

The Hamster Handbook

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Overview

Notes made by a ham newbie as he muddled his way through the learning curve.

Scenarios

1. just chatting ("rag chew")
2. automatic position reporting (see APRS)

3. operating remotely - QRM, solar-powered
4. operating remotely - canyons and other obstacles
5. disaster assistance - reconnecting to a net, operating in a net, operating the net

Morse Code

For completeness, Morse code (CW) is included. It requires you to learn Morse, however. From many perspectives, CW is optimal - low bandwidth, low power, it can get through when voice cannot, and the kit to start operating is probably the least expensive — assuming you can get past the 'learn Morse' part.

Morse code used to be called Continuous Wave (CW).

I guess *technically* CW is 'digital' and not some strange third type, so this section probably belongs under "Digital Modes".

Voice

AM, FM, sideband

EchoLink

EchoLink is voice + text messaging (depending on how you connect). The idea is to extend the reach by connecting "nodes" across the internet. You access a local node, squirt across the inet and finish the last mile from the radio at the far-end node.

[EchoLink] | *images/EchoLink.gif*

EchoLink node 598882 NY7S-R is West Valley Amateur Radio Club node.

EchoLink node N2QOJ-R runs Central Arizona Youth Net on Sundays at 5pm.

K7UGS Karen likes and uses EchoLink. I see Karen is operating EchoLink on a Samsung Galaxy S9 from Oregon! Apparently there is EchoLink for Android!

The EchoLink website says it does not run on Mac but they recommend EchoHam from the app store.

I was able to install EchoLink software on a Win11 VM, connect a USB microphone (it didn't like my bluetooth microphone) and bluetooth speakers and listened in on the Central Arizona Youth Net that meets Sunday nights (N2QOJ-R).

- Net Control is Landon AI7HE.
- Promoter/sponsor appears to be Joe Sammarino N2QOJ.

Digital Voice

Who would have thought there would be competition in digital voice? I see DMR on the European models, and that appears to be TDMA (duplexing two channels in one 12.5 kHz band). As a standard, all vendors can mfgr this, and several do.

I see C4FM WIRES-X on Yaesu radios. C4FM appears to refer to the digital voice, and WIRES-X appears to refer to linking across the internet.

AKA System Fusion? Circa 2014? Great audio quality. Can mux voice & data.

other reflectors (repeaters?) that work with C4FM:

1. FCS
2. YSF?

ICOM likes D-STAR. Japan Amateur Radio League, circa 2001. Oldest digital format.

Internet is the weak link, and many of these look to be proprietary.

Apparently there is work going on for Digital Voice on HF using open source: <https://freedv.org/>. This looks very promising.

D-Star

Register an account. I used <https://mdarc.org/repeater-systems/digital-voice/d-star/d-star-registration>

Set up your radio (ICOM) with your callsign as MyCall. You also need the call sign of a local repeater (dstarinfo.com/maps-by-region.aspx). I found W7MOT on White Tanks with DV A/B/C and DD A repeaters. This appears to be the Motorola Amateur Radio Club of Arizona.

[Newbie's Guide to Using D-Star](#) is pretty helpful for getting started.

Digital Mobile Radio (DMR)

TL;DR

- very, very dependent on the internet
- very, very complex
- there is software for PC that becomes a DMR radio, so you don't need to actually buy a radio

Allows more users in less space. Starts by using narrow band (12.5 kHz) rather than wide (25 kHz, typical FM). By using TDMA each frequency is divided into two "slots", effectively doubling usage of that frequency.

All DMR frequencies use Color Codes from 0-15 and all frequencies for a site will have the same color code. (think "talk groups" or receive tones on GMRS).

There are 6 different "flavors" of DMR. The flavors of DMR are:

1. Conventional Digital Mobile Radio (DMR)
2. Internet Protocol Site Connect (DMR)
3. Capacity Plus (Cap+)
4. Linked Capacity Plus - trunked multi-site multi-channel configuration of MotoTRBO which combines both Capacity Plus and IP Site Connect configurations.
5. Capacity Max
6. Connect Plus (Con+)

default: pistar/raspberry for pi-star hotspots

<https://whistlergroup.com/pages/understanding-dmr-digital-mobile-radio>

<https://minnesotadmr.com/wp-content/uploads/2017/02/DMR-Radio-1702.pdf>

Digital Modes

It appears that digital is where a lot of the experimentation is happening. While CW & voice are well understood and pretty stable, digital provides a ton of opportunities to play with protocols, error checking & correction, TDMA, data+voice and a ton of other things.

I'm attracted to digital modes because it appears it may be possible to get a message through with a low power transmitter when voice wouldn't cut it.

Packet

How does "packet" relate to APRS or WinLink? Or is "packet" some separate thingy?

"Since the late 1990s, most AX.25 usage has shifted to a different one-to-many communication paradigm with the Automatic Packet Reporting System (APRS)".

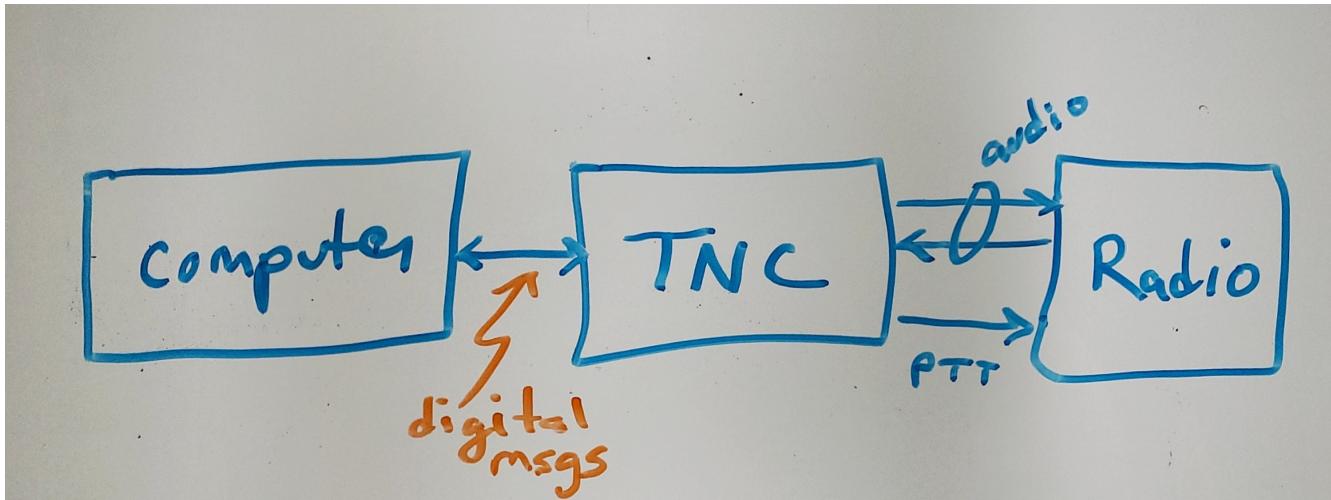
— wikipedia

Check out YouTube for Denver Radio Club "DRC Packet Radio Class 01". Circa 1992 but it has the details and the history. Excellent.

Direwolf

TNC - Terminal Node Controller

The TNC shows up in many of the digital packet solutions. A TNC is like a modem in that it talks analog (tones) to the radio and digital messages to the computer. The protocol appears to (often? always?) be AX.25.



