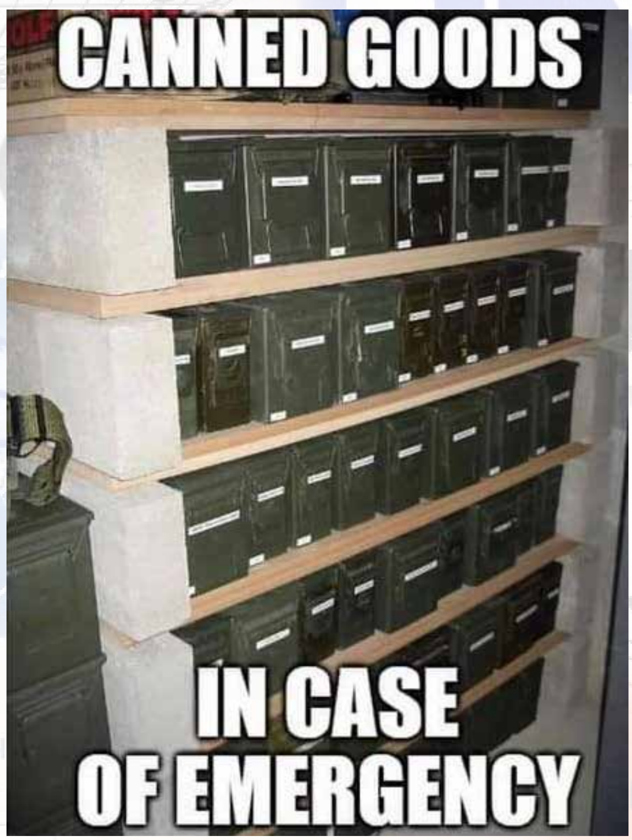
04/29/2023 | HAMS for PanCAN

Apr 29-May 1, 1400Z-2000Z, N3P, New Kensington, PA. WQ3Q. 3.960 7.172. Certificate & QSL. Skyview Radio Society- N3P, 2335 Turkey Ridge Rd., Upper Burrell, PA 15068. Multiple N#P Stations across the country will be located in each of the ten ARRL sections -All stations will be on SSB. This nationwide Special Event's aim is raising awareness of pancreatic cancer research and support by the PanCAN (Pancreatic Cancer Network) during its national Purple Stride event. Each station will highlight any ham operator, or friends and family members who are diagnosed with pancreatic cancer located in that Section.

Also, we'll provide access to how PanCAN helps patients with support and funding of research projects. Event Bonus stations will be located at Purple Stride locations and will offer special QSL cards. Each N#P station web page on the ARRL Special Event tab will provide QSL submission information. A Clean Sweep Certificate will be awarded for contacting all section stations. QSL card requests need SASE. For Clean Sweep certificate, include $1 please. . rybar1949@gmail.com

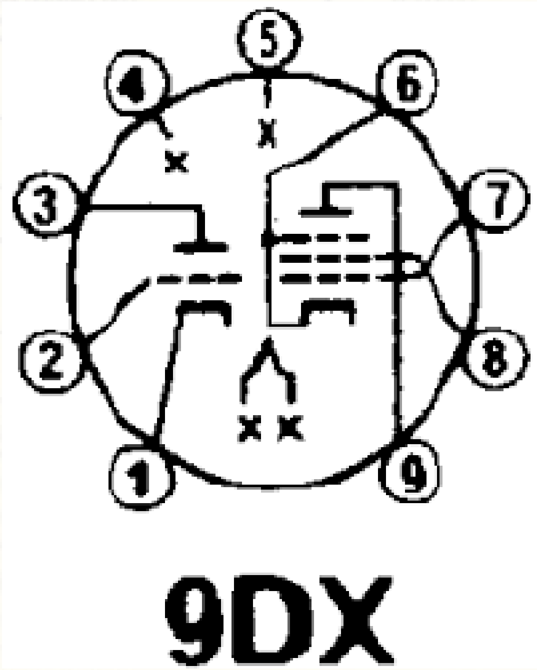
04/29/2023 | MERT20 Special Event

Apr 29, 1200Z-2359Z, KG4NXO, Ocala, FL. Marion County Emergency Management. 14.262 7.262 146.790 REF 37 D-STAR 3.862. Certificate & QSL. Emergency Operations Center /MERT, 698 NW 30th Avenue, Ocala, FL 34775. MERT is celebrating 20 years of amateur radio support to Marion County EM. For more information, go to www.mert20.org



6CX8 - Triode / Pentode

The 6CX8 Vacuum tube is a miniature type used in television receiver applications. The Pentode is used as a video amplifier. The triode is used as a sound IF amplifier, sweep-oscillator, sync-separator, sync-amplifier and sync-clipper in circuits. It requires a miniature 9-contact socket.



STANDARD COLOR CODE — RESI

TUBE OF THE MONTH

Electronic TUBES

6CX8—8CX8

TRIODE-PENTODE

DESCRIPTION AND RATING

The 6CX8 is a miniature tube containing a sharp-cutoff pentode and a medium-mu triode in one envelope. The pentode section is intended primarily for use as a video amplifier. The triode section is suitable for a sweep oscillator, sync separator, sync amplifier, or sync clipper.

Except for heater ratings, the 8CX8 is identical to the 6CX8. In addition, it incorporates a controlled heater warm-up characteristic which makes it especially suited for use in television receivers with series-connected heaters.

GENERAL

ELECTRICAL

	6CX8	8CX8	
Cathode—Coated Unipotential			
Heater Voltage, AC or DC	6.3±10%	8.0	Volts
Heater Current	0.75	0.6±6%	Amperes
Heater Warm-up Time*	....	11	Seconds

Direct Interelectrode Capacitances†		
Pentode Section		
Grid-Number 1 to Plate	0.06	μμf
Input	9.0	μμf
Output	4.4	μμf
Triode Section		
Grid to Plate	4.4	μμf
Input	2.2	μμf
Output	0.38	μμf
Pentode Grid-Number 1 to Triode Plate, maximum	.005	μμf
Triode Grid to Pentode Plate, maximum	.018	μμf
Pentode Plate to Triode Plate, maximum	0.17	μμf

MECHANICAL

Mounting Position—Any
Envelope—T-6½, Glass
Base—E9-1 Small Button 9-Pin

MAXIMUM RATINGS

DESIGN-MAXIMUM VALUES, See Note on page 2

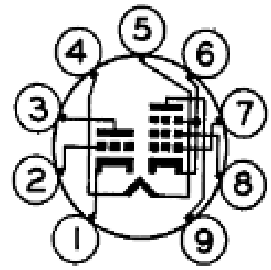
	Pentode Section	Triode Section	
Plate Voltage	330	330	Volts
Screen-Supply Voltage	330	...	Volts
Screen Voltage—See Screen Rating Chart			
Positive DC Grid-Number 1 Voltage	0	0	Volts
Plate Dissipation	5.0	2.0	Watts
Screen Dissipation	1.1	...	Watts
Heater-Cathode Voltage			
Heater Positive with Respect to Cathode			
DC Component	100	100	Volts
Total DC and Peak	200	200	Volts
Heater Negative with Respect to Cathode			
Total DC and Peak	200	200	Volts
Grid-Number 1 Circuit Resistance			
With Fixed Bias	0.25	0.5	Megohms
With Cathode Bias	1.0	1.0	Megohms

The tubes and arrangements disclosed herein may be covered by patents of General Electric Company or others. Neither the disclosure of any information herein nor the sale of tubes by General Electric Company conveys any license under patent claims covering combinations of tubes with other devices or elements. In the absence of an express written agreement to the contrary, General Electric Company assumes no liability for patent infringement arising out of any use of the tubes with other devices or elements by any purchaser of tubes or others.

