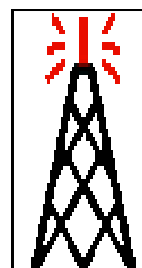


X-MITTER



***PUBLIC SERVICE
THROUGH COMMUNICATION***

February 2018 Vol. 57 No. 2



PyeongChang 2018™



PENN WIRELESS ASSOCIATION

CLUB INFORMATION

W3SK VHF Analog Repeater Frequency: 146.790 MHz (-0.6, 131.8pl)
W3SK UHF **Fusion** Repeater Frequency: 448.225 MHz

PWA Webpage URL: pennwireless.org
PWA Email: PennWirelessARC@gmail.com
PWA Executive Board: PWA-EBoard@googlegroups.com
Technet Email Reflector: PWA-Technet@googlegroups.com

Penn Wireless Association holds regular meetings consisting of general club business, current committee reports, group discussions, featured programs and a social period. This meeting is held at the Falls Township Building, 188 Lincoln Highway, Fairless Hills, PA on the fourth Monday of each month at 7:30 pm. Please contact the club vice president to add your business topic to the meeting agenda.

VISITORS ARE ALWAYS WELCOME!

PWA-Technet @ [googlegroups.com](mailto:PWA-Technet@googlegroups.com) Email Reflector

User Account Policy

Penn Wireless Association, Inc. does not knowingly profit and/or disseminate user e-mail information to "spam" lists. The reflector provides us a means to just send e-mail to those who wish to receive notification when new X-Mitter issues and other relevant information (including, but not limited to, volunteer requests, ARES/RACES meetings, Field Day information, & Club events) are available for you to view on PWA web sites. We routinely send mass e-mail notification to all users, but we avoid issuing e-mail that is unrelated to Amateur Radio. However, we may send a mass e-mail to all users only if there is a problem with the web site, during web site maintenance, or during an emergency or scheduled public service event in order to notify those Amateur Radio operators who may registered as a usewish to participate in RACES/ARES or PWA operations. If you have already r please review your account's distribution settings and if your e-mail is current so we may send you notification when new X-Mitter issues

X-MITTER

Newsletter Policy

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Field Day 2018

I heard you groan. February and he already wants to start talking about Field Day. The reality is, based on past experience, we should begin our 2018 Field Day discussion and preparation.

As a start, your E Board has taken the step of reserving our normal location at Plantation Field, Tyler Park. What's next? Well, we need a Member to step forward to assume the position of **Field Day Chairman**. Consensus among the older members is that it would be great to see one of our newer members rise to the occasion. Former F.D. chairmen are willing to assist anyone who agrees to take up the challenge. An effective Chairman is critical to a productive and enjoyable Field Day for all.

The Club needs Member input to determine the extent of PWA's Field Day 2018 effort.

It was suggested and approved at the last E Board meeting to move all Field Day discussion to the last segment of our General Membership meetings. The February meeting will start with a review of the E Board meeting, followed by a nice presentation from Tom Mills on QSL cards. At the conclusion of our scheduled programming we will begin our Field Day discussions. We will continue this format up to Field Day. Please consider remaining for the discussion. We need your input on how you'd like to see Field Day run this year.

'73 KE3LA



PENN WIRELESS ASSOCIATION

PWA News and Reminders

Congratulation Bob Hecht Bob N3AAK Hecht, PWA member and current President of Chap. 5, Quarter Century Wireless Association was recently honored by QCWA, International and presented with the organizations Meritorious Award. Bob has been instrumental in restoring Chapter Five to a strong and growing Chapter of QCWA.

Ed Wells' Embedded Processor Class continues on the 3rd Thursday of each month at the Falls Twp. Municipal Bldg.—Rm 202, 7:30 P.M.

PWA TechNet, Sunday evenings, 8:00 P.M. local on the W3SK repeater, 146.790 Mhz., - offset, 131.8 P.L. Join the discussion every Sunday night. Topics vary but always informative. Consider becoming Net Control. For information contact Ben Johns, K3JQH

PWA Fund Raising Event— 02/23/18, all day, Margaritaville Restaurant, Oxford Valley Mall. Tell the hostess that seats you you're with PWA and a portion of your bill will be donated to PWA

QCWA QCWA is open to all amateur radio operators who have been licensed for 25 years or more. Chapter Five is open to two levels of membership which allows amateurs who have not yet reached 25 years of licensing to become a member. Chapter Five encourages members to be part of their local radio clubs such as PWA. Several PWA members are also members of QCWA and we look forward to welcoming any amateur operator into QCWA.

PWA General Membership Meeting, 02/24/18, Main Meeting Rm., Falls Twp. Municipal Bldg., 7:30 P.M., V.E. Sessions available by appointment, contact Ben Johns, k3jqh@arrrl.net

Agenda: E Board meeting synopsis, refreshments, Tom Mills QSL card presentation, Field Day 2018 discussion.

Dues and Member participation are the life blood of PWA. Please stay active and up to date on your dues.

Not radio related, but definitely historical and of interest to some of us. After a 58 year drought, our Philadelphia Eagles are Super Bowl champions. It has been a long wait for the fans.

I hate to admit it, but I do remember the last time they were World Champs. The year was 1960. It seems like a lifetime ago and I guess it truly is. I was eleven years old and relatively new to the Philadelphia area, having relocated from the western end of the state five years prior.

So much seemed new then. A kinder, gentler and more refined time. Anything seemed to lie within the realm of possibility. Space exploration, new advances in science and technology and social progress seemed to dominate the news daily.

I guess it's true that you can't go back, just fondly remember the past. Perhaps we remember the past too fondly and view the present too harshly. Still, in my mind, a great time to grow up.

February also has seen the start of the 2018 Winter Olympics from South Korea. I unfortunately missed the opening ceremonies but did see recorded highlights. The coordinated drone display was something to behold. I've seen similar routines with small, centrally controlled robot teams but the drone display was remarkable. Not sure why, but I prefer the Winter Games to the Summer Games. Still waiting for my favorite event (Curling) to air.

Sorry for diverging from Ham radio. February is an active month for radio-related activities. Check the February Contest Corral for details.

'73

Jim—KE3LA



PENN WIRELESS ASSOCIATION

January General Membership Meeting Minutes

**Penn Wireless Association
P.O. Box 925
Levittown, PA**

Membership Meeting minutes - January 22, 2018

Meeting opened at 1938 by President KE3QC, Tom with the pledge of allegiance and a round of introductions.

Treasurer report by K3FKW, Ken: income \$x.xx, expenses \$x.xx, ending balance \$x.xx. Motion by K3JQH, Ben, passed

VE - K3JQH, Ben reports no one is scheduled for VE testing at this time.

Repeater - N3HTZ, Cully reports Echolink now working thanks to WB0YLE, Bryan.

All repeater functions are stable.

Membership - KB3ORG, Steve

Fundraising - KB3ORG, Steve that the restaurant donation program is tentatively scheduled for Feb 23.

Technet - K3JQH, Ben reports that all is running smoothly and that attendance was slightly down last Sunday probable due to football playoffs.

ARRL - KE3LA, Jim commented on member complains at ARRL hq.

PENN WIRELESS ASSOCIATION

January General Membership Meeting Minutes

Fusion - WA3QVU, Mark talked about the Fusion WIRES-X setup at Ben's house and the proposal to "lock down" our room to the W3SK node.

Mark also spoke on behalf of N3FEL, Howard about the "Builders Corner" and the small parts acquired from the estate of W3GK.

After the social break we had an excellent live demonstration of SharkRF openSPOT by W3LSX, Dennis.

Meeting adjourned at 2105 by motion of K3JQH, Ben.

Respectfully submitted - K3JQH, Ben, Recording Secretary

PENN WIRELESS ASSOCIATION

February E Board Meeting Minutes

Penn Wireless Association
P.O. Box 925
Levittown, PA

Executive board meeting - February 12, 2018

Meeting called to order by President Tom, KE3QC at 1744 with the following attendees: N3FEL, Howard, KB3ORG, Steve, K3FKW, Ken, KE3LA, Jim, K3TX, Dave, K3JQH, Ben and KB3LNP, Roy.

COMMITTEE REPORTS: (Ed. - Treasurer Report Figures Redacted)

VE - K3JQH reports one candidate scheduled for February so far.
KB3ORG commented that membership committee will have some presence at testing sessions to represent PWA.

Treasurer - K3FKW reports: Beginning balance \$x,xxx.xx, incoming \$xxx.xx, outgoing \$xxx.xx, current balance \$xxxx.xx.

Expenses - \$xxx.xx to Tyler park for Field Day pavilion and income of \$x.xx from Omaha Steaks incentive program.

Repeater - nothing to report.

Membership - KB3ORG reports 11 member dues collected with 2 currently delinquent, 3 membership expired and 3,5,7 members due in the next three months respectably, current active paid members at 36.

Fundraising - KB3ORG will schedule February 23 for the 10% meal kickback at Margaritas restaurant, Oxford Valley.

Program - February will be QSL presentation by AF4NC, Tom and March will be the club auction and April will be K3TX on CW.

PENN WIRELESS ASSOCIATION

February E Board Meeting Minutes

TECHNET - K3JQH reported that all is well with about 10 participants per session.

ARRL - K3TX reported on some turmoil at headquarters.
Dave also urged members to view "MYARRL" web site.

FUSION - some discussion on the current status of WIRES-X.

Constitution - K3JQH presented draft of proposed constitution amendments with open discussion to fine tune wording preparing for presentation at the next general meeting.

Open discussion:

President KE3QC opened discussion on Field Day.
Suggestion to convene a separate meeting of all interested parties after the General meeting is adjourned was approved.
Looking for a event chairperson.