There are lots of dead solutions out there. Mobilinkd appears to be one of the few hardware solutions still going. [Direwolf](#) is a software solution (multiple platforms) that leverages the considerable processing power in todays computers plugs the audio cards.

Apparently packets work pretty well on VHF but on HF the noise and contention is often a problem, so some people are experimenting with packets not using AX.25.

["Using FLdigi For APRS Over Non-AX.25 Modes"](#), Stephen H. Smith

FLdigi is similar to Direwolf in that it is software, but it is not operating on AX.25. It does, however, leverage the soundcard on your computer as a DSP to construct and decode the tones.

ALE - Automatic Link Establishment

Problem: after a disaster how to hams reconnect with each other?

Solution: ALE is a set of fixed frequencies and a protocol for scanning those frequencies to find and reconnect hams to each other.

APRS - Automatic Packet Reporting System

Don't make the mistake of calling it 'Automatic Position Reporting System' or Bob will get annoyed.

digipeater, iGate, microsat, aprsdroid

<https://aprs.fi>

[SMSGTE](#) is a way to bridge APRS messaging and SMS (cell phone texting).

Here's a combination that should work on mac & linux:

- direwolf (TNC)
- [Xastir](#) for display
- possibly alternative to Xastir is [YAAC](#)

FT-8

- Install WSJTX ('brew install wsjtx' on a mac).
- Install Grid Tracker ('brew install gridtracker') to get a map of contacts. You can see who is calling CQ and respond with a single click. I believe Grid Tracker can be set to report QSOs to LotW as they occur. Not required, but nice.
- Install [RUMLogNG](#) for any manual logging, solar activity monitor.
- Install JT-Bridge ('brew install jt-bridge'). Sits between WSJTX and RUMLogNG (is this really needed?).

What Is FT-8? / Why Use FT-8?

FT-8 is one of many digital modes. As such it is very efficient, able to get out a signal on low power over great distances, and decode msgs even below the level of human hearing.

FT-8 has a protocol for making contacts, but is not suitable for rag chewing. See JS8CALL or PSK31.

How To Set Up FT-8?

Make sure your callsign and grid square are set correctly.

settings / general

- double click on call sets TX enable
- disable TX after sending 73
- calling CQ forces call 1st

Logging? Perhaps [RUMlogNG](#) (mac app store) coupled with [JT-Bridge](#) (brew!) to xlate from WSJTX to RUMlogNG.

Using FT-8

NB FT-8 uses split frequencies!

WHAT FREQ TO USE?

1. [FT8 Operating Guide](#) Weak signal HF DXing for technophiles by Gary Hinson ZL2iFB

JS8CALL

Julian OH8STN likes JS8CALL for actual comms during emergencies. Works well with low power. Appears to be point-to-point rather than email.

APRS Messanger is obsolete. The developer recommends using JS8CALL.

RTTY

Radio TeleTYpe - pretty vintage stuff, but still being used, apparently.

Tutorial for beginners and MMTTY software (MSWin only, alas) available at <https://hamsoft.ca/pages/mmtty.php>

[MultiMode](#) (commercial) runs on a mac and will decode RTTY.

Seems like the RPi would be a natural for RTTY.

1. AFSK - ?

"LSB is the convention for AFSK"

WinLink

WinLink - global radio email - <https://www.winlink.org/>

[WoAD](#) is a WinLink client that runs on Android. This looks promising.

... there is even a setting in Winlink Packet for the D710.

All you need is USB-K5G cable either from RT Systems <https://www.rtsystemsinc.com/TM-D710-programming-software-and-USB-cable-s/1882.htm> or Amazon <https://smile.amazon.com/Valley-Enterprises-Programming-TM-D710A-TM-D710E/dp/B072QDHT11> (Valley Enterprises version is not compatible with RT Systems, but works really well for programming the radio with Kenwood software and accessing the TNC)

You plug the USB side into the PC. Plug the 8 pin accessory plug in the back of the head unit of the D710 labeled COM (NOT in the main body, that is the programming port). Start a Winlink Packet or Packet P2P session. Pick the D710 from the dropdown menu. Pick the correct Serial Port for your USB cable. Change the Maximum frames to 2. Click OK. Pick a frequency and you are off to the races.

Good forums for these questions are <https://groups.google.com/forum/#!forum/winlink-programs-group> https://groups.google.com/forum/#!forum/winlink_for_emcomm

73, Oliver K6OLI

— <https://www.arednmesh.org/content/kenwood-tm-d710g-and-winlink>

<https://www.arednmesh.org/content/kenwood-tm-d710g-and-winlink>

Antennas

Antenna Design

If you want to analyze an antenna design, AFAIK the only free software left for this is <https://www.qsl.net/4nec2/> It has a very steep learning curve, but it could be useful. (extra credit: is the fractal antenna in White Collar really an antenna? What properties do you get from the fractal shape?)

MMANA-GAL appears to be free antenna analysis software. MSWin only, sadly.

Calculating The Antenna Length For A Halfwave Dipole

The length of a dipole is found by

- $143 / \text{freq} = \text{meters}$
- $468 / \text{freq} = \text{feet}$

Each of the two radials would then be exactly half that calculated length for the halfwave dipole.

Wait. What? I was taught

wavelength = speed of light / frequency = $300 \text{ m/s} / \text{freq} \Rightarrow \text{meters}$

What's this "143" stuff? Well, part of it is the **halfwave** dipole, so I expected 150. The rest is, perhaps, reality bites for speed of radio through air & copper. Maybe.

Mobile Antennas

If you can stomach it, the NMO mount looks the best, as it's a permanent mount on your roof. Originally bought Browning BR-1015-UHF from Amazon (\$24) but what I received has the chrome plating flaking off and the fit & finish are poor.

Considering swapping for Larsen NMOK mount, which is *reputed* to be of better quality.

Antenna Standards

The nice thing about standards is that you have so many to choose from.

— Andrew Tanenbaum

Typically, the SO-239 (UHF Female/UHF Jack) is installed ON THE RADIO, and the PL-259 (UHF Male/UHF Plug) is installed ON THE CABLE. The two "mate" and are collectively known as a UHF Connection.

— <https://www.arcantenna.com/blogs/news/uhf-pl259-so239-what-is-the-difference>



For most desktop and mobile radios, the radio will have a female SO-239 connector. Likewise, many (not all) antenna bases will have female SO-239 connector. Therefore, typical 50 ohm coax with male PL-259 connectors on both ends would be used to connect radio to antenna.

Handheld radios tend to have SMA connectors. There doesn't appear to be any standard usage of male vs female, unfortunately.

Occasionally you find BNC connectors being used. Not clear when or why.

Antenna Vendors

[Ed's Antennas](#) are pretty sane looking 2M/1.25M/70cm antennas.

Radios

QRP Labs QDX (SDR)

This is an SDR radio, covering 4 HF bands at 5W. It's a kit that ends up about the size of a deck of cards. \$60 for the kit, \$80 if you include the case.

Pros:

1. micro size and small price!
2. perfect for all those digital modes
3. SINGLE USB CABLE between computer and radio. Genius!