GENERAL ELECTRIC

Supersedes ET-T1387, dated 11-56

BASING DIAGRAM

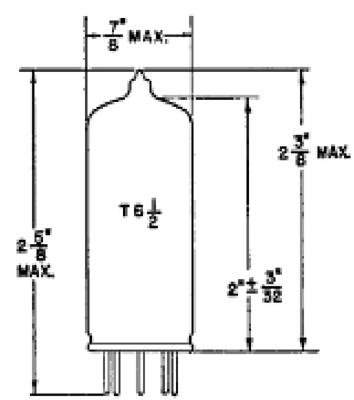


EIA 9DX

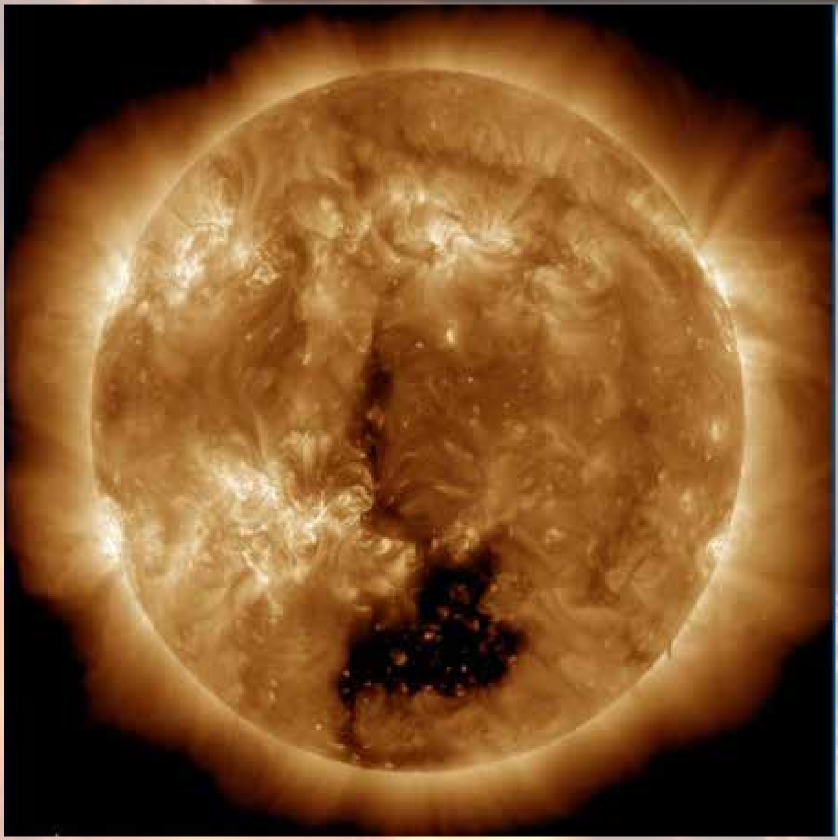
TERMINAL CONNECTIONS

Pin 1—Triode Cathode
Pin 2—Triode Grid
Pin 3—Triode Plate
Pin 4—Heater
Pin 5—Heater
Pin 6—Pentode Cathode, Grid Number 3, and Internal Shield
Pin 7—Pentode Grid Number 1
Pin 8—Pentode Grid Number 2 (Screen)
Pin 9—Pentode Plate

PHYSICAL DIMENSIONS



EIA 6-3



Sunspot numbers were lower again this week, with the average declining from 143.6 two weeks ago to 118.7 last week and now 68 this week. Average daily solar flux sank 8 points from 153.6 last week to 145.6.

Six new sunspot groups emerged over the week, one on March 17, another March 18, three more on March 19, one more on March 21 and another on March 22.

Predicted solar flux is 150, 145 and 145 on March 24-26, 150 on March 27-28, 145 and 150 on March 29-30, 138 on March 31 through April 1, then 136, 136 and 134 on April 2-4, 132 on April 5-7, 130 on April 8-9, then 132, 135, 138, and 140 on April 10-13, 142 on April 14-15, 143 on April 16, 140 on April 17-18, 142 on April 19-21, and 144 on April 22, 146 on April 23-24, 142 and 140 on April 25-26, 138 on April 27-28, and 136 on April 29-30.

Predicted planetary A index is 35, 30, 20, 15 and 10 on March 24-28, 8 on March 29-30, hen 18, 12, 12, 10 and 8 on March 31 through April 5, 5 on April 6-9, then 15, 12, 8 and 5 on April 10-13, 8 on April 14-15, then 12, 10, 5 and 5 on April 16-19, then geomagnetic unrest returns with 10, 36, 20, 10, 8 and 5 April 20-25, then 20, 18, 12, 12 and 10 on April 26-30.

On Thursday, Spaceweather.com reported, "The forecast did not call for this. During the early hours of March 23rd, a crack opened in Earth's magnetic field, and stayed open for more than 8 hours. Solar wind poured through the gap to fuel a strong G3-class geomagnetic storm." On Thursday it showed estimated planetary K index at 7, then dipping, and at 2100 UTC above 7. I noticed some very odd propagation. At 1900 UTC I called CQ on 10 meter FT8, and pskreporter.info showed I was only being heard in a small area in east Texas. Stations were concentrated between 1739 and 1892 miles in an area between Houston, San Antonio, Killeen and Nacogdoches. That was it! Heard nowhere else. I was running low power, using a simple end-fed one wavelength wire that is mostly indoors. Over the next half hour coverage extended east to Louisiana, then Alabama, then Georgia and South Carolina.

Great job by all who participated! It was a lot of fun too. Thank you Ruth Ann for organizing this for EPARA!


RADIO COMMUNICATIONS
SILVERADO


SERVICE TIRE
TRUCK CENTERS

EPARA SATComm Updates – Exciting Announcements

Attention all EPARA members. A group of club members have pooled and donated their resources and are generously investing their time towards reinvigorating the club satellite communications activities. We will now have the ability to offer our newly minted and licensed technician club members the opportunity to work FM satellites regularly. Club members can operate FM, SSB FM, and digital modes as well as regular ISS cross band repeater operations, as well as capture SSTV images from the ISS.

Equipment includes the ICOM 9700

The M2 LEO Pack satellite antenna system

The Yaesu G5500 Rotator, which provides continuous altitude and

azimuth real time tracking of the FM birds. And finally the SAT tracking system

which integrates the radio, and rotor as a system. Look for upcoming events!

A Quick &Easy Polarity Tester

This little gadget was found in an article in QST. It looked easy and it was.

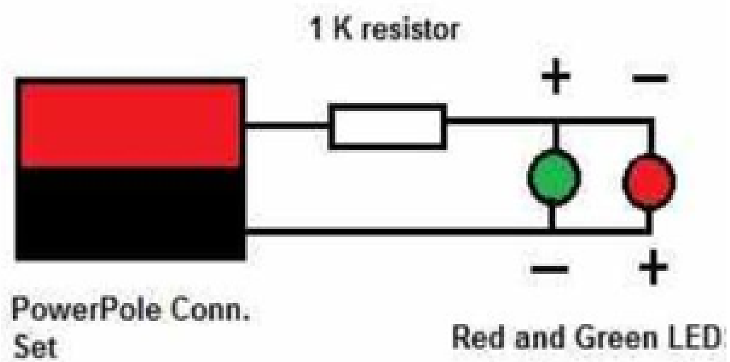
This little polarity tester is meant to be tossed in your "Go-Kit" for the times you might get deployed by your local ARES unit to an unfamiliar site. Sometimes operators either choose not to follow the "Power-Pole" standard or just make a mistake during assembly. The polarity tester allows you to plug the tester into any "Power-Pole" equipped power source and instantly know if it is wired properly.