Steve noted that PayPal cannot be used for club transactions unless the individual has his/her personal PayPal account.

Technet script will be updated on web site.

Meeting adjourned by motion of KB3ORG, 2nd by KE3LA

Respectfully: K3JQH, Ben

PENN WIRELESS ASSOCIATION

RRI First Quarter EMCOMM Exercise Q1 2018

Radio Relay International 2018 Q1 Emergency Exercise

Background:

Effective with the calendar year 2018, Radio Relay International will be conducting a series of emergency exercises. These will be conducted in the form of an exercise cycle beginning with basic drills and transitioning to the occasional full-scale exercises in cooperation with served agencies.

The purpose of these exercises is to further develop and enhance the national messaging layer. Each drill will have a unique purpose. Some will exercise a specific mode or method of communications. Others may emphasize a specific emergency management function, such as situational awareness reporting, welfare traffic management or the like. Ultimately, the goal will be to develop the building blocks of public service communications, ultimately culminating in the periodic exercise of an effective national messaging layer, which offers a *diverse* range of capabilities systematically harmonized to ensure effective response to any communications emergency.

First Quarter 2018: Field Deployment Exercise - CW

Date: April 21, 2018
Time: 1600Z to 1900Z

Purpose:

This exercise is designed to develop the capacity of volunteers to deploy survivable, portable stations to the field and establish effective, traffic-quality circuits with an emphasis on battery operation, low power consumption and renewable energy resources. This exercise combines fun, comradery, and a meaningful test of EMCOMM capabilities simulating a catastrophic disruption of commercial telecommunications common carrier resources.

Who may participate:

The exercise is open to all licensed radio amateurs. Some familiarity with radiogram format and basic transmission procedures is recommended. Please transmit at a speed that is consistent with your ability to copy CW. Information about radiogram format and basic procedures can be found in the Radio Relay International training manual TR-001 available at:

<http://radio-relay.org/wp-content/uploads/2017/11/RRI-Training-Manual-TR-001-2017-Draft-for-Distribution.pdf>

One may also want to review the companion power point slides and the RRI Field Manual at:

<http://radio-relay.org/wp-content/uploads/2017/03/RRI-Introductory-Training-2018.pdf>

<http://radio-relay.org/wp-content/uploads/2017/03/RRI-Traffic-Operations-Manual-2017-FINAL.pdf>

PENN WIRELESS ASSOCIATION

RRI First Quarter EMCOMM Exercise Q1 2018

Exercise Requirements:

1. Participants shall not use gasoline generators. All communications must be conducted using battery power. Renewable sources of energy should be included in the form of solar panels or other renewable energy technologies if available, however, this is not mandatory.
2. Participants shall originate a minimum of one radiogram message providing the following information:
 - a. Geodetic coordinates in decimal degrees.
 - b. Maximum RF power output used to establish communications
 - c. Number of individuals assisting with deployment
 - d. Club or EMCOMM organization affiliation (if applicable).
3. Radiogram format is required for all messages.
 - a. Precedence should be "Test Priority" (abbreviated TP").
 - b. Place of origin should be nearest city and state.
 - c. Date and time of origin should reflect the time at which the message was drafted and presented for transmission.
 - d. Address shall be: "RRI NECC MARION IL 62959"
 - e. Signature should include the first and last name of originator.

A sample radiogram might be:

3 TP K8QMN 9 LANSING MI 1343Z APR 21
RRI NECC
MARION IL 62959
<BT>
LOCATION 43<R>446N 83<R>982W MAXIMUM POWER
5 WATTS 3 PARTICIPANTS
<BT>
STEVE JOHANSON K8CBS
INGHAM COUNTY ARES

Frequency and calling procedures:

When practical, traffic should be concentrated at the top and bottom of the hour, although it may be originated at any time during the exercise operation. RRI Inter-Area Traffic Net (IATN) operators will monitor the following frequencies for message traffic:

7115 KHz
10115 KHz
14115 KHz

IATN operators will periodically announce their presence on frequency as follows:

QSX RRI de [CALL SIGN] K

PENN WIRELESS ASSOCIATION

RRI First Quarter EMCOMM Exercise Q1 2018

Please try to select/call the station that offers the strongest signal to increase the odds of establishing a successful circuit and traffic exchange.

Any station holding traffic may announce his presence on frequency to expedite the origination of his radiogram(s). Be certain to ensure the frequency is clear before calling. There are two procedures for doing this:

1. The least disruptive is to transmit the Morse letter "C." di-dit dit If an operator responds accordingly, you should standby until he clears his traffic.
2. An alternate method is to simply transmit the standard "QRL?" If an operator responds with "QRL," please standby until he clears the existing traffic exchange.

When announcing your presence on frequency, please do so as follows:

RRI RRI de [CALL SIGN] QTC 1 TP K

This exercise is open to relatively inexperienced operators. If you require a slower exchange, please do not hesitate to ask the receiving operator to slow down using "QRS."

Local EMCOMM organizations are at liberty to expand the exercise to a "gateway" configuration. For example, a local VHF SSB network might be established to test highly efficient simplex methods. A key station could then collect several radiograms and transfer them to the IATN circuits.

Propagation and Contest Interference:

Most weekends are now shared with multiple contests. Those deploying to the field are encouraged to be operational on at least two of the three assigned frequencies in case interference proves problematic. WARC bands, such as 30-meters may prove a useful option in the event contest activities prove problematic.

After the exercise:

Upon successfully clearing your message traffic, you may secure your portable station. However, some may want to monitor for a time to observe procedures and assess the performance of the network. Please retain a copy of any radiograms as originated and mail them to RRI for use in the evaluation phase of the exercise. In other words, your original radiogram will be compared against the copy received by the National Emergency Communications Coordinator to calculate network performance and accuracy. Please mail your copy(s) to:

Radio Relay International
PO Box 192
Buchanan, MI. 49107

You may also scan the radiogram(s) for transmission via e-mail to:

info@radio-relay.org

Participants are invited to send after-action reports, photographs of their field equipment, antenna configurations and other comments of interest to the above addresses for inclusion in a future issue of the "QNI Newsletter."

PENN WIRELESS ASSOCIATION

RRI First Quarter EMCOMM Exercise Q1 2018

RSVP Required:

If you plan to participate in the exercise, please RSVP by no later than February 15, 2018 the above e-mail address. RSVP is essential to determine interest level before allocating volunteer resources.

Advance Preparation:

Those planning to participate may want to monitor a CW traffic net for a time in advance of the exercise to become familiar with transmission procedures and radiogram format.



PENN WIRELESS ASSOCIATION

ARRL

Contest Corral

February 2018

Check for updates and a downloadable PDF version online at www.arrl.org/contests.

Refer to the contest websites for full rules, scoring information, operating periods or time limits, and log submission information.