Cons

1. it's a kit
2. it sold out immediately and the global parts shortage is delaying resupply
3. it uses 9V instead of 12V. Why?

Watch this in future. Expect 12V power and assembled radios at a higher price. Still probably the

closest to perfect for digital on HF.

RTL-SDR V3

Featured on Frugal Radio on YouTube.

Typical SDR features:

1. Spectrum Analyzer!
2. multiple VFOs, so you can listen on multiple broadcasts simultaneously.

Nooelec SMART V4 (SDR)

Featured on Frugal Radio on YouTube.

Generic DVB (SDR)

Featured on Frugal Radio on YouTube.

AirSpy (SDR)

Featured on Frugal Radio on YouTube.

[AirSpy](#). He demoed

ADALM-PLUTO (SDR)

Featured on Frugal Radio on YouTube.

Free SDRs Online

Featured on Frugal Radio on YouTube.

1. [kiwisdr.com](#) - worldwide list of receivers, despite the name
2. [websdr.org](#)

In demo he routed audio from free web SDR to his decoder using PC-HFDL. HFDL (High Frequency Data Link) is the generic term for a system in use by long haul airlines for aircraft tracking and text messaging.

SDR Software

There appears to be lots of SDR software for MSWin.

For the mac:

1. CubicSDR ([short tutorial](#))
2. airspy (which version?) seems to be available through Brew
3. [GQRX](#)
4. [SDRTrunk](#)

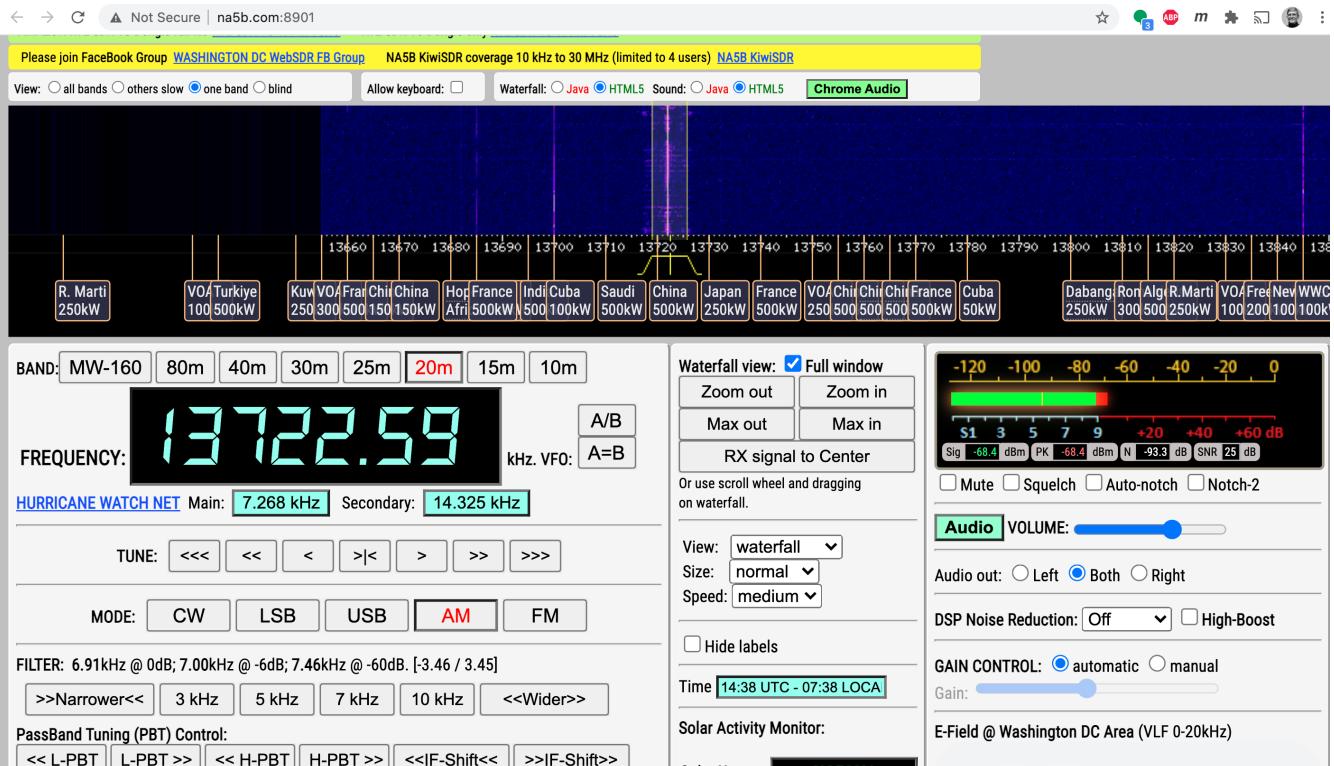
You may need to route the audio in some complex ways. Virtual Audio Cable works for MSWin only. Nearest mac solution appears to be <https://vb-audio.com/Cable/>

[DragonOS](#) is a linux solution for RPi with SDR software preloaded. This may be worth looking at.

See Also Radio Reference [website](#) for loads of reference data, especially for trunking.

Coolest Website Ever

Imagine being able to operate a ham radio (receive only) from your browser. Practice dialing in signals and understanding the bands. Thanks to Software Defined Radio [SDR] and some generous people, you can!



There is a list of other operating locations here: <http://websdr.org/>

SDR is pretty magical, in that dozens of people can operate simultaneously.

Projects

Project #1 - APRS on the Cheap

Minimal materials to get experience with APRS. Proposed solution: APRSDroid running on cell

phone, connected to a dual-band Handy Talkie (HT).

SITE for APRSdroid and where you can download it free

Physical wiring and cable construction

operating APRSdroid - what can you do with it?

Project #2 - EchoLink on the Cheap

See the section on EchoLink. Install on a PC. Join the Sunday night net using your computer (or android).

Project #3 - WinLink on Android

See the section on WinLink and replicate it by sending email over winlink on Tera HT (using the cable from project #1 above).

1. can you receive email?
2. can you send/receive from e.g. gmail??
3. can you replicate this with mobile radio in your truck?

How does the choice of SSID affect this? What would a sane policy for using SSID with WinLink be?

Project #4 - Listen to the International Space Station

Even with a handheld, if you know the frequency and when to expect them, you can always listen in.

https://spotthestation.nasa.gov/sightings/view.cfm?country=United_States®ion=Arizona&city=Phoenix#.YQBMBRNKg-Q

Project #5 - See How Far You Can Whisper

Using something like WSJT-X and the WSPR protocol, you can experiment to see how far you can actually go on a few watts (or less!). Multi-platform, multiband, cool mapping tool to see your results.

WSPR

April 2022 - I still don't have an HF radio yet, so I "borrowed" a websdr at <http://44.127.32.234:8901/>. Tune it to 14095.6 kHz, which is the WSPR freq for 20 meters.

You wire up the audio from your web browser to WSJT-X using VB-Cable for mac. You must set the audio to 48,000 samples per second all the way through the chain! You do this using the MIDI controls on the mac (not the audio controls).