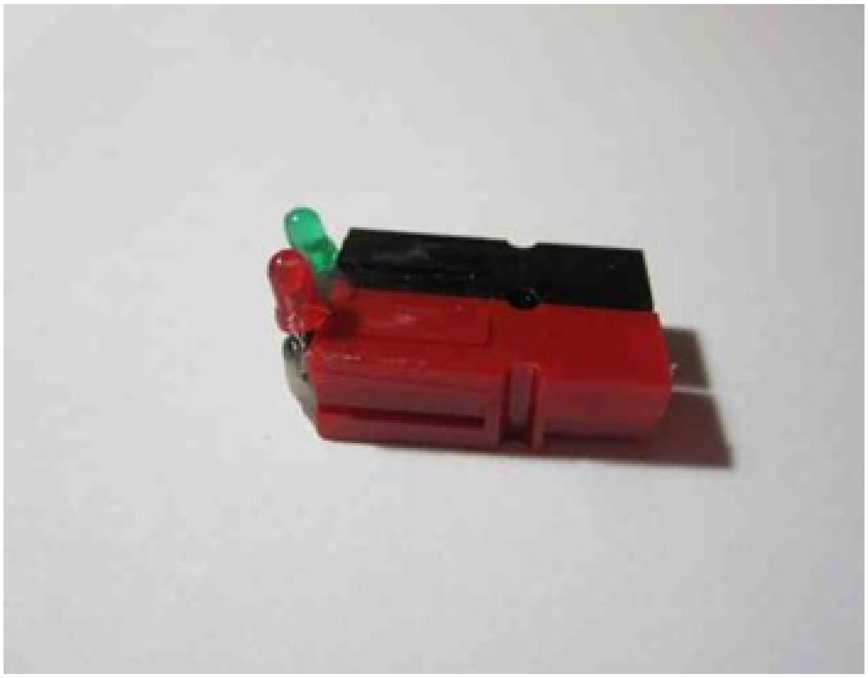
The parts list is very short:

1 pair of powerpole connectors (one red, one black plus the 2 contacts).
1 resistor (1/4 watt 1000 ohms).
1 red LED
1 green LED
1 short (about 2") of hookup wire.
Some small diameter heat shrink tubing to insulate the LED leads.

The circuit is shown below. Building the device starts with soldering the 1K resistor to one of the powerpole contacts. Insulate the positive lead of the green LED and the negative lead of the red LED and solder both to the open lead of the resistor. Solder the length of hook-up wire to the other powerpole contact. Install the contacts into the powerpole housings. The contact with the resistor soldered to it goes into the red housing and the contact with the hookup wire goes into the black housing. Now position the LEDs close to the back of the powerpole housings and solder the open leads of the LED's to the hookup wire. Trim off excess wire and component leads and insulate the whole rear end of the powerpole connectors with hot glue or epoxy. Keep the LEDs clear of the insulating material so you can still see them. See the photos for a clear view of what I mean. You are done.

To test the unit, plug it into the powerpole connector from a power source. If the source is wired correctly the green LED will glow. If not, the red LED will light up. It really is that easy. Green is GOOD, Red is BAD.





I have replaced the previous somewhat fuzzy image with a new photo taken today 2-7-16

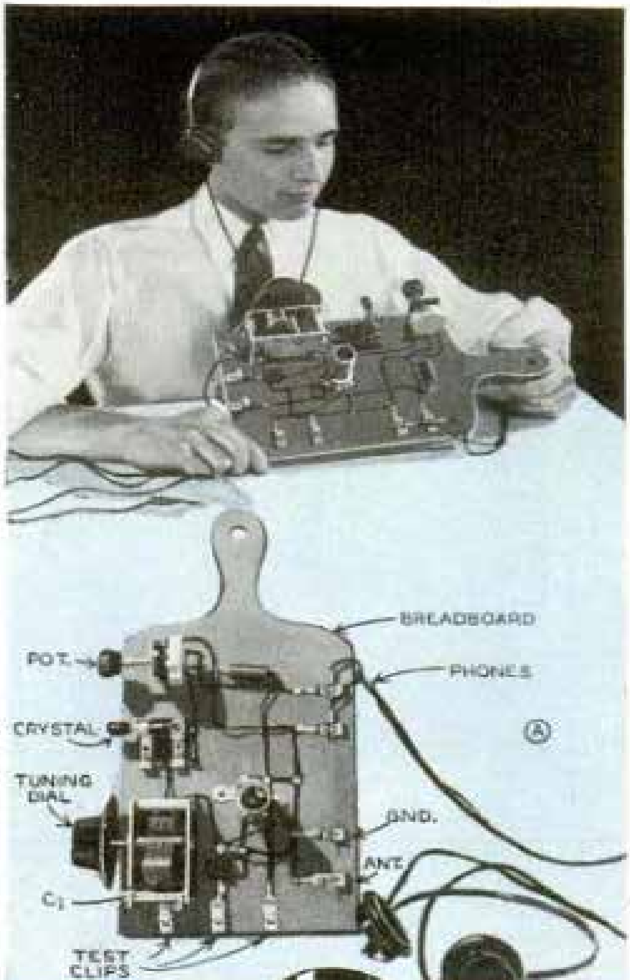
This is the latest version of the tester. I am now using a single LED that lights red with the polarity in one direction and green with the polarity in the other direction. So the part count is now two plus the Power Pole pair, one bicolor LED and one 1K resistor. I fill the spaces at the back of the Power Pole connector with hot glue to prevent anything from shorting out the tester including prying fingers.

73 10-21-18

Credit: http://www.n1gy.com/polarity-tester.html

Crystal Receiver and Test-Set Combination

By M. N. Beitman



BUILD this breadboard style, efficient crystal set, and use it also as a testing instrument. The highly selective crystal-detector circuit will provide good reception from local stations and requires only a handful of inexpensive parts.

If the unit is used for receiving regular radio stations, the three terminals provided for test purposes are not employed. When you wish to use the unit for tracking down trouble in any faulty radio set, follow these simple instructions: Remove the antenna and ground wires. Connect the chassis ground terminal directly to the metal chassis base of the radio set to be tested, by means of a short length of wire, and prepare to trace the signal to the actual fault in the receiver. If you are testing the circuit after the detector tube, use the A.F. test terminal for the "tracer wire." The volume control of the crystal set is adjusted to keep the response in the headphones at a comfortable level. For tracking the signal in the R.F. or 456 k.c. I.F. sections, use the terminal marked R.F.