Start - Finish Date-Time	Start Date-Time	Finish Date-Time	Bands	Contest Name	Mode	Exchange	Sponsor's Website
1 1800	1 2200	28		NF9AU 10 Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	www.uneth.net/activity-contests
2 1400	4 0200	All		YLRL YL-OM Contest	CW Ph Dig	Serial, RS(T), SPC	ylrl.org/index.php
3 1400	3 2359	1.8-28		FYBO Winter QRP Sprint	CW Ph Dig	RS(T), SPC, name, power, temperature	arizonasocptions.apple-land1.com
3 1400	3 2359	1.8-28		Minnesota QSO Party	CW Ph Dig	Name, county or SPC	www.w0aa.org
3 1800	3 1900	3.5		AGCW Straight Key Party	CW	RST, serial, class, name, age	www.agcw.org
3 1700	3 2100	3.5-28		FISTS Winter Slow Speed Sprint	CW	RST, SPC, name, mbr or power	fistsna.org
3 0000	4 2359	1.8-UHF		Vermont QSO Party	CW Ph Dig	RS(T), county or SPC	www.vnm.org/vtqso.html
3 0001	4 2359	28		10-10 International Winter Contest, SSB	Ph	Name, mbr or "Q," SPC	www.ten-ten.org/
3 1200	4 1159	1.8-28		Black Sea Cup International	CW Ph	RS(T), clublog or ITU zone	beso.ucoz.ru
3 1200	4 1200	3.5-28, 144		F9AA Cup, CW	CW	RST, serial	www.site.uco.asso.fr
3 1200	4 2359	3.5-28		Mexico RTTY International Contest	Dig	RST, XE state or serial	www.rthyline.mx
3 1800	4 2359	1.8-28		British Columbia QSO Party	CW Ph Dig	RS(T), BC district or SPC	www.orcadoc.org
4 0000	4 0400	3.5-14		North American Sprint, CW	CW	Other station's call, your call, serial, name, SPC	ncjweb.com/Sprint-Rules.pdf
5 1900	5 2000	3.5		RSGB 80 Meter Club Championship, SSB	Ph	RS, serial	www.rsghoc.org/hf
6 0200	6 0400	3.5-28		ARS Spartan Sprint	CW	RST, SPC, power	arspp.blogspot.com
7 2000	7 2100	3.5		UKERC 80 Meter Contest	Ph	4-char grid square	www.ukercs.com
10 1100	10 1300	7, 14		Asia-Pacific Spring Sprint, CW	CW	RST, serial	jafic.org/apssprintrules.pdf
10 1700	10 2100	3.5-28		FISTS Winter Unlimited Sprint	CW	RST, SPC, name, mbr or power	fistsna.org
10 1900	10 2300	1.8		RSGB 1st 1.8 MHz Contest	CW	RST, serial, UK district code (if any)	www.rsghoc.org/hf
10 0000	11 2359	3.5-28		CQ WW RTTY WPX Contest	Dig	RST, serial	www.cqwpw.com
10 1000	11 1000	1.8-28		SARL Field Day Contest	CW Ph Dig	RS(T), number of words, category, province (or DX)	www.sarl.org.za
10 1200	11 1200	1.8-28		Dutch PNCC Contest	CW Ph	RS(T), PA province or serial	paco.veron.nl
10 1200	11 1200	1.8		KCJ Topband Contest	CW	RST, prefecture/district/continent code	www.kcj-cw.com
10 1200	11 2359	1.8-50		SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
10 1500	11 1500	1.8-28		OMISS QSO Party	Ph	RS, SPC, mbr (if any)	omiss.net/Facilitator/property.php
11 1200	11 1800	3.5, 7		Balkan HF Contest	CW Ph	RS(T), serial	arbh.ba
12 0100	12 0259	3.5-14		COC Winter QSO Party	CW	RST, SPC	www.colonadocqclub.org
12 1300	16 2359	All (no WAAC)		ARRL School Club Roundup	CW Ph	RS(T), Class (WCS), SPC	www.arrl.org/school-club-roundup
14 0000	14 2359	1.8-7		PODXS 070 Club Valentine Sprint	Dig	Name, OM/YL, SPC	www.podxs070.com
14 0130	14 0330	3.5-14		NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
14 1900	14 2030	3.5		RSGB 80 Meter Club Championship, Data	Dig	RST, serial	www.rsghoc.org/hf
17 0800	17 1000	7		SARL Youth Day Sprint	Ph	RS, age	www.sarl.org.za
17 1900	17 2059	1.8-28		Field Hall Sprint	Dig	RST, name, mbr, SPC, grid	sites.google.com/site/fieldhallclub
17 0000	18 2359	1.8-28		ARRL International DX Contest, CW	CW	WVE: RST, SP: DX: RST, power	www.arrl.org/arrl-dx
17 1200	18 1159	1.8-28		Russian PSK WW Contest	Dig	RST, Oblast or serial	www.rndclub.ru
17 2300	18 2300	1.8-14		AWA Amplitude Modulation QSO Party	Ph	Name, SPC	www.anlogwireless.org
18 1300	21 0800	1.8-144		Classic Exchange, Phone	Ph	Name, RS, SPC, roving model	www.classicexchange.org
19 0200	19 0400	1.8-28		Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
21 1900	21 2030	3.5		AGCW Semi-Automatic Key Evening	CW	RST, serial, 2-digit year first used a bug	www.agcw.org
22 1900	22 2030	3.5		RSGB 80 Meter Club Championship, CW	CW	RST, serial	www.rsghoc.org/hf
23 2200	25 2200	1.8		CQ 160-Meter Contest, SSB	Ph	WVE: RS, SP: DX: RS, CQ zone	www.cq160.com/rules.htm
24 0800	25 1800	3.5-28		REF Contest, SSB	Ph	RS, F Department or serial	concourse-e-f.org/reglements
24 1300	25 1300	3.5-28		UBA DX Contest, CW	CW	RST, serial, ON province (if any)	www.uba.be/en
24 1900	25 0159	1.8-50		South Carolina QSO Party	CW Ph Dig	RS(T), county or SPC	scqso.com/rules
24 1800	25 0559	3.5-28		North American QSO Party, RTTY	Dig	NA: Name, SPC; DX: Name	www.ncjweb.com
25 0900	25 1700	3.5-28		High Speed Club CW Contest	CW	RST, mbr or "NM"	www.highspeedclub.org
25 1300	25 1800	3.5-14		SARL Digital Contest	Dig	RST, serial	www.sarl.org.za
25 1500	26 0059	3.5-144		North Carolina QSO Party	CW Ph Dig	NC county or SPC	nars.org/ncqsoparty
29 0000	29 0200	1.8-28		SKCC Sprint	CW	RST, SPC, name, mbr or power	www.skccgroup.com
29 2000	29 2100	3.5		UKERC 80 Meter Contest	CW	4-char grid square	www.ukercs.com

All dates refer to UTC and may be different from calendar dates in North America. No contest activity occurs on the 60-, 30-, 17-, and 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 WIA7BNM Contest Calendar at www.hornucopia.com/contestcal and is extracted for publication in QST 2 months prior to the month of the contest. ARRL gratefully acknowledges the support of Bruce Horn, WIA7BNM, in providing this service.

PENN WIRELESS ASSOCIATION

ARRL

Contest Corral

March 2018

Check for updates and a downloadable PDF version online at www.arrl.org/contests.

Refer to the contest websites for full rules, scoring information, operating periods or time limits, and log submission information.

Start - Finish Date-Time	Date-Time	Bands	Contest Name	Mode	Exchange	Sponsor's Website
3 0000	4 2359	1.8-28	ARRL International DX Contest, SSB	Ph	RS, SP (WME) or power (DX)	www.arrl.org/arrl-dx
3 0000	10 2359	3.5, 7, 21, 28, 144	Novice Rig Roundup	CW	RST, QTH, name, class	noviceroundup.com
3 0800	3 0800	7-14	Wake-Up! QRP Sprint	CW	RST, serial, suffix of previous QSO	qrp.net/contest/wakeup
3 1800	4 1359	1.8-28	Open Ukraine RTTY Championship	Dig	State/province/canton, serial	las.ho.ua/openarty
4 0700	4 1100	3.5	UBA Spring Contest, CW	CW	RST, serial, UBA Section (if UBA)	uba.be/hf/contest-rules
4 1200	4 1400	7	SARL Hamnet 40-Meter Simulated Emergency Test	Ph	RS, serial	www.sarl.org.za
4 1200	4 2200	3.5	NSARA Contest	CW Ph Dig	RS(T), county (if Nova Scotia)	nsara.ve1cfj.net
5 2000	5 2130	3.5	RSGB 80-Meter Club Championship, Data	Dig	RST, serial	www.rsghoc.org/hf
6 0800	6 0400	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqp.blogspot.com
6 1900	6 2100	3.5	AGCWYL-CW Party	CW	RST, serial, name	agcw.org/index.php/en
7 1800	7 2200	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	www.nrau.net
7 2000	7 2100	3.5	UKIICC 80-Meter Contest	Ph	4-char grid square	www.ukiicc.com
7 2300	11 2300	7-14	AWA John Rollins Memorial DX Contest	CW	RST, eqpt type, eqpt year	www.antiquewireless.org
10 1000	11 1000	3.5-28	RSGB Commonwealth Contest	CW	RST, serial	www.rsghoc.org/hf
10 1000	11 1000	50-1296	SARL VHF/UHF Analogue/Digital Contest	Dig	RS, 6-char grid square	www.sarl.org.za
10 1200	11 1200	3.5-28, 144	PSAA Cup, SSB	Ph	RST, serial	www.sate.ure.asso.fr
10 1200	11 1200	28	South America 10-Meter Contest	CW Ph	RS(T), CQ zone	sat10m.com.ar
10 1200	11 2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
10 1400	10 2000	3.5-28	AGCW QRP Contest	CW	RST, serial, class, mbr or "NM"	agcw.org/index.php/en
10 1500	11 1500	1.8	Stew Perry Topband Challenge	CW	4-char grid square	www.k1en.net/stew
10 1500	11 2000	3.5-50	Oklahoma QSO Party	CW Ph Dig	RS(T), county or SPC	k5cm.com/oklog.htm
10 1600	11 1600	3.5-28	EA PSK33 Contest	Dig	RSQ, EA province or serial	concursos.ure.es/en
10 1800	11 0559	3.5	Testa Memorial HF-CW Contest	CW	RST, serial, 4-char grid square	www.radioport.org.uk
10 1800	11 1800	1.8-50	QOWA QSO Party	CW Ph Dig	Year licensed, name, SPC or QOWA chapter	www.qowa.org
10 1900	11 1900	1.8-28	Idaho QSO Party	CW Ph Dig	RS(T), county or SPC	idahocallinfo.com
10 2200	10 2300	1.8-28	QRP ARCI Spring Thaw SSB Sprint	Ph	RS, SPC, mbr or power	www.qrp-arci.org
11 0000	11 0400	3.5-14	North American Sprint, RTTY	Dig	Other's call, your call, serial, name, SPC	ncjweb.com
11 0700	11 1100	144	UBA Spring Contest, 2 Meters	CW Ph	RS(T), serial, UBA Section (if UBA)	uba.be/hf/contest-rules
11 1800	11 2200	3.5	WAB 3.5 MHz Phone	Ph	RS, serial, WAB square or country	wab.internap.net
11 1800	12 0100	All	Wisconsin QSO Party	CW Ph Dig	County or SPC	www.wsmc.org
12 0000	12 0200	1.8-28	4 States QRP Group Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqgp.com
13 1700	18 1700	3.5-28, 144	CLARA Chatter Party	CW Ph	RS(T), name, SPC	www.clarrylca.com
14 2000	14 2130	3.5	RSGB 80-Meter Club Championship, CW	CW	RST, serial	www.rsghoc.org/hf
17 0200	19 0200	3.5-28	BARTG HF RTTY Contest	Dig	RST, serial, 4-digit UTC time	www.bartg.org.uk
17 1200	18 1200	1.8-28	Russian DX Contest	CW Ph	RS(T), 2-char oblast or serial	www.rdxo.org
17 1400	17 1900	144, 432	AGCW VHF/UHF Contest	CW	RST, serial, power class, 6-char grid	agcw.org/index.php/en
17 1400	18 0200	1.8-144	Louisiana QSO Party	CW Ph Dig	RS(T), LA Parish or SPC	lqap.louisianacontestclub.org
17 1400	18 2359	All	Virginia QSO Party	CW Ph Dig	Serial, VA county or SPC	www.qsl.net/1sterling
17 2000	17 2159	1.8-28	Feld Hell Sprint	Dig	RST, mbr, SPC, grid	sites.google.com/site/feldhellclub
18 0700	18 1100	3.5	UBA Spring Contest, SSB	Ph	RS, serial, UBA section (if UBA)	uba.be/hf/contest-rules
19 0100	19 0300	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qpcontest.com/pigrun
19 1800	19 2059	3.5-7	Bucharest Contest	CW Ph Dig	RS(T), serial, sector or country code	yoltest2018.blogspot.ro
22 0000	22 0200	3.5-14	NADCC CW Sprint	CW	RST, SPC, mbr or power	nadccinfo.com
22 2000	22 2130	3.5	RSGB 80-Meter Club Championship, SSB	Ph	RS, serial	www.rsghoc.org/hf
24 0000	24 2359	1.8-VHF	FOC QSO Party	CW	RST, name, mbr (if any)	g1foc.org/qso-party
24 0000	25 2359	1.8-28	CQ WW WPX Contest, SSB	Ph	RS, serial	www.cqwpw.com
25 0800	25 1000	50	UBA Spring Contest, 6 Meters	CW Ph	RS(T), serial, UBA section (if UBA)	uba.be/hf/contest-rules
28 0000	28 0200	1.8-28	SKCC Sprint	CW	RST, SPC, name, mbr or power	www.skccgroup.com
28 2000	28 2100	3.5	UKIICC 80-Meter Contest	CW	4-char grid square	www.ukiicc.com
31 1200	1 1159	1.8-28	Russian WW MultiMode Contest	CW Ph Dig	RS(TQ), 2-char oblast or serial	www.rdrclub.ru
31 1200	1 1200	3.5-28	UKI DX Contest, CW	CW	RST, serial, UKI district code, serial	www.ukiicc.com