In WSJT-X Preferences

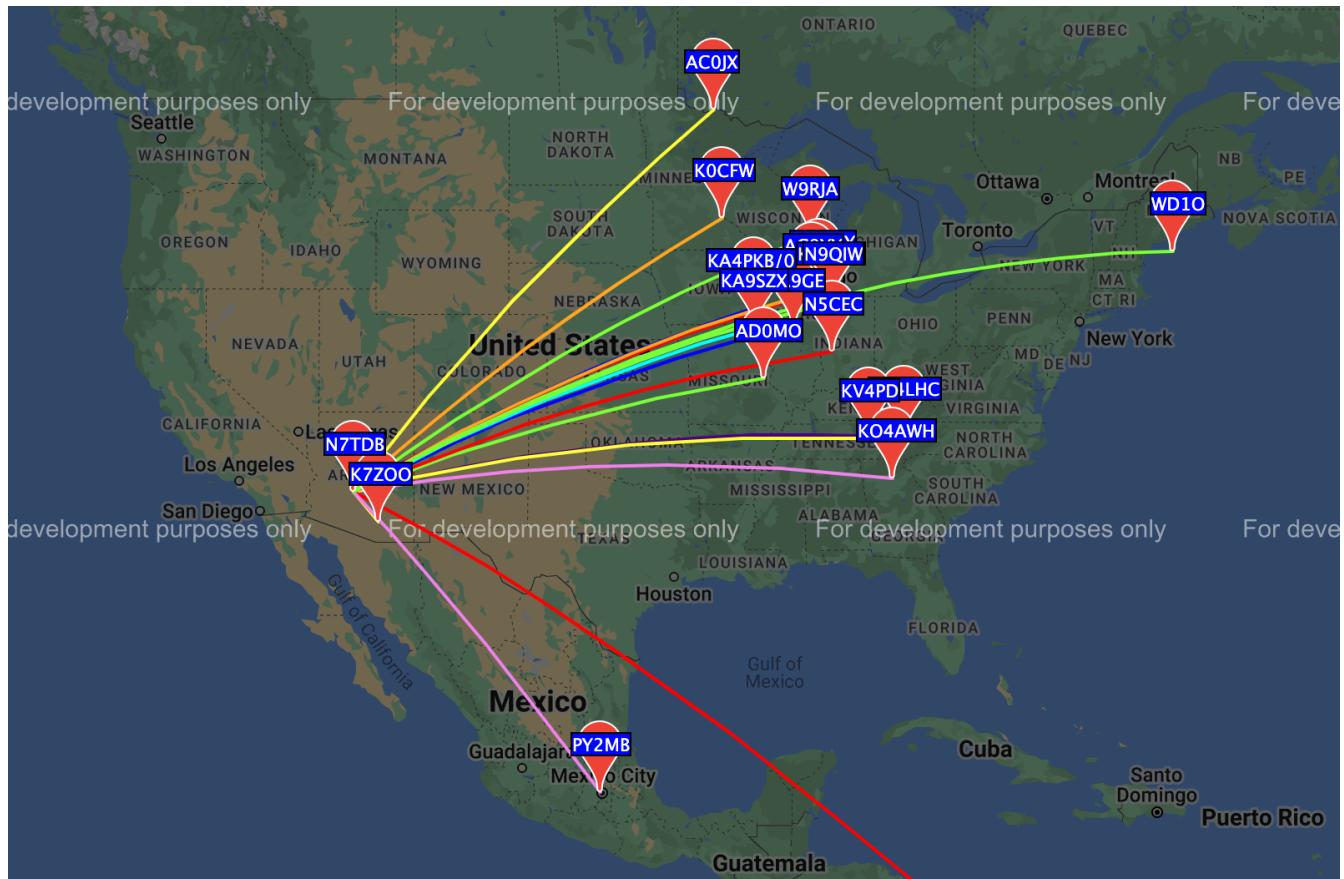
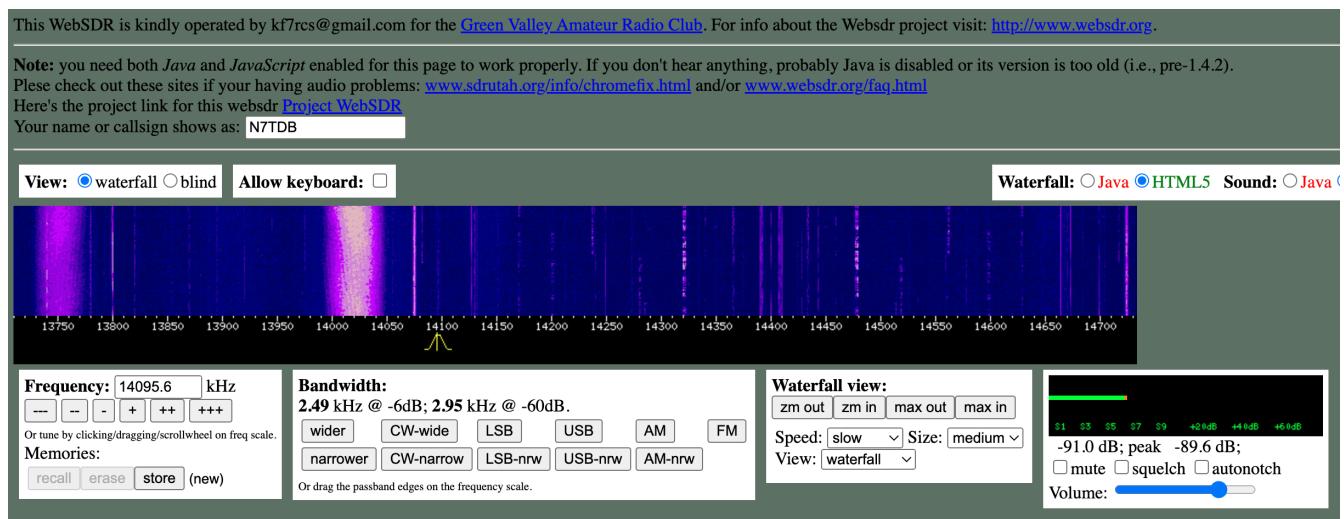
1. general: your call sign and grid locator
2. radio: rig=none
3. audio: input=VB-Cable, output=mac speakers

Mode = WSPR (the frequency should automatically switch to 14095.6 if you are on 20M).

If you wait a few minutes you will start to see WSPR signals from all over the country!

You can go to [WSPR websight](#) and see a map of your contacts (assuming you enabled preferences / reporting / enable PSK reporter spotting).

When I get a radio I would like to repeat this using my own rig and antenna.



Project #6 - Send A Text Message From Your Radio

Try using [SMSGTE](#) to connect (bi-directionally!) your APRS-enabled radio with SMS.