When working with the A.F. connection you will hear the signal best with the cat's whisker off the crystal. However, when

(Continued to page 136A)

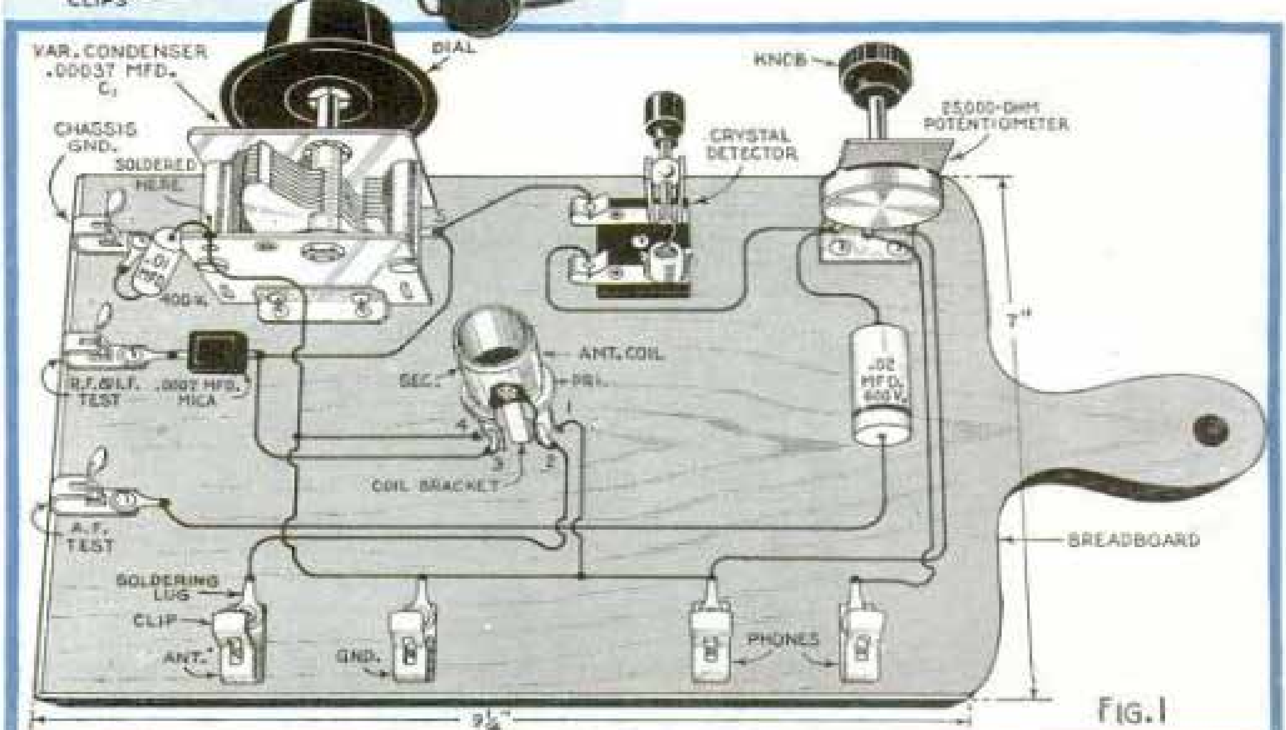


FIG. 1

Crystal Receiver and Test Set

(Continued from page 138)

using the R.F. connection, adjust the crystal detector for best results. It will be helpful to turn the variable condenser for the loudest response while exploring the R.F. section of any standard radio circuit. If no signal is heard when contact is made with the "tracer wire" to a section where the signal may be expected, such as the tube plate prong, or control grid cap, this portion of the circuit may be assumed to be at fault. For example, R.F. contact to the control grid of a detector-oscillator should result in a soft signal; the plate of the I.F. tube in a loud signal. Using the A.F. tracer

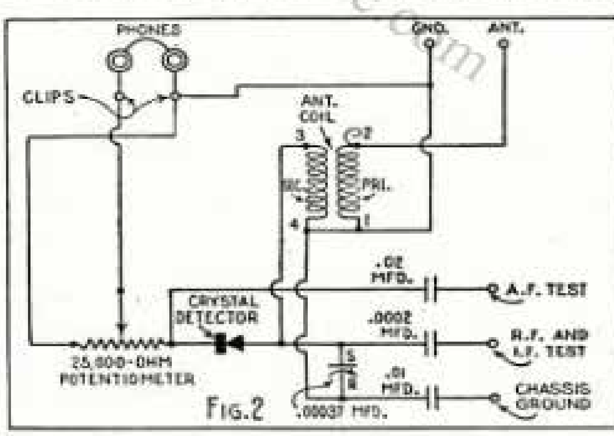


FIG. 2

connection, contact with the grid of the first audio tube would produce a soft signal in the headphones, and the plate of A.F. power-output tube a loud signal.

To start construction, obtain a small breadboard of the handy handle-type, illustrated, from any hardware or department store, and mount all parts as shown in the simplified wiring diagram Fig. 1 and photo (A). Carefully wire the circuit just as shown in Fig. 1 and check your wiring with the schematic circuit diagram Fig. 2. The antenna coil can be any good high-impedance primary type. All parts are easily identified, as shown in diagram Fig. 1. The Fahnestock clips are fastened directly to the breadboard by means of small brass wood screws. A 2¾-in. strip of metal 1¼ in. wide is bent over ½ in. to form a mounting bracket for the 25,000-ohm volume control, a small knob is provided for this potentiometer, and the tuning dial is a common 3-in. type. A pair of 2,000-ohm headphones, and a well insulated, long antenna and good ground complete the assembly.

Measuring the Frequency Accuracy and Stability of WWV and WWVH

An examination of just how accurate these frequency standard stations are.

Michael A. Lombardi, KØWWX

Radio station WWV is known as a source of accurate time. However, since March 6, 1923, the original purpose of WWV has been to provide standard frequency signals, with signals broadcast in the LF and MF bands. As detailed in Hoy J. Walls' "The Standard-Frequency Set at WWV" in the October 1924 issue of *QST*, this was in the early days of broadcast radio, when having an accurate frequency reference was essential for keeping stations from interfering with each other. A century later, the standard frequency signals remain essential to radio broadcasters, calibration laboratories, space weather researchers, and radio amateurs.

WWVH joined WWV on the air in 1948. Both stations broadcast on 2.5, 5, 10, and 15 MHz, with WWV also available on 20 and 25 MHz (see Figure 1). This article examines the frequency accuracy and stability of the WWV and WWVH signals as transmitted and as received. We'll use the term WWV/H when referring to both stations.

Basic Terminology

Frequency accuracy is the difference between the actual frequency of a signal and its *nominal frequency*. Nominal frequency examples include the 14.074 MHz displayed on a transceiver dial when working FT8, and the 10.000 MHz carrier frequency assigned to WWV/H. Measuring how much they differ requires comparing them to a reference frequency that is known to be more accurate. That comparison produces a quantity called Δf, where Δ indicates the difference between two frequencies.

Δf is often a tiny fraction of 1 Hz. It is common practice to divide Δf by the nominal frequency f and to express frequency accuracy as a unit-less value. For instance, if a nominal 10 MHz (10^7 Hz) signal is inaccurate by 1 Hz, we can say that its accuracy is one part per 10 million, or one part in 10^7. Table 1 shows accuracy values for three nominal WWV/H frequencies (2.5, 5, and 10 MHz) when Δf is equal to 1 Hz, 1 mHz, or 1 µHz.

Figure 1 — The antenna in the foreground is a standby broadband antenna with an inverted cone design. It can operate at any of the WWV frequencies from 2.5 to 25 MHz. The primary 5 MHz antenna is in the background.

Stability indicates how much a frequency changes over a given period, not how accurate the frequency is with respect to its nominal value. Stability is just as important as accuracy because the accuracy during a given period can never be better than the stability during that same period. Stability sets the limits for the possible accuracies we can obtain.

Consider a transceiver that produces a stable, yet inaccurate frequency. We can correct it by adjusting the local oscillator until the frequency is accurate. Next, consider a transceiver that is not stable, but that temporarily produces an accurate frequency after its local oscillator is adjusted. That oscillator won't stay accurate for long because its frequency is constantly changing. Hams often use the term "drift" instead of "instability." A transceiver with an unstable or drifting local oscillator can only be fixed with continuous adjustments.

The *Allan deviation* (ADEV) is a statistic used by engineers and scientists to estimate frequency stability. It is computed by taking the differences of successive pairs of frequency accuracy estimates, obtained as $\Delta f / f$, then applying a statistic similar to standard deviation to these differences. There are many references about ADEV, including *NIST Special Publication 1065*.[1] Free software tools for calculating ADEV are also available.[2, 3] In the following sections, we'll use stability data obtained with ADEV to establish accuracy limits for the WWV/H signals, both as transmitted and as received.