All dates refer to UTC and may be different from calendar dates in North America. No contest activity occurs on the 60-, 30-, 17-, and 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 WAZBNM 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, W4BNM, in providing this service.

Call Ham Radio "CB" one more time...



I dare you, I double dare you !

K1TA

**So I bought a new transceiver
and she asked...**



**“Are you going to sell any of
your old ones?”**

PENN WIRELESS ASSOCIATION

LOCAL NETS

Net Name	Day	Local Time	Frequency	Comments
DEN	Tuesday	1900	147.03+	Philmont repeater PL 91.5
Digital Education Net – training on all digital modes				
WARC	Wednesday	2000	147.09+	WARC repeater PL 131.8
Warminster Amateur Radio Club Net				
BCARES	Wednesday	2030	147.270+	N3KZ repeater PL 100
Bucks County ARES NBEMS training using Fldigi – 1500 on waterfall				
BCARES	Wednesday	2100	147.09+	WARC repeater PL 131.8
Bucks County ARES voice net				
Montco ARES	Thursday	1900	146.835-	MCARES repeater PL 88.5
They send one practice NBEMS message during voice net using Flmsg				
CCARES	Thursday	1930	446.175-	CCARES repeater PL 100
Chester County ARES voice net				
CCARES	Thursday	1945	446.175-	CCARES repeater PL 100
NBEMS training net after voice net using Fldigi				
NY NBEMS	Saturday	1000	3.583 mHz	1500 on waterfall FLDIGI
SATERN	Saturday	1300	14.065 mHz	1000 on waterfall FLDIGI
Salvation Army NBEMS net – early checkins starting at 1200				
Shortwave Radiogram Broadcast – for information see:				
http://swradiogram.net/				
Pa NBEMS	Sunday	0800	3.585 mHz	1500 on waterfall FLDIGI
NJ NBEMS	Sunday	0930	3584.5 mHz	1500 on waterfall FLDIGI
PEMA	Sunday	0900	3.987.5 mHz	Voice Net
PWA	Sunday	2000	146.790-	PWA repeater PL 131.8
Penn Wireless Association Technical Net				

All About Antennas Part 3

By Bob Grove W8JHD

Last month we discussed the many physical aspects of antenna design, not only in construction but in location. Now let's take a close look at some of the electrical considerations.

Matching the System

The term "impedance matching" always comes up when referring to an antenna and transmission line. To impede means to oppose, so what is being opposed in an antenna system?

When a battery is connected to a light bulb, the resistance of the filament is the impedance, dissipating the opposed energy as heat and light. Ohm's law reveals that there is a simple relationship between resistance, voltage and current. When a transmitter is connected to an antenna in free space, RF energy is radiated into space; the voltage and current are controlled both by the antenna's radiation resistance and any capacitive or inductive reactance which may be present.

Why does an open circuit like a dipole accept and radiate power? An antenna is a specialized form of transmission line; it is coupled to space, which has an impedance of 377 ohms. The center feed point impedance of a half-wave dipole, however, is much lower than that.

Resonance

The impedance of an antenna is a combination of radiation resistance, conductor resistance, and reactance. Radiation resistance is desirable; it's what accepts power and radiates it into space. Conductor resistance, however, wastes power as heat. Reactance opposes incoming energy; it is caused when an antenna is too long or too short at a particular frequency, so that when the wave (signal voltage) traveling along the antenna is reflected from the ends, it returns to the feed point "out of phase" with the incoming wave.

A half-wave antenna is naturally "resonant"; an arriving signal travels that half-wave length in half its cycle, then reflects back in the other direction, finishing that cycle when it returns to its starting point, the electromagnetic equivalent of a vibrating guitar string.

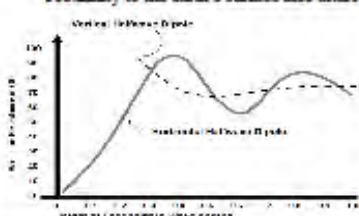
Measurements will reveal maximum current (and minimum voltage) at the center, and maximum voltage (minimum current) at the ends of the wire. A multiple-half-wave (full-wave, wavelength-and-a-half, etc.) antenna will have a standing wave on every half-wavelength section.

Radiation Resistance

An infinitely-thin, half-wave dipole in free space (at least several wavelengths away from other objects) would have a center feed point impedance (radiation resistance) of 73 ohms. Constructed of normal wire the impedance is

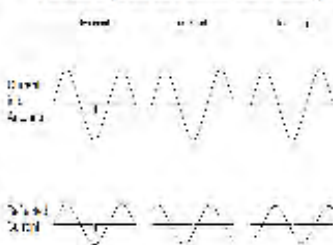
closer to 65 ohms; if thicker tubing, 55-60 ohms. This impedance rises as we move the feed point off center. If we use a folded dipole (See figure.) the feed point impedance rises to about 300 ohms.

Proximity to the earth's surface also alters



the feed point resistance of a horizontal dipole, typically dropping from 100 to nearly 0 ohms as the antenna is lowered from 0.33 wavelengths to the earth's surface, and fluctuating between 60 and 100 ohms at heights between 0.33 and 1 wavelength.

Vertical dipoles fare better, since their pat-



terns do not radiate directly downward where they would interact with the earth. Once elevated at least 0.25 wavelength, their impedance remains a relatively constant 70 ohms.

A vertical antenna with drooping radials has lower impedance, nominally 50 ohms; if those radials were horizontal (at right angles to the vertical element), the feed-point impedance would be about 35 ohms.

If 50-ohm coax is attached to an antenna's 50-ohm feed point, we have a perfect (1:1 ratio) impedance match, but if that 50 ohm coax is attached either to a 25 or 100 (50/25 or 100/50), is that bad? No. Is 3:1? No.

The simple fact is that if there is no resistive loss in the feed line or antenna (of course there always is), 100% of the generated power will be radiated by the antenna regardless of the mismatch.

What really happens with an impedance mismatch? Some of the signal voltage reflects back from the antenna junction through the coax to the transmitter where it is re-reflected and

eventually radiated into space. The higher the voltage (that is, the worse the mismatch), the more power is absorbed by the resistive insulation, heating it. That's where low-loss coax is important. An impedance mismatch does not produce radiation from the feed line.

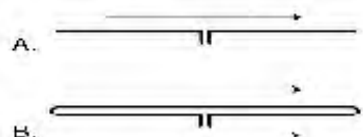
When receiving, all signal voltage gathered by a perfectly matched antenna is fed to the receiver, but with a mismatch, the reflected signal is radiated back into space. In practice, this is usually of minor consequence, especially at HF and below, where atmospheric noise is a dominant influence on signal interference.

The Transmission Line

In the early days of radio when open-wire transmission lines were common, the voltage fields produced by standing waves would light up bulbs and deflect meters brought near the lines; nowadays, with the near-universal use of coaxial cable which encloses the electrostatic fields, such measurements are not as easy.

Connecting an unbalanced line (coax) to a balanced antenna can cause RF currents to flow on the outside of the line, but these are not standing waves. So what gives a transmission line its characteristic impedance (surge impedance)? A feed line can be considered as a radio-frequency, low-pass filter consisting of an infinite number of series inductances shunted by an infinite number of parallel capacitances.

The impedance of this distributed network



is theoretical, based upon the dielectric constant of the insulation, the spacing of the conductors, no losses, and infinite length.

While the most common feed line impedances are 50, 75 and 300 ohms (TV twin lead), there are more than two dozen commercially-available impedances from 32 to 600 ohms.

So why 50 or 75 ohms?

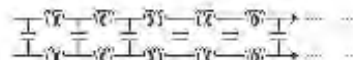
Why have we chosen impedance standards like 50 and 75 ohms for coax? For transmitters, the best power-handling capability is at 77 ohms, while the best voltage tolerance occurs below 30 ohms. 50 ohms is a good compromise and it matches several standard antenna designs.