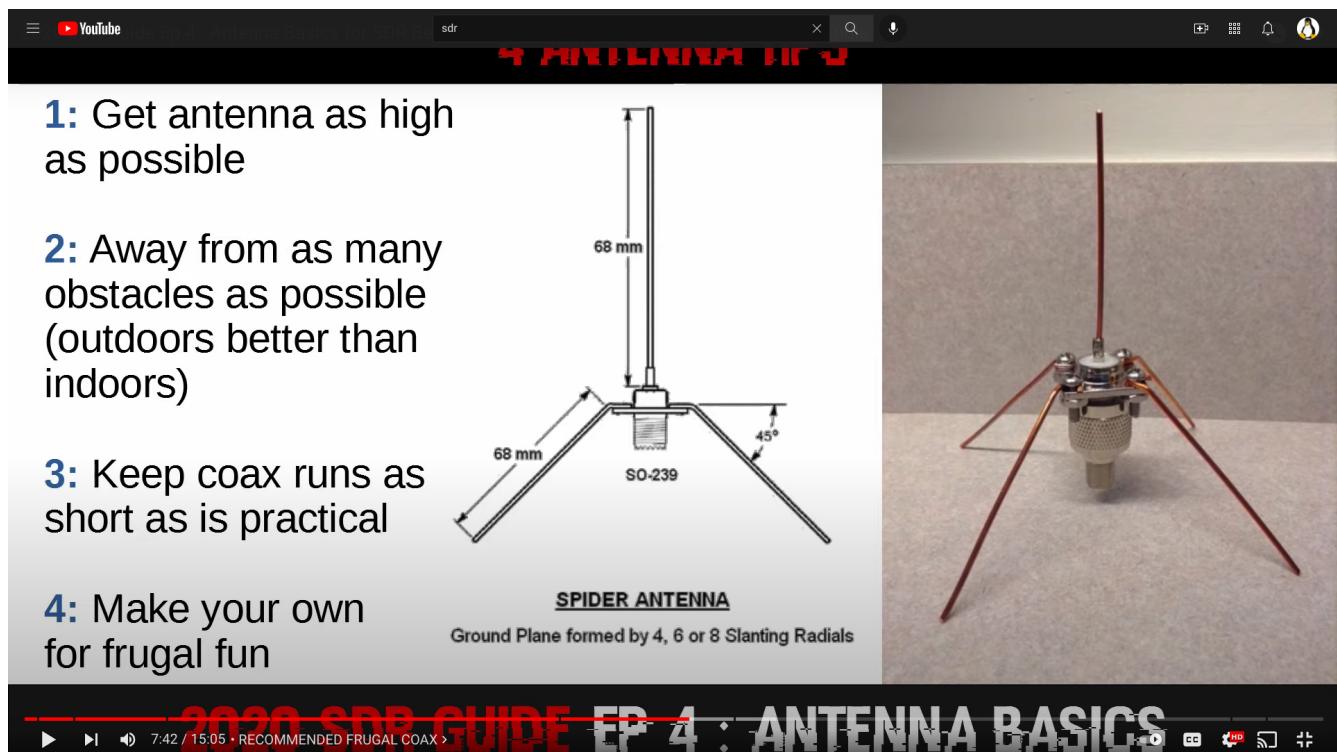
Project #7 - Build A UHF/VHF Antenna

See [ARRL Quickstart Guide For All Hams](#), page 12, "Build A Portable Ground Plane Antenna", by Zack Lau, W1VT.

It seems cheap and simple, and you don't need an SWR meter. These are measurements for UHF & VHF antennas.

NB VX-6R can operate on 70 cm, 1.25 M and 2 M, so potentially three antennas. Can this same design work for receiving on other frequencies?

Project #8 - Build Spider Antenna for SDR (ADS-B)



<https://www.amateurradiosupplies.com/product-p/cz7520.htm> - UHF Male to F Female adapter. You will want this to connect SO239 on antenna to the F-connector on the RG6 (assuming you use the cheap coax).

ADS-B is air traffic, centered around 1090 MHz. $300/1090 = 0.275\text{M}$ or 27.5 cm for the full wavelength. The measurements in that picture are for $1/4 \lambda$, thus the 6.8 cm.

I believe this is the original post: <https://discussions.flightradar24.com/t/three-easy-diy-antennas-for-beginners/16348>

This is a subsequent post from someone else that adds more details: <https://lucsmail.com/2017/02/06/making-antennas-for-1090mhz-ads-b-aircraft-tracking/>

Reference Materials

Phonetic Alphabet

A	Alfa/Alpha	AL FAH
B	Bravo	BRAH VOH
C	Charlie	CHAR LEE
D	Delta	DELL TAH
E	Echo	ECK OH
F	Foxtrot	FOKS TROT
G	Golf	GOLF
H	Hotel	HOH TELL
I	India	IN DEE AH
J	Juliett	JEW LEE ETT
K	Kilo	KEY LOH
L	Lima	LEE MAH
M	Mike	MIKE
N	November	NO VEMBER
O	Oscar	OSS CAH
P	Papa	PAH PAH
Q	Quebec	KEH BECK
R	Romeo	ROW ME OH
S	Sierra	SEE AIRRAH
T	Tango	TANG OH
U	Uniform	YOU NEE FORM
V	Victor	VIK TAH
W	Whiskey	WISS KEY
X	X-ray	ECKS RAY
Y	Yankee	YANG KEY
Z	Zulu	ZOO LOO

Q-Codes

Q-signals are a system of radio shorthand as old as wireless and developed from even older telegraphy codes. Q-signals are a set of abbreviations for common information that save time and allow communication between operators who don't speak a common language. Modern ham radio

uses them extensively. The table below lists the most common Q-signals used by hams. While Q-signals were developed for use by Morse operators, their use is common on phone, as well. You will often hear, “QRZed?” as someone asks “Who is calling me?” or “I’m getting a little QRM” from an operator receiving some interference or “Let’s QSY to 146.55” as two operators change from a repeater frequency to a nearby simplex communications frequency.

QRG	Your exact frequency (or that of) is __ kHz. <i>Will you tell me my exact frequency (or that of)?</i>
QRL	I am busy (or I am busy with __). Are you busy? Usually used to see if a frequency is busy.
QRM	Your transmission is being interfered with __ (1. Nil; 2. Slightly; 3. Moderately; 4. Severely; 5. Extremely.) Is my transmission being interfered with?
QRN	I am troubled by static __. (1 to 5 as under QRM.) Are you troubled by static?
QRO	Increase power. Shall I increase power?
QRP	Low power / decrease power. Shall I decrease power?
QRQ	Send faster (____wpm). Shall I send faster?
QRS	Send more slowly (____wpm). Shall I send more slowly?
QRT	Stop sending. Shall I stop sending?
QUU	I have nothing for you. Have you anything for me?
QRV	I am ready. Are you ready?
QRX	I will call you again at _ hours (on __ kHz). When will you call me again? Minutes are usually implied rather than hours.
QRZ	You are being called by _ (on __ kHz). Who is calling me?
QSB	Your signals are fading. Are my signals fading?
QSK	I can hear you between signals; break in on my transmission. Can you hear me between your signals and if so can I break in on your transmission?
QSL	I am acknowledging receipt. Can you acknowledge receipt (of a message or transmission)?

QSO	I can communicate with _ <i>direct (or relay through _).</i> Can you communicate with __ direct or by relay?
QSP	I will relay to . Will you relay to ?
QST	General call preceding a message addressed to all amateurs and ARRL members. This is in effect “CQ ARRL.”
QSX	I am listening to on _kHz. <i>Will you listen to on _kHz?</i>
QSY	Change to transmission on another frequency (or on _kHz). <i>Shall I change to transmission on another frequency (or on _kHz)?</i>
QTC	I have _messages for you (or for _). How many messages have you to send?
QTH	My location is ___. What is your location?
QTR	The time is ___. What is the correct time?