The Transmitted Accuracy of WWV and WWVH

Understanding WWV/H accuracy requires knowledge of atomic clocks, Coordinated Universal Time (UTC), and NIST's own version of UTC, UTC(NIST). Atomic clocks define the units of both time interval and frequency. The second is defined by counting energy transitions of the cesium-133 atom; by international agreement, the time interval required for 9,192,631,770 of these transitions defines 1 second. Frequency is measured by counting the cycles that occur during a 1-second interval, so cesium atomic clocks serve as primary measurement standards for time interval and frequency. The International Bureau of Weights and Measures in Paris, France, is responsible for computing UTC, which serves as the international standard for time interval and frequency.

Supporting real-world measurements in the US is a key responsibility of NIST. It involves maintaining primary standards for all physical quantities, including time and frequency. Like UTC, UTC(NIST) is based on a weighted average of atomic clocks — most of which are hydrogen masers — to ensure the best stability. UTC(NIST) differs from UTC because it produces physical signals. The physical signals closely agree with the UTC computations, producing time accurate to within a few nanoseconds and frequency stable to parts in 10^{15} when averaged for 1 day.

Because NIST operates WWV/H, it controls the radio station signals with UTC(NIST). The WWVH time scale consists of a single cesium clock, with other cesium clocks available on standby. The time scale at WWV includes five cesium clocks that are combined with a weighted average algorithm in a similar fashion as UTC and UTC(NIST). However, the absence of hydrogen masers makes the WWV time scale about a factor of 10 less stable than the primary time scale in Boulder.

Locking the WWV/H time scales to UTC(NIST) ensures continuous accuracy. The stations broadcast time accurate to within nanoseconds and frequency accurate to less than 1×10^{-13}, limited by their stability over a given measurement period. To demonstrate this, we made measurements comparing the WWV/H time scales to UTC(NIST) during June and July 2022. The results are shown in Figure 2, which graphs frequency stability versus the averaging period in hours. The WWV time scale, advantaged by more atomic clocks and fewer frequency corrections, is more stable than the WWVH time scale at short averaging periods. But, their stability is about equal when averaged for 72 hours, reaching parts in 10^{15}. After 24 hours of averaging, both stations are stable and accurate to well below 1×10^{-13}.

The Received Accuracy of WWV and WWVH

WWV/H often serve as calibration references, by which the device under test (DUT) is typically a quartz oscillator found in a test instrument, such as a frequency

Table 1 — Examples of Frequency Accuracy Numbers for Varying Quantities of Δf

Nominal Frequency (MHz)	Frequency Accuracy (when Δf = 1 Hz)	Frequency Accuracy (when Δf = 1 mHz)	Frequency Accuracy (when Δf = 1 μHz)
2.5	4×10^{-7}	4×10^{-10}	4×10^{-13}
5	2×10^{-7}	2×10^{-10}	2×10^{-13}
10	1×10^{-7}	1×10^{-10}	1×10^{-13}

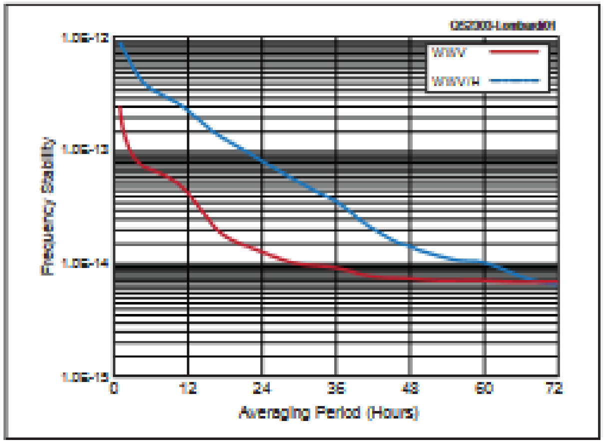


Figure 2 — The transmitted frequency stability of WWV and WWVH for averaging periods ranging from 1 to 72 hours.

counter, or in a radio receiver or transmitter. Historically, most of these calibrations have involved some variation of the zero-beat method, or methods where WWV/H signals are used to trigger an oscilloscope. Modern ham transceiver calibrations often involve computers. One method, described in Dave McCarter's, VE3GSO, "Measuring Frequencies at VE3GSO" in the April 2015 issue of *QST*, involves measuring *Δf* at several WWV/H test points with software and a sound card, then using the results to calibrate a receiver dial. Software such as *fldigi* and *WSJT-X* include built-in frequency measurement tools that can utilize WWV/H. This is also detailed in Michael Foerster's, WØIH, "Using *WSJT-X* to Graph Radio Frequency Stability" in the August 2021 issue.

For calibrations with WWV/H as the reference, two tenets generally hold true. First, the calibration is a quick check of frequency, with little or no averaging. During an ARRL Frequency Measuring Test, the contestant has just 1 minute to determine the frequency of the incoming signal, which precludes extensive data collection. The second tenet is that the exact accuracy of the received WWV/H signal is unknown. All we know is that the received signal is the reference, and it is believed to be more accurate than the DUT. We can guess (and usually we're correct) that the received accuracy of WWV/H will be within 1 Hz, or within one part in 10^7 at 10 MHz (see Table 1). That's accurate enough to calibrate a transceiver because the tuning resolution of modern transceivers is usually no finer than 1 Hz, with older equipment having coarser resolution.

If our goal is to determine the true accuracy of received WWV/H signals without making guesses, we need to flip both tenets by averaging the data. We also need to make WWV/H the DUT, not the reference. Finally, we should know in advance that the received accuracy of WWV/H will be much worse than the transmitted accuracy, likely 1,000 to 1 million times worse! This means that signals accurate at the µHz level when broadcast will only be accurate at the mHz-to-Hz level when received.

To understand why so much accuracy is lost, consider how HF radio signals propagate. A huge advantage of HF signals is their ability to travel long distances via skywave propagation. However, this advantage becomes a disadvantage when measuring frequency. As shown on **www.arrl.org/qst-in-depth**, HF signals are refracted when they reach the ionosphere. The signals that propagate at a steep enough angle pass through the ionosphere into space, but the remaining signals are reflected to Earth. Therefore, the signal path between the transmitter and receiver is related to the change in the ionosphere's height at the point of reflection. When the height of the ionosphere is increasing at the point of reflection, the signal path gets longer and the received frequency decreases. Conversely, if the height of the ionosphere is decreasing, the signal path gets shorter and the received frequency increases. Groundwave signals that travel along Earth's surface are not affected by the motion of the ionosphere, but their coverage area is limited. The skip zone, or the area where the signals can't be received, begins just beyond the reach of the groundwave signals and ends where the first skywave signals return to Earth.

The difference between the received and transmitted frequencies is called the *Doppler shift* or *Doppler frequency*. It can be considered equivalent to the *Δf* quantity discussed earlier, as it indicates the difference between the received frequency and the nominal frequency of the carrier. Therefore, if we can measure the Doppler shift, we can determine the received accuracy of WWV/H. This measurement capability is now available through the efforts of the Ham Radio Science Citizen Investigation (HamSCI; **www.hamsci.org**), which advances scientific research through amateur radio activities. Their goal is more ambitious than simply measuring WWV/H; they are building a space weather network to monitor how solar activity affects Earth's atmosphere, including its impact on telecommunication and electrical utilities. This project is also discussed in the August 2021 issue, in "Ham Radio Creates a Planet-Sized Space Weather Sensor Network" by Kristina Collins, KD8OXT; David Kazdan, AD8Y, and Nathaniel A. Frissell, W2NAF. WWV/H are ideal space weather beacons because they transmit signals of known accuracy on multiple frequencies in the HF spectrum. Measuring WWV/H from numerous locations allows HamSCI to collect vast amounts of ionospheric data, which is a feat that wouldn't be possible without radio amateur participation.