For receiving purposes, 75 ohms is optimum for low coax losses, so it was adopted by the cable TV industry. Conveniently, it also matches several antenna designs.

The impedance a transmitter or receiver "sees" when it is mismatched to a length of transmission line connected to an antenna is a composite of the length of the line along with its losses, the SWR (see "Traveling Waves" below), and the load (feed point impedance of the antenna to which it is connected). If they are all properly matched, however, the impedance is determined only by the characteristic of the line.

Magical line lengths

Trick No.1: The impedance measured at the bottom of an electrical-half-wavelength transmission line (or any whole-number multiple of a half-wavelength), regardless of the characteristic impedance of the feed line, is the feed point impedance of the antenna.



For example, if, at some frequency, an antenna has a feed point impedance of, say, 143 ohms, then we will read 143 ohms at the bottom of a 50-, 72- or 300-ohm, electrical-half-wavelength line connected to it.

Keep in mind that this is an electrical-half-wavelength; we must multiply the free-space half-wavelength by the velocity factor of the coax. For example, a half-wavelength at 14 MHz is 33 feet; using coax with a velocity factor of 66% would mean that you would actually cut the line to a length of 22 feet.

Trick No.2: We can use a quarter-wavelength piece of transmission line as an impedance-matching transformer using the formula:

$$\text{stub} = \sqrt{Z_{\text{feedline}} \times Z_{\text{load}} \text{ (antenna)}}$$

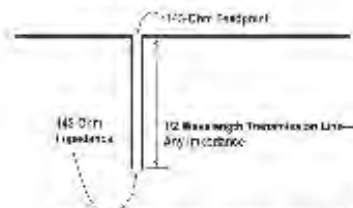
For example, by substituting actual values in the solution below, if we wish to attach a 100-ohm antenna to a length of 50 ohm cable, we can insert a quarter-wavelength matching stub of 70 (often marked 72 or 75) ohm cable.

$$\sqrt{50 \times 100} = \sqrt{5000} = 70.7 \text{ ohms}$$

Don't forget to multiply the free-space quarter-wavelength by the velocity factor and shorten the length of the cable accordingly. For example, a quarter-wavelength at 14 MHz is 234/14, or 16.7 feet; using coax with a velocity factor of 66%, the actual physical length would be cut to 11 feet.

If the line needs to be physically longer, use odd multiples of the quarter-wavelength and the transformation will remain the same.

Off-Center-Fed Dipole



But remember, most antennas exhibit a very narrow frequency bandwidth for a given impedance, so all this magic occurs only around one frequency; on single-element antennas like dipoles and verticals, it also works on odd-harmonic multiples, although the match degrades as we increase the number of multiples.

Remember as well, to take into account the velocity factory of the coax. For example,

if a half-wavelength at 7 MHz is 66 feet in free space, then the electrical half-wavelength of coax with a velocity factor of 67% would be 44 feet.

Standing Waves or Traveling Waves?

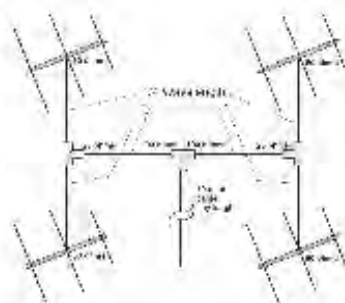
When the system is non-resonant, the waves reflect back from any point where the impedance changes, passing across each other in phase. Typically, these changes occur where the transmission line attaches to the antenna.

Early instrumentation could not detect which waves, forward or reflected, were being measured; their composite voltage was shown on a voltmeter, periodically distributed along the transmission line. They were assumed to be standing waves and the name has stuck.

The comparison of those summed voltage peaks to the minimum voltages interspersed between them is called "voltage standing wave ratio" or "VSWR." Engineers prefer to measure the "voltage reflection coefficient," the comparison of the reflected voltage to the incident voltage at any one point on the line.

Since power (measured in watts) is a product of voltage times current, as the current rises, the voltage falls (and vice versa); thus, the current peaks are half way between the voltage peaks. The ratio of the current peak to minimum is the same as that of the voltage, so "VSWR" is usually shortened to "SWR" to accommodate both units.

For example, if a 300-ohm resistive antenna feed point is attached to a 50-ohm line, we would have a 4:1 SWR. The presence of inductive or capacitive reactance adds further to an antenna's impedance.



Half Wavelength Transmission Line—Any Impedance

When transmitting, the high voltages produced by high SWR may arc across the feed line insulation or tuning components, and high current may waste energy by heating the feed line conductors. Since these are stationary points on the line for any particular frequency, the transmitter (or matching device) may experience either high voltage or high current, depending upon the length of the line.

In a receiving system, antenna-to-transmission-line mismatch will also produce losses in the transmission line; additionally, any impedance mismatch between the receiver and the

antenna system will reflect power back to the antenna where it will be re-radiated back into space.

Feedline loss

Single-wire feed, popular in the early 1900s but now virtually abandoned, matched best at high-impedance feed points (hundreds or even thousands of ohms); it was commonly used to off-center-feed antennas in the early days of radio, often with an SWR exceeding 10:1, but they were efficient radiators.

The lowest-loss transmission line commercially available is open-wire, parallel feed line known as "ladder line." It accommodates high power and high SWR with virtually no loss.

Disadvantages of open-wire feeders include:

- (1) A separation requirement between it and any nearby moisture or metal by two to four times the separation of its two wires to avoid some SWR increase resulting from interaction with its unenclosed field;
- (2) Unbalancing the line by allowing one wire to come closer than the other to nearby metal or moisture;
- (3) Inability to bend at sharp angles without additional reflective losses;
- (4) Impedance mismatch when attaching to standard low impedance antennas and transmitters (except when used in multiples of a half-electrical-wavelength long at specific frequencies);
- (5) Balanced matching requirements when used with unbalanced equipment (like every transmitter model);
- (6) Vulnerability to electrical noise pickup if slightly unbalanced;
- (7) Changes in characteristic impedance from rain, ice and snow;
- (8) and rarity of parallel-line connectors on radio equipment.

Solid-dielectric, parallel feed line like TV twin lead may also be used for receiving and low-power transmitting provided all the caveats regarding open-wire feeders are observed.

Because its closer conductor spacing confines its field more, it may be brought within two or three inches of nearby metal or moisture. But the plastic insulation on inexpensive TV twin-lead disintegrates with time, collecting moisture and residue in its cracks, making it lossy.

Coaxial cable, on the other hand, may approach the efficiency of open wire, may be run underground or through metal pipe, is electrical-noise resistant, and mates easily with conventional connectors.

Here are the reasons that most coax is lossier than open-wire feed line:

- (1) Its conductors are smaller, offering more resistance to waste the current as heat.
- (2) The dielectric (insulation) surrounding the conductor dissipates some power; the higher the frequency, the higher the dissipation.

These two factors explain why large diameter, foam dielectric, short length, coax cables are preferred, especially for transmitting. There is also a safety reason: coax doesn't radiate its energy.

Of course, mammoth coax is wasted if smaller will do; after all, in house wiring, we

don't use enormous #4 bus wire when #12 safely passes all the current that is required.

So what is the best coax? Generally speaking, the bigger the better, with aluminum-sheathed hard line taking the prize. But will you know the difference between that and, say, Belden 9913, foam dielectric RG-8/U, RG-213/U or RG-214/U? Not unless you are running at least 100 feet at 1000 MHz or higher, or are transmitting more than 1000 watts.

For receiving purposes, or for transmitting up to 200 watts, it's even easier. Since we aren't developing high voltages, we can use smaller-diameter cable, just so long as it's not lossy.

Generally speaking, coax with a high velocity factor rating suffers the least loss. Below 30 MHz use RG-58/U, RG-59/U, RG-6/U, or RG-8/X for runs of up to 100 feet. For VHF/UHF to 1000 MHz, use any of these but the RG-58/U.

Don't let 70 ohm (instead of 50 ohm) impedance throw you; you won't hear the difference for receiving, and the impedance mismatch for a 50 ohm transmitter is only 1.4:1 which is inconsequential, resulting in a loss of less than 0.2 dB, which is imperceptible.

Generally speaking, the thinner the coax, the poorer the cable. Skinny RG-174/U should be used only for the shortest runs (a few feet).

Never use shielded audio cable in place of coax for radio frequency work; it is very lossy, has dreadful shielding, inviting interference during reception, and radiation during transmission. Its reputation for causing radio-frequency interference (RFI) when used to interconnect digital accessories is notorious!

But even good coax deteriorates with time; foam-dielectric coax, initially superior in performance, loses grace first, falling victim to moisture intrusion. Many experts (especially cable vendors!) recommend replacing coax every five years.

So, how can we tell if the coax is still good? One way is to short-circuit the far end of the cable and attach the near end to an SWR meter which, in turn, is connected to a low-power transmitter. The short will reflect 100% of the power reaching it, sending it back to be registered as reflected power. The higher the SWR, the better, because it means that energy is not being absorbed along the way. Replace coax that shows a short-circuit SWR lower than 3:1.

An easier test is to attach an ohmmeter on its resistance scale across the shield and center conductor of the coax, leaving the far end open. There should be no reading on the meter (several megohms resistance). If there is a reading, the lower the resistance, the worse the coax. It may be showing the consequences of water intrusion or corrosion.