REF: ARRL

Band Chart

US Amateur Radio Bands

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

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

LF – Low Frequency band

2200 Meters (135 kHz) E,A,G
1 W EIRP maximum



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

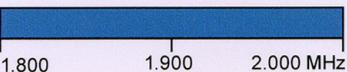
MF – Medium Frequency bands

630 Meters (472 kHz) E,A,G

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

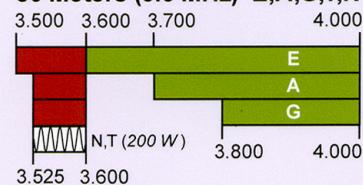


160 Meters (1.8 MHz) E,A,G

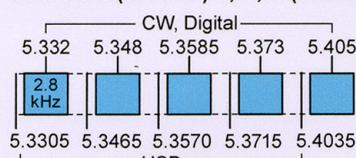


HF – High Frequency bands

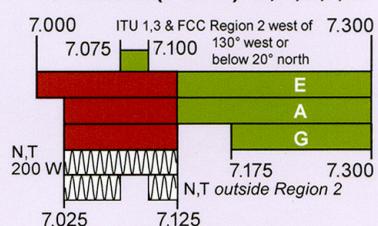
80 Meters (3.5 MHz) E,A,G,T,N



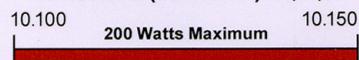
60 Meters (5.3 MHz) E, A, G (100 W)



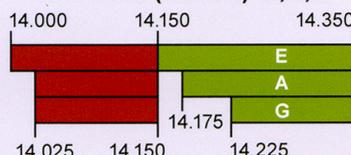
40 Meters (7 MHz) E,A,G,T,N



30 Meters (10.1 MHz) E,A,G



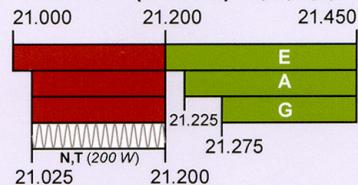
20 Meters (14 MHz) E,A,G



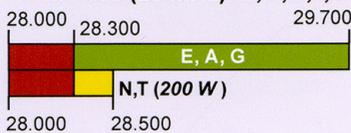
17 Meters (18 MHz) E,A,G



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

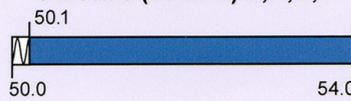


10 Meters (28 MHz) E,A,G,T,N

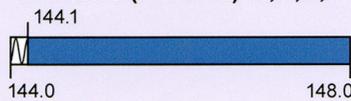


VHF – Very High Frequency bands

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



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

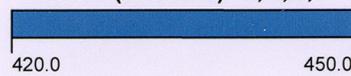


1.25 Meters (222 MHz) E,A,G,T,N



UHF – Ultra High Frequency bands

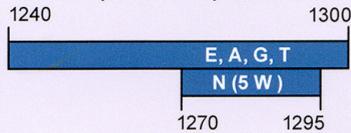
70 cm (420 MHz) E,A,G,T



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



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



SHF&EHF – Super and Extremely High Frequency bands

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

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

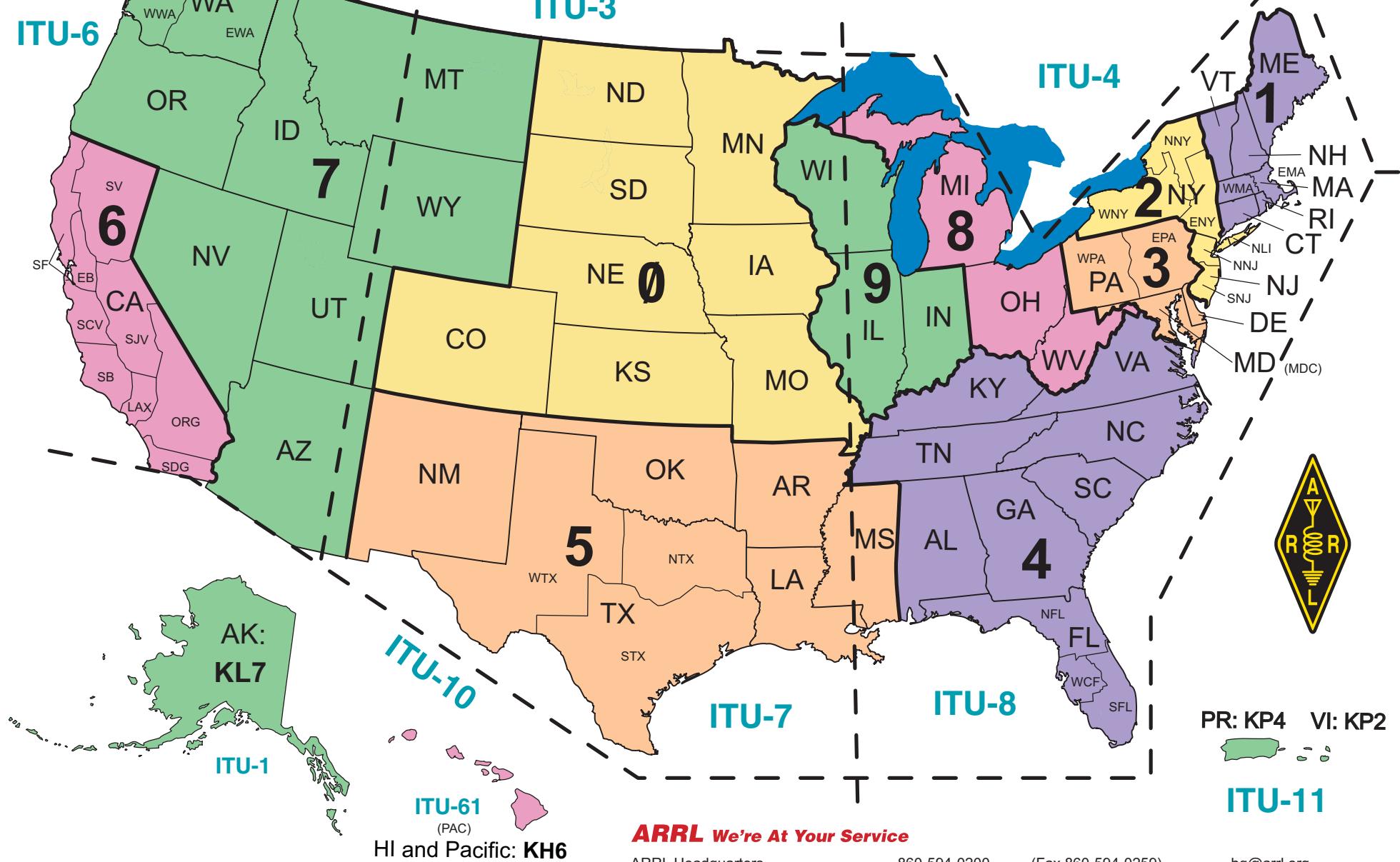
See www.arrl.org/band-plan for detailed band plans.

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ITU Zones (U.S.)