Even so, HamSCI's initial efforts to measure WWV/H via amateur stations had some shortcomings. One problem was that every station needed a frequency reference more accurate than the received WWV/H signals. Otherwise, the measurements would determine only the inaccuracy of the receiver's local oscillator.[4] Another problem was that amateurs who continuously measured WWV/H with their regular rig couldn't pursue other ham activities; a separate dedicated receiver was needed.

Both problems were solved by the development of the low-cost Grape 1 Personal Space Weather Station (PSWS). The Grape 1 PSWS can be viewed at **www.arrl.org/qst-in-depth**, and it consists of three main components: a WWV/H receiver and antenna, a GPS disciplined oscillator (GPSDO), and an instrument controller. The receiver, a simple heterodyne unit designed for this application, allows selection of either 2.5, 5, or 10 MHz. The GPSDO, a Leo Bodnar Mini Precision GPS Reference Clock, provides the local oscillator signal for the receiver and includes a phase-locked loop (PLL) that is set 1 kHz below the incoming carrier frequency. The PLL output is mixed with WWV/H, producing a 1 kHz frequency that is used to measure the Doppler shift. The GPSDO ensures that atomic clock accuracy is present at the receiving sites because its signals are referenced to the time scale of the US Naval Observatory, UTC(USNO), which is a national standard of time and frequency equivalent to UTC(NIST). The instrument controller is a Raspberry Pi 4 Model B that runs a modified version of *fldigi* in frequency analysis mode. The measurement data stored every second includes the time of day, the signal amplitude, and the Doppler frequency (with 1 mHz resolution).[5]

The HamSCI researchers are mainly interested in studying events such as traveling ionospheric disturbances (TIDs). These are caused by variations in the electron density of the ionosphere, so skywave reception is of primary interest. Figure 3 graphs the Doppler frequency of the 10 MHz WWV signal, as measured for 72 hours at W2NAF in Pennsylvania, located 2,466 kilometers from the transmitter. At this distance, the 10 MHz signals were not always receivable, and readings where the signal amplitude was less than 5 mV were discarded. The Doppler frequency peaks and changes direction around sunrise and sunset. The peak-to-peak variation is about ±1.5 Hz, but the

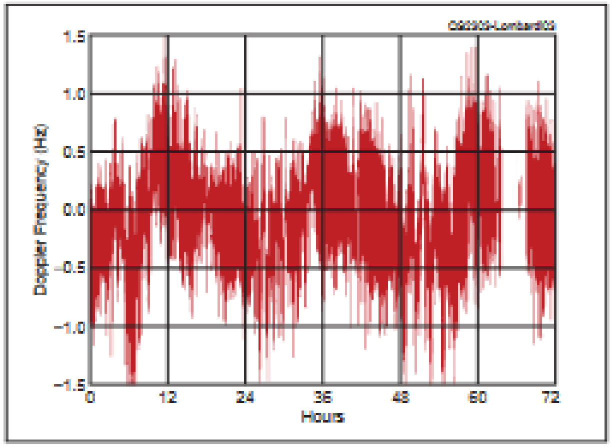


Figure 3 — The Doppler frequency shift of 10 MHz WWV skywave signals, as measured for 72 hours from Pennsylvania, at a distance of 2,466 kilometers from the transmitter.

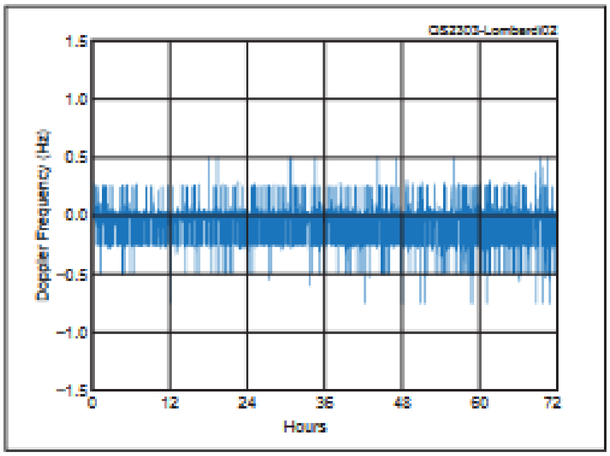


Figure 4 — The Doppler frequency shift of 5 MHz WWV groundwave signals, as measured for 72 hours from Colorado, at a distance of 14 kilometers from the transmitter.

Doppler frequency is usually less than 1 Hz, with the average close to 0 Hz.

The accuracy of the skywave data in Figure 3 is more than adequate for ham radio applications, but better accuracy can be obtained via groundwave reception. This was demonstrated by measuring the 5 MHz signal for 72 hours from station WØDAS in Colorado, located just 14 kilometers from the transmitter (see Figure 4).[6] For comparison, the groundwave data were graphed with the same ±1.5 Hz scale used for the skywave data. But here, the Doppler frequency rarely exceeds 0.5 Hz, with no discernible variation at sunrise or sunset because the ionosphere was not involved.

To determine the accuracy limits, the frequency stability of 10 amateur stations was computed using 72 hours of

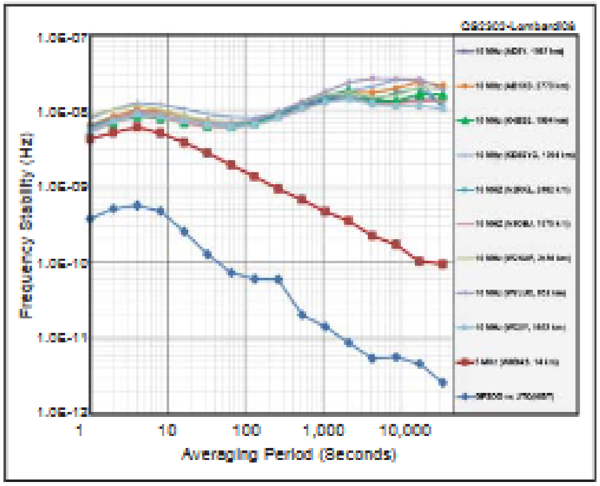


Figure 5 — The received frequency stability of WWV, measured at nine sites receiving sky wave and at one site receiving ground wave. The frequency stability of the reference GPSDO is also shown.

data and by measuring the Doppler frequency every second. The 10 stations include the two shown in Figures 3 and 4, plus eight additional stations that received 10 MHz skywave signals.[7] The results are featured in Figure 5, with stability estimates provided out to periods of 32,768 seconds (about 9.1 hours). The nine stations receiving the 10 MHz sky wave produced remarkably similar results, with stabilities ranging from about five to eight parts in 10^9 for 1-second periods. Averaging for periods of 1 hour or longer made the stability worse, increasing to a few parts in 10^8. Averaging for 24 hours would partially cancel the sunrise/sunset effect and likely improve those results. In contrast, the stability of the groundwave data continuously averaged down, reaching about 1×10^{-10} after a few hours for an accuracy limit of less than 1 mHz. To prove that the reference oscillator was not the limiting measurement factor, we measured the stability of a Leo Bodnar GPSDO via direct comparison to UTC(NIST) in Boulder. Those results show that the GPSDO was at least a factor of 10 more stable at all averaging periods than the groundwave measurements, thus contributing no significant measurement uncertainty.