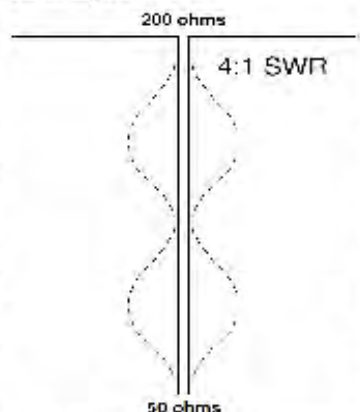
A high SWR between the feed line and antenna may appear as a low SWR at the transmitter. Corroded or loose connectors, lossy cable and other resistive agents can all contribute to a deceptively low SWR reading.

Since no cable is 100% efficient, the SWR measured at the transmitter will always be lower than the actual mismatch at the antenna; the poorer (lossier) the cable, the lower (and more misleading) the reading.

Only by connecting an SWR meter directly to the antenna feed point can we get a true SWR

reading. Use good cable and that SWR difference is but a few percent.

So how does transmission line loss in decibels translate to percentage of power loss? If system impedances are matched properly, a 1 dB loss uses up 20% of the power; 3 dB represents 50%; and 6 dB attenuation means that 75% of the power is being used to heat the coax, whether transmitting or receiving.



In an unmatched system, line losses are even worse. High-SWR voltages dissipate more power in the transmission line's dielectric (insulation breakdown), current peaks dissipate more power in the conductor (resistive losses) and both effects are aggravated by rising frequency. The result is that power is being wasted as heat.

For example, a 6:1 SWR in 100 feet of RG-8/U at 14 MHz produces only a 1 dB loss, but at 450 MHz it becomes 6 dB, and at 900 MHz, 8 dB. With poorer-quality cable, losses are much worse. It pays to use good cable!

Keep in mind that these are coax losses; if you use open-wire feeders, the loss at 10:1 or even 20:1 SWR is insignificant. Such high SWR was present on early, micro-power earth satellites, but we heard those fine 23,000 miles below, demonstrating once again that SWR alone has nothing to do with radiation efficiency.

Contrary to popular myth, high antenna SWR does not radiate any more harmonics or television interference (TVI) than a 1:1 SWR, assuming that the transmitter is properly tuned on frequency.

Keeping SWR to a minimum by proper transmission-line impedance matching is a preventive against damage, especially to modern transceivers with marginal power specifications.

Automatic power-reduction circuits often kick in with an SWR as low as 2:1, making matching a requirement to achieve full output power.

Tuning the System

Antenna tuners, antenna tuning units (ATUs), transmatches, couplers and matchboxes are different names for the same thing: combinations of adjustable capacitors and coils to compensate for inductive and capacitive reactances in the antenna system. Transmatches

(the preferred term) also provide adjustable impedance transformation between the receiver or transmitter and line, and some provide balanced-to-unbalanced matching as well.

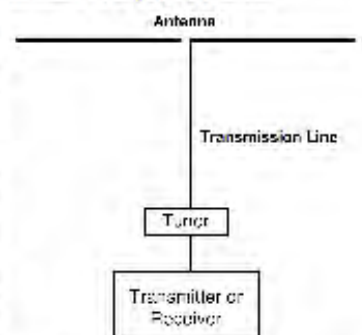
Every length of metal has some frequency or frequencies at which it is naturally resonant; that is, the inductive reactance equals the capacitive reactance, thus mutually canceling the reactance and leaving only the radiation resistance. If an antenna is too long for it to be naturally resonant at some desired frequency, we say it is inductive; a series capacitance can "tune out" that inductive reactance which opposes the incoming RF power.

Conversely, an electrically-short (capacitive) antenna can be adjusted by a series inductance. Contrary to a popular notion, a loading coil does not "add the missing length" to a short antenna; its inductive reactance cancels the antenna's capacitive reactance. We can also neutralize these reactances with a transmatch connected at the transmitter output.

Quoting antenna guru Walt Maxwell, W2DU, when the transmatch is properly tuned, "...the entire system is made resonant...all reactances in the system are cancelled...the net reactance is ZERO! In addition, by obtaining a conjugate match at the antenna tuner, a conjugate match is inherently obtained at any other junction in the system where a mismatch existed prior to obtaining the match with the tuner."

A transmatch is adjusted to provide capacitive and inductive values of equal magnitude, but of opposite phase, to the returning reflected power, thus re-reflecting it back toward the antenna in phase with the transmitted power.

We don't electrically alter any reactance in the antenna system, we merely neutralize their effects, thus matching all impedances in the process. All that is left is the antenna's radiation resistance, so all power is radiated.



This "tuned feed-line" approach can be used with single wire, open parallel line, twin lead, or coax equally well. Since a transmatch is typically connected between the transmitter (or receiver) and feed line, it can only impedance-match those two points; it has no effect whatsoever on matching the feed line to the antenna. We would need to connect the transmatch between the feed line and antenna feed point to produce a match there.

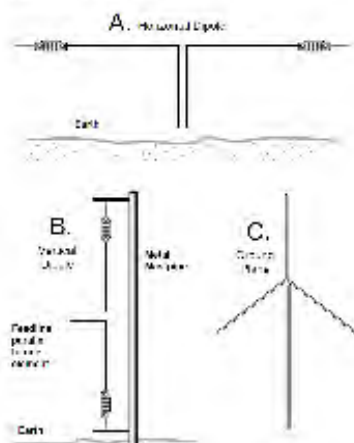
Just because it's a transmatch doesn't mean it's a good transmatch. Flimsy construction and small-gauge wire may mean additional losses, especially at higher power levels. High-power transmatches are invariably more efficient than the low-power variety.

Efficiency

Efficiency is a commonly misunderstood concept in antenna system design; it is simply the percentage of transmitter-generated signal which is radiated by the antenna, or received signal voltage which is delivered to the receiver. If there were no resistive or insulation losses, any antenna and feed line would be 100% efficient whether or not they are properly matched.

Balanced or Unbalanced?

Most elevated, horizontal antennas are fed at or near the center; they are said to be balanced, both from a standpoint of symmetry as well as reference to ground.



Most vertical antennas are unbalanced, often making use of radial systems as an artificial ground reference. There is nothing inherently superior about one over the other; it is merely a question of whether they are best fed by twin lead (balanced) or coax (unbalanced). Balun (balanced-to-unbalanced) transformers, which we will discuss later, as well as transmatches can be used to match balanced to unbalanced circuit elements, and to match impedances.

What is the penalty for misbalancing the feed point? It may cause some RF current to flow on the surface of the feed line, or some stray radiation from the feed point, producing some distortion in the pattern's symmetry, affecting gain somewhat.

Next Month

The last part of this series. Choosing an antenna to match the task. How about accessories? Final take-home points.

PENN WIRELESS ASSOCIATION

February 2018

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
Technet 8PM						
11	12	13	14	15	16	17
Technet 8PM	PWA E-Board Meeting 7:00PM		Valentine's Day 	Embedded Processor Class		
18	19	20	21	22	23	24
Technet 8PM					Margaritville Fund Raising Event	
25	26	27	28			
Technet 8PM	PWA General Membership Meeting 7:30 P.M.					

PENN WIRELESS ASSOCIATION

March 2018

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
Technet 8PM						
11	12	13	14	15	16	17
Technet 8PM	PWA E-Board Meeting 7:00PM			Embedded Processor Class BEWARE THE IDES OF MARCH!		
18	19	20	21	22	23	24
Technet 8PM						St. Patrick's Day 
25	26	27	28	29	30	31
Technet 8PM	PWA General Membership Meeting 7:30 P.M.					

Lightning Protection: Taming Thor's Thunder- On A Budget

*Learn How To Affordably Safeguard Your Valuable Radio
Equipment—And Maybe Something Far More Precious*

by Kenneth J. Meyer, K9KJM, K9KJM@ARRL.net



If you're a radio hobbyist, your radio equipment is extremely valuable to you. It's an investment, and like all investments it needs protection. One way to protect that investment is by making sure that you have adequate lightning protection in place. There are plenty of sources explaining how to protect your radio shack from lightning damage, but few people implement the proper protection because of the perceived high cost of (copper) supplies. While this article certainly isn't the "last word" on the subject, it will show you that you don't have to take an expensive approach and provide you with tips on how to properly protect your station—without breaking the bank.

First, let's dispel some old wives' tales regarding lightning. For starters, it is possible to take a direct lightning strike to your antenna mast, tower, or other support without your equipment suffering damage. Commercial, police, fire, and ambulance systems, cell phone towers, broadcast stations, etc., take direct lightning strikes during most large lightning storms, and when they're properly protected they don't suffer any damage. True, that equipment does have extensive ground systems and shiny copper straps that cost a lot of money to have installed, but it's possible to add protection on a budget. Don't listen to those misinformed folks who say "Nothing can protect from a direct lightning strike." Radio equipment survives lightning strikes all the time.

But wait, you say, doesn't a typical lightning bolt have millions of volts and many thousands of amps of power? Well, yes, they can. But lightning bolts, like lots of other things, come in all different sizes. While a large, powerful lightning strike of several "strokes" of longer than normal duration can have lots of power, even the largest strikes can be handled with large low-inductance conductors because of the very short duration of even the longest and largest strikes.

Indeed, part of the confusion over the years about lightning stems from the fact that lightning strikes can be large or small. So when someone tells you that his sta-

Kenneth J. Meyer, K9KJM, is an extra class amateur radio operator who has actually used all of the cost-saving ideas in this article to install lightning protection systems on a low budget. He has supervised many commercial tower installations.



A worker "cadwelding" (see text) #2 solid copper wire with 4-inch-wide flat copper strap. The dark material around the copper strap is Hager "ground enhancement."

tion was hit with a direct lightning strike and suffered no damage, despite having only minimal grounding with small-size conductors, that may be true—but he may have been extraordinarily lucky and taken only a minor hit.