ARRL WAS Map

Worked All States

Dashed lines mark
ITU zone boundaries.**ARRL We're At Your Service**

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vec@arrl.org

ARRL The national association for
AMATEUR RADIO

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International Call Sign Directory

Call Sign Series	Allocated To
AAA-ALZ	United States of America
AMA-AOZ	Spain
APA-ASZ	Pakistan (Islamic Republic of)
ATA-AWZ	India (Republic of)
AXA-AXZ	Australia
AYA-AZZ	Argentine Republic
A2A-A2Z	Botswana (Republic of)
A3A-A3Z	Tonga (Kingdom of)
A4A-A4Z	Oman (Sultanate of)
A5A-A5Z	Bhutan (Kingdom of)
A6A-A6Z	United Arab Emirates
A7A-A7Z	Qatar (State of)
A8A-A8Z	Liberia (Republic of)
A9A-A9Z	Bahrain (State of)
BAA-BZZ	China (People's Republic of) (see carve-out for Taiwan below)
BM-BQ, BU-BX	Taiwan
CAA-CEZ	Chile
CFA-CKZ	Canada
CLA-CMZ	Cuba
CNA-CNZ	Morocco (Kingdom of)
COA-COZ	Cuba
CPA-CPZ	Bolivia (Republic of)
CQA-CUZ	Portugal
CVA-CXZ	Uruguay (Eastern Republic of)
CYA-CZZ	Canada
C2A-C2Z	Nauru (Republic of)
C3A-C3Z	Andorra (Principality of)
C4A-C4Z	Cyprus (Republic of)
C5A-C5Z	Gambia (Republic of the)
C6A-C6Z	Bahamas (Commonwealth of the)
* C7A-C7Z	World Meteorological Organization

C8A-C9Z	Mozambique (Republic of)
DAA-DRZ	Germany (Federal Republic of)
DSA-DTZ	Korea (Republic of)
DUA-DZZ	Philippines (Republic of the)
D2A-D3Z	Angola (Republic of)
D4A-D4Z	Cape Verde (Republic of)
D5A-D5Z	Liberia (Republic of)
D6A-D6Z	Comoros (Islamic Federal Republic of the)
D7A-D9Z	Korea (Republic of)
EAA-EHZ	Spain
EIA-EJZ	Ireland
EKA-EKZ	Armenia (Republic of)
ELA-ELZ	Liberia (Republic of)
EMA-EOZ	Ukraine
EPA-EQZ	Iran (Islamic Republic of)
ERA-ERZ	Moldova (Republic of)
ESA-ESZ	Estonia (Republic of)
ETA-ETZ	Ethiopia (Federal Democratic Republic of)
EUA-EWZ	Belarus (Republic of)
EXA-EXZ	Kyrgyz Republic
EYA-EYZ	Tajikistan (Republic of)
EZA-EZZ	Turkmenistan
E2A-E2Z	Thailand
E3A-E3Z	Eritrea
** E4A-E4Z	Palestinian Authority
E5A-E5Z	New Zealand - Cook Islands (WRC-07)
E6A-E6Z	New Zealand - Niue
E7A-E7Z	Bosnia and Herzegovina (Republic of) (WRC-07)
FAA-FZZ	France
GAA-GZZ	United Kingdom of Great Britain and Northern Ireland
HAA-HAZ	Hungary (Republic of)
HBA-HBZ	Switzerland (Confederation of)
HCA-HDZ	Ecuador
HEA-HEZ	Switzerland (Confederation of)

HFA-HFZ	Poland (Republic of)
HGA-HGZ	Hungary (Republic of)
HHA-HHZ	Haiti (Republic of)
HIA-HIZ	Dominican Republic
HJA-HKZ	Colombia (Republic of)
HLA-HLZ	Korea (Republic of)
HMA-HMZ	Democratic People's Republic of Korea
HNA-HNZ	Iraq (Republic of)
HOA-HPZ	Panama (Republic of)
HQA-HRZ	Honduras (Republic of)
HSA-HSZ	Thailand
HTA-HTZ	Nicaragua
HUA-HUZ	El Salvador (Republic of)
HVA-HVZ	Vatican City State
HWA-HYZ	France
HZA-HZZ	Saudi Arabia (Kingdom of)
H2A-H2Z	Cyprus (Republic of)
H3A-H3Z	Panama (Republic of)
H4A-H4Z	Solomon Islands
H6A-H7Z	Nicaragua
H8A-H9Z	Panama (Republic of)
IAA-IZZ	Italy
JAA-JSZ	Japan
JTA-JVZ	Mongolia
JWA-JXZ	Norway
JYA-JYZ	Jordan (Hashemite Kingdom of)
JZA-JZZ	Indonesia (Republic of)
J2A-J2Z	Djibouti (Republic of)
J3A-J3Z	Grenada
J4A-J4Z	Greece
J5A-J5Z	Guinea-Bissau (Republic of)
J6A-J6Z	Saint Lucia
J7A-J7Z	Dominica (Commonwealth of)
J8A-J8Z	Saint Vincent and the Grenadines

KAA-KZZ	United States of America
LAA-LNZ	Norway
LOA-LWZ	Argentine Republic
LXA-LXZ	Luxembourg
LYA-LYZ	Lithuania (Republic of)
LZA-LZZ	Bulgaria (Republic of)
L2A-L9Z	Argentine Republic
MAA-MZZ	United Kingdom of Great Britain and Northern Ireland
NAA-NZZ	United States of America
OAA-OCZ	Peru
ODA-ODZ	Lebanon
OEA-OEZ	Austria
OFA-OJZ	Finland
OKA-OLZ	Czech Republic
OMA-OMZ	Slovak Republic
ONA-OTZ	Belgium
OUA-OZZ	Denmark
PAA-PIZ	Netherlands (Kingdom of the)
PJA-PJZ	Netherlands (Kingdom of the) - Netherlands Caribbean
PKA-POZ	Indonesia (Republic of)
PPA-PYZ	Brazil (Federative Republic of)
PZA-PZZ	Suriname (Republic of)
P2A-P2Z	Papua New Guinea
P3A-P3Z	Cyprus (Republic of)
P4A-P4Z	Netherlands (Kingdom of the) - Aruba
P5A-P9Z	Democratic People's Republic of Korea
RAA-RZZ	Russian Federation
SAA-SMZ	Sweden
SNA-SRZ	Poland (Republic of)
SSA-SSM	Egypt (Arab Republic of)
SSN-STZ	Sudan (Republic of the)
SUA-SUZ	Egypt (Arab Republic of)
SVA-SZZ	Greece

S2A-S3Z	Bangladesh (People's Republic of)
S5A-S5Z	Slovenia (Republic of)
S6A-S6Z	Singapore (Republic of)
S7A-S7Z	Seychelles (Republic of)
S8A-S8Z	South Africa (Republic of)
S9A-S9Z	Sao Tome and Principe (Democratic Republic of)
TAA-TCZ	Turkey
TDA-TDZ	Guatemala (Republic of)
TEA-TEZ	Costa Rica
TFA-TFZ	Iceland
TGA-TGZ	Guatemala (Republic of)
THA-THZ	France
TIA-TIZ	Costa Rica
TJA-TJZ	Cameroon (Republic of)
TKA-TKZ	France
TLA-TLZ	Central African Republic
TMA-TMZ	France
TNA-TNZ	Congo (Republic of the)
TOA-TQZ	France
TRA-TRZ	Gabonese Republic
TSA-TSZ	Tunisia
TTA-TTZ	Chad (Republic of)
TUA-TUZ	Côte d'Ivoire (Republic of)
TVA-TXZ	France
TYA-TYZ	Benin (Republic of)
TZA-TZZ	Mali (Republic of)
T2A-T2Z	Tuvalu
T3A-T3Z	Kiribati (Republic of)
T4A-T4Z	Cuba
T5A-T5Z	Somali Democratic Republic
T6A-T6Z	Afghanistan (Islamic State of)
T7A-T7Z	San Marino (Republic of)
T8A-T8Z	Palau (Republic of)
UAA-UIZ	Russian Federation