Summary

The standard frequency broadcasts of WWV/H began a century ago and remain essential today, serving both as calibration references and space weather beacons. The frequency accuracy of the transmitted WWV/H signals is less than one part in 10^{13}. The frequency accuracy of the received signals, limited by their stability over the measurement interval, ranges from a few parts in 10^8 for sky wave to about one part in 10^{10} for ground wave.

Acknowledgments

The author thanks the dedicated NIST staff members who operate the UTC(NIST) time scale and WWV/H, and the dedicated members of HamSCI for advancing scientific research through amateur radio. We are grateful for National Science Foundation grants AGS-2002278, AGS-1932997, and AGS-1932972, which support the HamSCI PSWS Project.

Notes

[1]W. J. Riley, K2HRT, "Handbook of Frequency Stability Analysis," *NIST Special Publication 1065*, Jul. 2008, pp. 136.

[2]W. J. Riley, K2HRT, wrote the *Stable32* software for Windows, which calculates ADEV and many similar statistics. *Stable32* is available on GitHub via IEEE (**www.github.com/IEEE-UFFC/stable32**) and from **www.stable32.com**.

[3]Open-source Python libraries for ADEV are available from **www.pypi.org/project/AllanTools**.

[4]K. Collins, KD8OXT; A. Montare, KB3UMD; N. Frissell, W2NAF, and D. Kazdan, AD8Y, "Citizen Scientists Conduct Distributed Doppler Measurements for Ionospheric Remote Sensing," *IEEE Geoscience and Remote Sensing Letters*, Mar. 2021, vol. 19, article no. 3504605, pp. 1-5.

[5]J. Gibbons, N8OBJ; K. Collins, KD8OXT; D. Kazdan, AD8Y; and N. Frissell, W2NAF, "Grape Version 1: First prototype of the low-cost personal space weather station receiver," *HardwareX*, Apr. 2022, vol. 11, article no. E00289, pp. 1-13.

[6]David Swartz, WØDAS, is the president of the WWV Amateur Radio Club. For more information about the club, visit **https://wwvarc.org**.

[7]The eight stations, listed alphabetically with their state and distance from the transmitter in parentheses, are: AD8Y (Ohio, 1,967 kilometers), AB1XB (Massachusetts, 2,778 kilometers), K4BSE (Georgia, 1,994 kilometers), KD8SYG (Ohio, 1,994 kilometers), N2RKL (New York, 2,402 kilometers), N8OBJ (Ohio, 1,975 kilometers), W7LUX (Arizona, 852 kilometers), and WCØY (Indiana, 1,662 kilometers). The skywave data shown in Figure 5 were collected on May 29 – 31, 2022.

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- ✔ A simplified diagram of HF signal propagation showing the groundwave and skywave coverage areas, as well as the skip zone, where no signals are received
- ✔ The Grape Version 1 Personal Weather Station

Michael A. Lombardi, KØWWX, has worked at NIST since 1980 and has been a radio amateur since 1996. He currently leads the Time Realization and Distribution group that operates UTC(NIST) and radio stations WWV, WWVH, and WWVB.

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

A Multi-Band End-Fed Antenna

Dan Wiley, W6AZI

After receiving my Technician-class license in 2021, I soon realized that an antenna would be the most important station component to consider for effective operations from my small backyard.

I started by making a list of performance requirements and practical considerations for the design. I wanted to have reasonable DX performance on the CW and digital portions of the 80-, 40-, and 20-meter bands at low power (below 20 W). I also wanted it to be low cost and lightweight, be easy to assemble and disassemble, only require a few alterations to my property, and have minimal grounding requirements and visual impact (see Figure 1).

The Vertical End-Fed Idea

I scoured the web for compact multi-band antenna designs that can operate down to 80 meters. I came across a popular sloped inverted-L design by Steve Nichols, GØKYA, that I thought might be a good starting point. On *GØKYA's Amateur Radio Blog*, Steve wrote an article titled "A shortened multi-band End-Fed Half Wave (EFHW) antenna for 80-10m" (**https://g0kya.blogspot.com/2017/01/a-shortened-multi-band-end-fed-half.html**). His design includes a loading coil near the far end of the antenna to accommodate 80-meter operation.

My idea was to adapt his design to be vertical. This would allow the takeoff angle to be lower for improved DX operation and would meet my space and aesthetic requirements. The high impedance of a resonant end-fed antenna meets my minimal grounding requirement, as a 12-foot counterpoise is all that's required. I started modeling the antenna with *EZNEC* (**www.eznec.com**) to work out the dimensions. After a number of iterations, I converged on an overall antenna length of 75.6 feet, which informed my choice for a mast later on. The original GØKYA loading coil value of 110 µH proved to be a good compromise of overall length, impedance, and bandwidth for 80-meter operation.

I found that the Spiderbeam 18-meter (60-foot) telescoping fiberglass mast (**www.spiderbeam.us/product_info.php?info=p232_Spiderbeam%2018m%20fiberglass%20pole.html**) best met my requirements for length, cost, weight, ease of assembly, and aesthetics. Some additional parts that I needed included:

Figure 1 — The view of the antenna from my front yard. The narrow, black, single-mast design is unobtrusive. So far, no neighbors have complained. The tiny black blob near the top of the mast is the loading coil.

1. A 150-foot spool of #18 AWG braided bare copper wire.
2. A loading coil form. I purchased a 1.5 × 12-inch sink tailpiece from ACE Hardware (item number 4223392).
3. #20 AWG loading coil magnet wire (36 feet).
4. Heat shrink for the loading coil that was 7 inches long and had an inside diameter of 2 inches.

▲**Figure 2** — On the left, the loading coil is shown uncovered, and the right image shows it covered with heat shrink.

▶**Figure 3** — A close-up view of the loading coil is on the left, and the right image shows it installed on the mast.

The Loading Coil Assembly

I made the 110 µH loading coil by close-winding 83 turns of #20 AWG magnet wire around a plastic sink drain tailpiece that was 1.5 inches in diameter and 5 inches long. I drilled holes near the ends of the tube to hold the windings in place and to provide strain relief. After checking the inductance with an LCR meter, I covered the coil with heat shrink to protect it from the elements. I then filled the wire holes from inside the tube with epoxy to keep out moisture (see Figure 2). When installed, the mast runs through the tube, and the coil is secured to the mast with zip ties (see Figure 3).

Mounting the Mast

The mast must be mounted and guyed safely and securely. I mounted my mast to the corner eaves of my house, about 8 feet above the ground, using two 0.375-inch eye bolts, a 0.5-inch crossbolt, washers, and nuts (see Figure 4). The base of the mast is held in place by a heavy stack of concrete patio bricks. The antenna wire is zip-tied to the mast above the

Figure 4 — What the mast looks like once it's mounted to the eaves. Note the stack of heavy patio bricks holding the mast in place.

eaves and sloped diagonally down to my window, where it's fed through and connected to my antenna-matching network (see Figure 5).

Impedance Matching

I used a homebrew L network with a tapped inductor and a variable capacitor to impedance-match the antenna to 50 Ω (see Figure 6). The schematic can be seen in Figure 7.

Tuning the Length

Tuning the antenna involves alternately adjusting the length of the short wire between the loading coil and the top of the mast for resonance at 80 meters, and the long wire between the impedance-matching network and the loading coil for resonance at 40 meters. The end result is maximum resistive impedance and minimum reactance at 80 and 40 meters.

I used a RigExpert antenna analyzer with a dual banana adapter connected to the antenna wire and a 12-foot counterpoise to measure the antenna impedance directly. When using this method, it's important to have the antenna wire connected to a bleeder resistor, or temporarily to ground, to discharge any static electricity prior to connecting the antenna to the antenna analyzer. Otherwise, the analyzer can be damaged by electrostatic discharge (ESD), as I once discovered the hard way.