In these tough economic times, why take chances with your valuable equipment, especially when it can be safeguarded inexpensively?

Proven Approaches For The Frugal Hobbyist

The first order of business for properly protecting a station—or home for that matter—is to make sure you bond (that is, electrically connect) all ground points together with a low-inductance conductor, such as a flat copper strap or a heavy gauge wire. This means that your electric power entrance ground, cable TV entrance, telephone landline entrance, ham shack ground, mast or tower ground, etc., all need to be bonded together.

Think of your equipment like a boat on a rough sea: When a large wave—a lightning strike, in our case—causes everything to move up and down together, the equipment is safe. Damage happens when there is a potential difference between ground paths; bonding eliminates that difference. Bonding is of extreme importance and we'll get back to it shortly.

The actual device used (lightning arrestor, grounding coax switch, etc.) is much less important than the proper bonding and grounding of coax shields before they enter the building. It's also important to understand that damage from lightning to most home stations comes in via surges to the electric AC power system, and not from direct antenna strikes, except in rare cases.

A VERY important step in protection is to install a "whole-house"-type of surge suppressor at your electrical power entrance panel. Such protectors are available from most electric shops, home supply stores, or companies specializing in these devices. A suitable device should cost between \$50 and \$100 or so retail, although I've found whole-house protectors (Delta LA 302-R) on eBay for only \$35. Such protectors must be installed in the main breaker panel. If you are not comfortable working in this way, hire a professional electrician to install it.

When lightning strikes the power line in your neighborhood, the power company arrestor on the pole (or underground pedestal) will divert much of the surge to ground, but there will still be a very large spike of energy entering your home. It's the job of this whole-house protector to dump much of that to ground right at the entrance panel. Then the familiar surge suppressor outlet-type

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strips have a much better chance of getting the surge down to a level that won't damage your devices.

The Ties That Bond

Now let's get back to bonding your grounds together. Just hooking a light-gauge wire between the grounds is not enough. You need a low-resistance, low-inductance conductor (in this case, low inductance means having lots of surface area; see <http://members.cox.net/pc-usa/station/inductance.htm> for more). This is where many hobbyists throw up their hands in despair as they check out the prices of #2 stranded copper wire, or similar. Copper prices recently surpassed \$4/pound, making it beyond the means of many of us. While prices have come down since, retail copper products remain fairly expensive, but a little legwork (or phone work) can pay off in a big way here.

A flat copper strap of between 2 to 6 inches wide by about .025 inch thick is the material of choice, but it can be quite sized if bought from a lightning protection company at full retail. In most cases, you can go right to your local home supply store and buy (or order) copper roof flashing for much less. An even better low-cost source could be an upscale roofer or roofing company that installs copper flashing. All will have "scraps" that can be purchased for just above scrap prices. The seamless roof gutter installation companies are another good source. They mostly use aluminum, but usually have copper available. (Note: Do make sure you watch out for the really paper-thin copper,

which is nothing more than decorative. It looks and feels like copper "tin foil," and that material is much too thin for grounding. You want copper that is about .020 inch or so thick, or about the thickness of both sides of a paper matchbook cover).

Speaking of aluminum, it's usually not a good idea to use aluminum as a bonding conductor—at least outdoors and certainly not underground. Although aluminum is a great electrical conductor, there are serious corrosion problems associated with transitioning between copper and aluminum, and aluminum turns to a white powder in many soil types. Spend the extra effort to find copper.

If you have to run wire instead of flat copper strap because you were unable to obtain enough of a good wide strap, use the largest size wire you can get. Here again, old, used copper wire will work every bit as well as shiny new stuff, and outdoors or underground no one will know the difference! Check with local scrap yards for some nice heavy copper wire. Other sources include construction or wrecking companies that tear down buildings. Offer to pay more than they could get at the scrap yard for some of the heavy copper wire.

Even plain household copper wire can be used with a little planning. Common #12 or #14 gauge plastic insulated home wire can be stripped of its insulation easily with a knife. It's then an easy matter to attach a number of strands of flat wire to an electric drill motor on one end and to a vise on the other and twist them into a larger size wire. Another possible low-cost conductor is flexible (soft) copper tube. A good size is 3/8 inch, and even new on sale this costs less than a dollar a foot. As an electrical conductor, tubing is almost as good as solid #2 copper wire.

It is important to keep a fairly large radius on all bends in the wire or strap (no sharp bends!). And try to keep your conductors always pointing downward—don't have them point down and then back up, then back down, etc.

Grounding Rods

Most hobbyists know that ground rods need to be driven for an effective ground system, but many don't know that those rods should be spaced about twice as far apart as their depth. For instance, you should space rods that are eight feet deep about 16 feet apart; if you space them closer, they lose effectiveness. Again, bond the rods together with copper wire or strap. Power company research has shown that #6 copper wire can handle approximately 96 percent of all direct lightning strikes without fusing open. (Research also found that it was much more economical for the power companies to just replace material damaged by those very rare "huge" lightning bolts that overwhelmed #6 wire rather than use heavier gauge wire at each power pole. Typically, only critical locations that simply cannot be allowed to fail, like tall tower sites or electric power substations, will use much larger diameter wire.) Nice, shiny new 5/8-inch heavy copper-clad steel rods sell for about \$10 each in home supply stores.

Most installations should have at least six driven rods, depending on surrounding soil type. For instance, if you have wet, swampy soil you may get by with fewer ground rods than if you're on top of a sandy, dry soil hill. If deep rods can't be sunk, additional shorter rods, or a large radial wire system will work to provide a good ground. In extreme cases, where it's hard to drive in rods of any depth, a homebrewed ground enhanced rod can be made up of a section of used copper pipe that's drilled full of holes and filled with rock salt. Bury it as deep as you can, placed vertically, horizontally, or whatever.



A spectacular shower of sparks as the Cadweld exothermic material burns, producing the weld between a #2 copper wire and a 5/8-inch copper-clad ground rod. The black color graphite mold containing the molten weld metal is clearly seen.

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Ready to weld. A flat copper strap (scrap from a copper roof gutter installation that the author straightened out) with a stranded #6 copper ground wire. Locking-type pliers holding the wire in place, Silvaloy Excel 15 rod, and small handheld torch using MAPP gas are also shown.



Completed weld. It took only a few drops of the welding rod to make a very secure weld. Note the change in color of the copper. To make the rod flow, the copper needs to be brought up to an almost red color.

A very low-cost source of high-quality ground rods can be as close as your local utility. Check with the power company or teleco parts manager for used "pull out" ground rods. As these rods are just copper-clad steel, there's practically no scrap value to them. Often such old rods will be given to you, especially if you mention that you're a ham radio operator, member of ARES, REACT, or associated with any other type of emergency communications service. Yes, the rods will be bent up beyond recognition, but can be straightened between two trees. Or if they're bent too badly, cut them in half to make two good four-foot-deep rods. A bonus to using these old rods is that most of them will come complete with a commercial-quality wire clamp still attached to them, and hours soaking in some penetrating oil should make those old clamps function as good as new (and those clamps are expensive brand new!).

While you're talking to the person in charge of disposing of those old rods, it doesn't hurt to also ask if he can sell any used copper wire that would be suitable for grounding. Avoid the small 4 feet deep by 3/8 inch diameter "ground rods" sold in discount stores. This is not so much because of their size but because they're normally just copper plated, not heavily copper clad, and will turn to rust in a very short time.

Putting it All Together

Now, how do you join all these parts together, or more properly, how do you actually join the copper strap and wire to the rods? Nowadays the "pros" mostly use exothermic welding, like Cadweld, to do the job. (Exothermic welding uses several chemicals that burn at a very high temperature to "weld" metals together.) While that type of bonding is very good, it's far from low cost. You either have to buy or have access to many molds of the various types, or buy the "one shot" weld kits, and both approaches are fairly costly. Good-quality mechanical clamps are also pretty expensive.



This photo, taken in the author's ham shack, shows a "single point ground" panel with various coax switches that put unused antennas to ground, along with several brands of lightning arrestors. The copper sheet is "bonded" with the outdoor ground system with a 6 inch wide copper strap. The sheet is .022 inch thick copper screwed to a 3/4 inch thick plywood panel.

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Close up of a completed "Carlweld" exothermic weld at a #2 solid copper wire to the top of a 5/8-inch-thick ground rod and examples of ground wire relative sizes. From left, #8 stranded copper ground wire, #2 copper wire, #2/0 wire, #1/0 wire, Galvalume 5/8-inch ground rod.

A good low-cost approach to connecting all the elements is to obtain some of the welding "braz" rod used in the air conditioning trade, which goes by the name of Silfoss, Silvaloy, among others. These are "hard" braze rods with a silver/copper/nickel content. A small handheld propane torch will flow and weld them together under most conditions with light or fairly heavy gauge wire (the actual brazing process is very similar to plain old soft soldering; it just requires more heat to "flow" or melt the rod).

To do a good job in the real world with heavier gauge wires, you can use MAPP gas. This comes in a small container, just like propane, for a handheld torch but burns at a much higher temperature than propane and will work in flowing the weld in most cases. If you don't already own a small propane/MAPP gas handheld torch assembly, one can be purchased at a reasonable price from most home supply or hardware stores. They have many uses besides welding a ground system and would be a good investment. Or borrow one from a friend if your budget's really tight.

The hard silver solder/sicks, or brazing rods, cost around \$2 each, and one stick can make lots of connections. They can be purchased at most larger welding supply stores, and you can also check with your local air conditioner/refrigeration repairman. If some of your copper is really old and oxidized, a light sanding to clean it up will help the rod flow more easily. I use a small vise grip type pliers to hold conductors close while welding. DO NOT use any type of soft solder for these connections! This includes all types of lead/tin and the newer so-called plumbing "silver solder," which is still a very low temperature solder. Such solders will turn to a white powder

underground in most soils and will blow apart if subjected to a direct lightning strike of any large magnitude.

Single Point Grounding

One of the most important concepts to remember is to have what is known as the "single point" ground, usually close to where all I/O (Input/Output) lines (like coax, rotor wires, etc.) enter the building. Commercial towers with a large bankroll to spend on lightning protection use a heavy copper plate, usually about 1/4 inch thick by 4 inches tall by 24 inches wide, to bolt all the lightning arrestors to. You can save lots of money and have just as effective a system by simply using some .025-inch-thick copper sheet, screwed to a piece of 3/4-inch-thick plywood.

Make this plate whatever size it takes to fit all of your coax switches (the ones that connect all unused antennas to your ground system) and attach whatever lightning arrestors you plan to use. Bolt that panel to your outdoor ground system with as wide a copper strap as you can manage to get through your wall or window, and keep that interconnecting strap as short and as free from bends as possible.

Lastly, install the actual lightning arrestors themselves. Industrial Communications Engineers (I.C.E.) makes a good-quality one. Polyphaser also makes good arrestors, which are usually used at the public safety and commercial communication tower sites. I also like Alpha-Delta and similar constructed "strip line" grounding coax switches for VHF and UHF, and I use older ceramic rotary coax switches that ground unused ports for HF.

I personally run antennas. In, I have no intention of operating from during a thunderstorm to the grounding coax switch, and I run antennas that I do plan to use while a storm is raging overhead through a quality arrestor.

Now, Do Your Research

In well over 30 years of operation with my personal systems and also in overseeing commercial repeater tower sites with antennas at the very top of tall towers, I have NEVER had damage to radio equipment—and these antennas and towers were hit by direct lightning strikes numerous times, as measured by Polyphaser LSC-12 Strike counters.

While nothing in life is 100 percent certain, following the correct bonding and grounding procedures will go a long way toward protecting your station. Even if you can't follow through with all the recommendations, taking some of the steps along the proper path will reduce damage—and, more importantly, the odds of personal injury—over having nothing in place at all.

There is no cookie-cutter formula for effective lightning protection. Each site and installation has enough variables to make it unique. Soil conditions, equipment layout, and other parameters combine to make all situations different. You need to do plenty of research (see some suggested resources below) before you can decide what's the best way to protect your station.

Again, this article was not intended as a definitive source on how to install an effective system, but to provide you with a good starting point on how to do a proper job on a low budget.

For additional information, I suggest visiting the following sites for starters:

ARRL: www.arrl.org/tis/info/pdf/0208053.pdf
Polyphaser: www.com-m-m.com/polyweb/appendixA1.htm
I.C.E.: www.iceradioproducts.com/
A good resource can also be found at <http://members.cox.net/pc-usa/station/ground0.htm>.

Volunteer Examiners

Take the FCC Amateur Exam...

Our ARRL/VEC VE Team is ready and willing to administer any license grade/upgrade or code element test. Confirm your intention to test with Ben Johns, VE Contact at 215-657-5994 not later than the Friday evening before the 4th Monday of the month. Please advise us in advance of any special needs you may have in successfully completing the intended test. Our testing session begins promptly at 6:30 pm and remains active until all license grades desired are administered. We do not recommend, nor is it our practice, to administer repeat examinations of similar license grades to any candidate. However, progressive license grades may be attempted by any applicant at no additional charge. Please come prepared with the following items.

- ◆ Confirmation of appointment letter, email, note, etc. Walk-ins are not guaranteed a test session.
- ◆ Test fee of \$15 in cash or personal check payable to ARRL/VEC.
- ◆ Either of the following ID methods:
 - One legal photo ID (driver or non-driver license, passport, radiotelegraph license, or other legal photo ID)

OR

- Any two of the following IDs: Non Photo ID/Driver License, Social Security Card, Birth certificate, Minor's work permit, Utility bill, bank statement, business correspondence specifically naming the person, postmarked envelope addressed to the person at their mailing address as it appears on the FCC Form 605

- ◆ Any of the following ID numbers: Taxpayer ID (Social Security Number), IRS issued EIN (Employer Information Number), Alternate taxpayer ID Number (ATIN), FCC Issued Registration Number (FRN), FCC Issued Licensee ID Number
- ◆ The ****original**** plus one copy of your FCC license or CSCE (Certificate of Successful Completion of Examination). The original will be returned immediately to you.
- ◆ If applicable, a Physician's Statement if necessary to validate your claim of difficulty at reading, writing or speaking when requesting special assistance.
- ◆ A calculator is recommended and allowed if ALL internal memories are cleared and can be demonstrated free of information. A simple four-function calculator is suggested.
- ◆ One or more black-lead pencils and eraser, and a ball point pen.

Good Luck!



*Penn Wireless Association
P.O. Box 925
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License Information:

Call Sign: _____ Class: ☐ Novice ☐ Tech ☐ General ☐ Advanced ☐ Extra

Date First Licensed _____ Previous Calls: _____

Preferences:

ARRL Member? _____ Other Clubs? _____

Bands/Modes Frequently Operated _____

Emergency Power? _____ Portable/Mobile? _____

Favorite Amateur Radio Activities: (note all that apply)

- | | | | |
|-----------------------------------------|---------------------------------------|------------------------------------------|----------------------------------------------|
| <input type="checkbox"/> Awards | <input type="checkbox"/> Traffic | <input type="checkbox"/> Contesting | <input type="checkbox"/> Digital Radio |
| <input type="checkbox"/> Rag Chewing | <input type="checkbox"/> MARS | <input type="checkbox"/> Field Day | <input type="checkbox"/> QRP |
| <input type="checkbox"/> Projects | <input type="checkbox"/> Newsletter | <input type="checkbox"/> Fund Raising | <input type="checkbox"/> Renewable Energy |
| <input type="checkbox"/> DX'ing | <input type="checkbox"/> Fox Hunting | <input type="checkbox"/> Public Service | <input type="checkbox"/> QSL Card Collection |
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PWA relies on Members volunteering their time and expertise to insure a vibrant and active club. Please consider joining or chairing one of the above listed Committees.

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Member Shack Photos - WA2DIT



Kenwood TS-820S 10, ,15,20,40,80 and 160 Meter transceiver with a VFO-820 remote tuner pushing 200W into an MFJ-949C Versa Tuner II feeding a Hustler 5-BTV (not pictured) in the backyard. On top is an Alinco DJ-F1 2M HT and a no name 15W amplifier feeding a Cushcraft AR2 Ringo in the attic.

I am not very active, but it all works.

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Member Shack Photos - NY3J



The main computer with the two 22 inch monitors is a Windows 10 dual quad processor for my digital operating and logging. The second computer on the right with a 32 inch TV monitor is a Linux computer that I use to connect to a Web SDR station so I can see stations that I can't copy on RF. I can also test my Fldigi connections locally on simplex because I have a Signalink connected to both computers. The HF rig is a Kenwood TS-590S. I'm using the built in USB sound card for both digital and rig control. Attached to the TS-590S is a WinKeyer USB electronic keyer for keyboard CW and a Bencher Paddle for sending CW. On the shelf is a Kenwood TM-V71A and a Kenwood TM-D700. Out of site are the 5 HT s that I have in their chargers. This used to be my daughter's bedroom before she moved out. Now it's an empty nester's extra room :-)

Ron NY3J

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Member Shack Photos - KB3MTW



The silver box on the far left is a 902/2 DEMI transverter with a speaker that's connected to a Yaesu 857 all mode. Above the 857 (blue screen) is a 222Mhz transverter. Atop that is my ham shack pig mascot.

The light visible under the table is a 45 amp power supply. On the table directly to the front is an antenna switch for transverter selection. Directly above the selector switch is a smaller Astron power supply. To the right of the power supply is an Alinco 222 Mhz FM radio. To the right is another speaker and behind it an SWR meter (103Khz to 535 Mhz).

On the extreme right is my Yaesu 8800 dual bander. On the top shelf (next to the orange screen 857) is my Kenwood TS2000X. With it I can operate 6m, 2m, and 1.2Ghz. My 857 handles the 903 Mhz and 222Mhz transverters. The two monitors are used for FT8 and MSK144 digital modes.

'73
Michelle
KB3MTW

2/17/2018

NBC News Left Field Report Says Hams "Could Save Our Lives" In a Disaster

News

NBC News Left Field Report Says Hams "Could Save Our Lives" in a Disaster

02/08/2018

A team from NBC News' nascent digital news unit Left Field was in Hawaii to visit with some radio amateurs to produce a report when the false nuclear missile alert happened on January 13.

Left Field's report points out how much we rely on cell phones and 21st century technology...and what we would do if these suddenly were no longer available. Amateur Radio operators "are standing at the ready and may save us all," NBC Left Field said in the tease to its [YouTube version](#) of its report. Accessible [directly from NBC News](#), the report, with Left Field's Jacob Soboroff, runs 7:22.

"Ham radio is one of the ways you'd be able to hear what's happening," when conventional telecommunications systems fail, Soboroff told his viewers.

Among those interviewed in the piece are ARRL Section Manager Joe Speroni, AH0A, and Assistant Section Manager Kevin Bogan, AH6QQ. NBC News says its Left Field unit "is a new internationally minded video troupe that makes short, creative documentaries and features specially designed for social media and set-top boxes."

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Hawaii Assistant ...

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