Tuning the length is a tedious process. I had to collapse most of the telescoping sections of the mast every time I needed to adjust the short wire length at the top. Reaching resonance on both bands required several iterations, but this is a necessary step for achieving optimal performance.

Testing the Antenna

The measured impedances of the antenna range from 2.2 to 5.9 kΩ at resonance. The SWR plots for the 40- and 20-meter bands are fairly flat, with an SWR of 1.5 or less at each end of the CW and digital portions of each band. The 80-meter 2:1 SWR bandwidth is about 40 kHz wide, due to shortening the antenna with a loading coil. This means the matching network needs to be readjusted if the transmit frequency is changed significantly.

On-air testing met or exceeded my expectations on all bands. From my southern California location (DM04), I am repeatedly able to reach the Neumayer Station III, DPØGVN, in Antarctica on WSPR with only 5 W. After 5 months of FT8 operation, I've reached a DXCC count of 90, including a contact with Justin Furner, ZS5KT, in South Africa, which is near my antipode. On-air test results and additional details can be found on the *QST* in Depth web page (**www.arrl.org/qst-in-depth**).

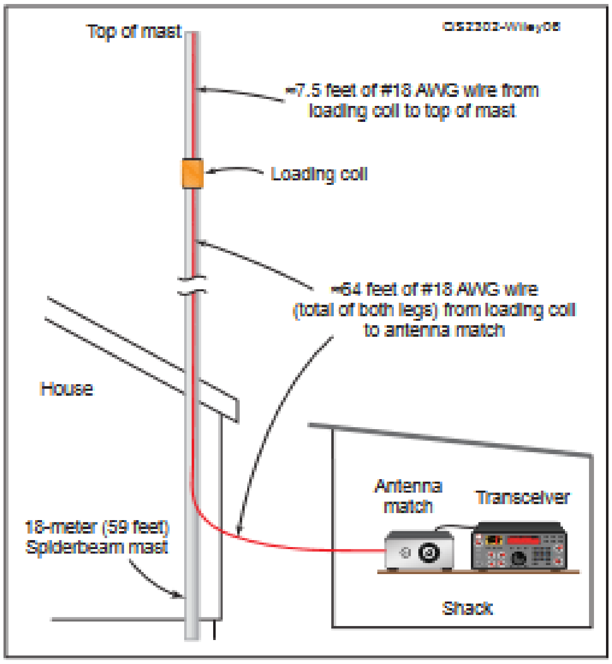

Figure 5 — A diagram of my antenna. Your wire lengths may vary, depending on the geometry and the proximity to structures when tuned to resonance. The lengths shown here are a reasonable starting point.

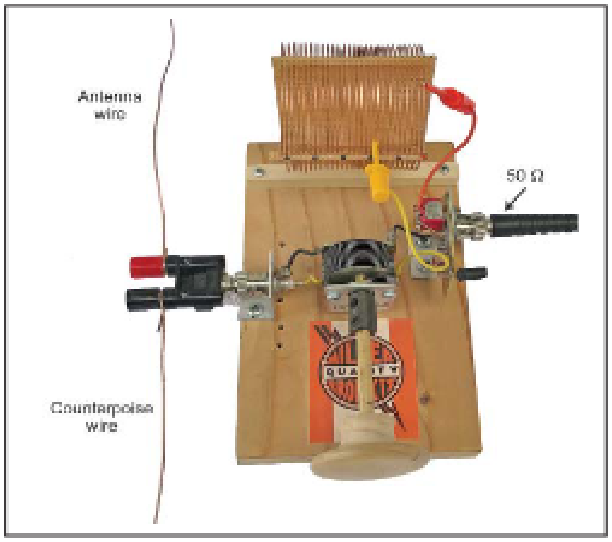

Figure 6 — My homebrew L network for impedance-matching the antenna.

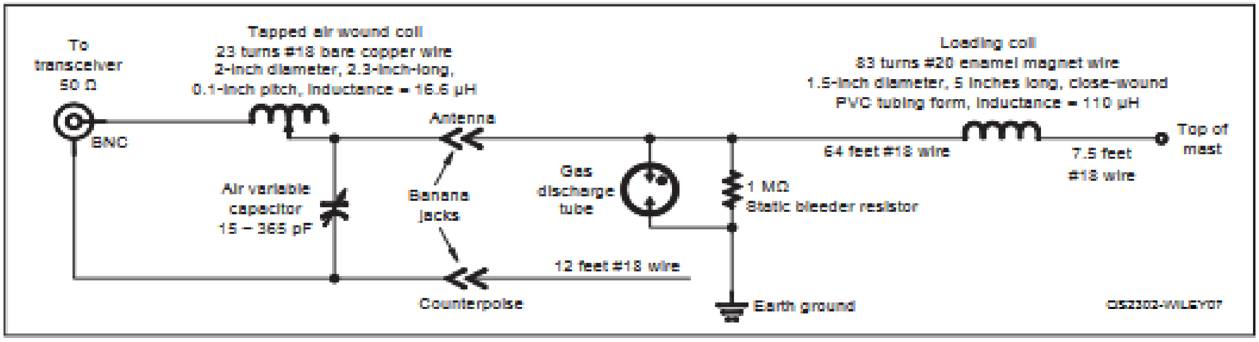

Figure 7 — The full antenna system schematic showing the matching network, lightning and ESD protection, counterpoise, and antenna connections. A gas discharge tube is used for lightning protection, and a 1 MΩ resistor bleeds off static charges.

Final Comments

As a newly licensed ham, I couldn't have asked for a more educational project. The process of designing, modeling, constructing, and testing this antenna involved learning about antenna theory and modeling, impedance matching, antenna analyzers, construction techniques, solar weather, radio propagation, the Reverse Beacon Network, FT8, and WSPR. This antenna design met all of my original design goals, and it's been quite satisfying to see it perform well on 80, 40, and 20 meters.

I wish to thank my good friend and mentor Anthony Felino, WN6Q, for his help and support, and for urging me to write this article.

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Dan Wiley, W6AZI, worked as an electronic engineer for 43 years, designing image processing and video systems for industrial and medical applications. He is now retired. He received his Technician license in December 2020, and his Amateur Extra-class license in January 2022.

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MEMBERSHIP APPLICATION

EPARA

Eastern Pennsylvania Amateur Radio Association
Address: PO Box 521, Sciota, PA 18354
Email: N3IS@qsl.net
Website: www.qsl.net/n3is

Date: ________________________

Name: ____ **Callsign** _________________

License: Novice Technician General Advanced Extra

Address: ____

City: ______________________________________ **State:** _____ **Zip:** _________

Home Phone: _____________________________________

Cell Phone: _______________________________________

Email: ____

* **Note**: We do not publicize your phone or email information.

ARRL Member: _____ **Skywarn Spotter:** _____ **ARES/RACES Member:** _____ **VE:** _____

Interests:
DX _____ Contest _____ CW _____ QRP _____ Digital Modes_____ Antique Radio Equipment _____
Building Antennas _____ Electronic Repairs _____ Elmering _____ Kit Building _____ EmComm: ____

Others: ____

How did you get interested in Ham Radio?

____

Please list any relevant qualifications or assets you have or are willing to share/contribute to the club.

Use reverse side if needed:

____

____

____

Sponsored or Reviewed by: __________________________ **Callsign:** _______________

Membership Rates,

Membership: **$20.00** per year Spouse: **$10.00** per year
Full time Student: **$15.00** per year Senior:(Over 62 years of Age): **$15.00** per year