UJA-UMZ	Uzbekistan (Republic of)
UNA-UQZ	Kazakhstan (Republic of)
URA-UZZ	Ukraine
VAA-VGZ	Canada
VHA-VNZ	Australia
VOA-VOZ	Canada
VPA-VQZ	United Kingdom of Great Britain and Northern Ireland
VRA-VRZ	China (People's Republic of) - Hong Kong
VSA-VSZ	United Kingdom of Great Britain and Northern Ireland
VTA-VWZ	India (Republic of)
VXA-VYZ	Canada
VZA-VZZ	Australia
V2A-V2Z	Antigua and Barbuda
V3A-V3Z	Belize
V4A-V4Z	Saint Kitts and Nevis
V5A-V5Z	Namibia (Republic of)
V6A-V6Z	Micronesia (Federated States of)
V7A-V7Z	Marshall Islands (Republic of the)
V8A-V8Z	Brunei Darussalam
WAA-WZZ	United States of America
XAA-XIZ	Mexico
XJA-XOZ	Canada
XPA-XPZ	Denmark
XQA-XRZ	Chile
XSA-XSZ	China (People's Republic of)
XTA-XTZ	Burkina Faso
XUA-XUZ	Cambodia (Kingdom of)
XVA-XVZ	Viet Nam (Socialist Republic of)
XWA-XWZ	Lao People's Democratic Republic
XXA-XXZ	China (People's Republic of) - Macao (WRC-07)
XYA-XZZ	Myanmar (Union of)
YAA-YAZ	Afghanistan (Islamic State of)
YBA-YHZ	Indonesia (Republic of)

YIA-YIZ	Iraq (Republic of)
YJA-YJZ	Vanuatu (Republic of)
YKA-YKZ	Syrian Arab Republic
YLA-YLZ	Latvia (Republic of)
YMA-YMZ	Turkey
YNA-YNZ	Nicaragua
YOA-YRZ	Romania
YSA-YSZ	El Salvador (Republic of)
YTA-YUZ	Serbia (Republic of) (WRC-07)
YVA-YYZ	Venezuela (Republic of)
Y2A-Y9Z	Germany (Federal Republic of)
ZAA-ZAZ	Albania (Republic of)
ZBA-ZJZ	United Kingdom of Great Britain and Northern Ireland
ZKA-ZMZ	New Zealand
ZNA-ZOZ	United Kingdom of Great Britain and Northern Ireland
ZPA-ZPZ	Paraguay (Republic of)
ZQA-ZQZ	United Kingdom of Great Britain and Northern Ireland
ZRA-ZUZ	South Africa (Republic of)
ZVA-ZZZ	Brazil (Federative Republic of)
Z2A-Z2Z	Zimbabwe (Republic of)
Z3A-Z3Z	North Macedonia (Republic of)
Z6A-Z6Z	Kosovo (Republic of)
Z8A-Z8Z	South Sudan (Republic of)
2AA-2ZZ	United Kingdom of Great Britain and Northern Ireland
3AA-3AZ	Monaco (Principality of)
3BA-3BZ	Mauritius (Republic of)
3CA-3CZ	Equatorial Guinea (Republic of)
3DA-3DM	Kingdom of Eswatini
3DN-3DZ	Fiji (Republic of)
3EA-3FZ	Panama (Republic of)
3GA-3GZ	Chile

3HA-3UZ	China (People's Republic of)
3VA-3VZ	Tunisia
3WA-3WZ	Viet Nam (Socialist Republic of)
3XA-3XZ	Guinea (Republic of)
3YA-3YZ	Norway
3ZA-3ZZ	Poland (Republic of)
4AA-4CZ	Mexico
4DA-4IZ	Philippines (Republic of the)
4JA-4KZ	Azerbaijani Republic
4LA-4LZ	Georgia (Republic of)
4MA-4MZ	Venezuela (Republic of)
4OA-4OZ	Montenegro (Republic of) (WRC-07)
4PA-4SZ	Sri Lanka (Democratic Socialist Republic of)
4TA-4TZ	Peru
* 4UA-4UZ	United Nations
4VA-4VZ	Haiti (Republic of)
4WA-4WZ	Democratic Republic of Timor-Leste (WRC-03)
4XA-4XZ	Israel (State of)
* 4YA-4YZ	International Civil Aviation Organization
4ZA-4ZZ	Israel (State of)
5AA-5AZ	Libya (Socialist People's Libyan Arab Jamahiriya)
5BA-5BZ	Cyprus (Republic of)
5CA-5GZ	Morocco (Kingdom of)
5HA-5IZ	Tanzania (United Republic of)
5JA-5KZ	Colombia (Republic of)
5LA-5MZ	Liberia (Republic of)
5NA-5OZ	Nigeria (Federal Republic of)
5PA-5QZ	Denmark
5RA-5SZ	Madagascar (Republic of)
5TA-5TZ	Mauritania (Islamic Republic of)
5UA-5UZ	Niger (Republic of the)
5VA-5VZ	Togolese Republic
5WA-5WZ	Samoa (Independent State of)
5XA-5XZ	Uganda (Republic of)

5YA-5ZZ	Kenya (Republic of)
6AA-6BZ	Egypt (Arab Republic of)
6CA-6CZ	Syrian Arab Republic
6DA-6JZ	Mexico
6KA-6NZ	Korea (Republic of)
6OA-6OZ	Somali Democratic Republic
6PA-6SZ	Pakistan (Islamic Republic of)
6TA-6UZ	Sudan (Republic of the)
6VA-6WZ	Senegal (Republic of)
6XA-6XZ	Madagascar (Republic of)
6YA-6YZ	Jamaica
6ZA-6ZZ	Liberia (Republic of)
7AA-7IZ	Indonesia (Republic of)
7JA-7NZ	Japan
7OA-7OZ	Yemen (Republic of)
7PA-7PZ	Lesotho (Kingdom of)
7QA-7QZ	Malawi
7RA-7RZ	Algeria (People's Democratic Republic of)
7SA-7SZ	Sweden
7TA-7YZ	Algeria (People's Democratic Republic of)
7ZA-7ZZ	Saudi Arabia (Kingdom of)
8AA-8IZ	Indonesia (Republic of)
8JA-8NZ	Japan
8OA-8OZ	Botswana (Republic of)
8PA-8PZ	Barbados
8QA-8QZ	Maldives (Republic of)
8RA-8RZ	Guyana
8SA-8SZ	Sweden
8TA-8YZ	India (Republic of)
8ZA-8ZZ	Saudi Arabia (Kingdom of)
9AA-9AZ	Croatia (Republic of)
9BA-9DZ	Iran (Islamic Republic of)
9EA-9FZ	Ethiopia (Federal Democratic Republic of)
9GA-9GZ	Ghana

9HA-9HZ	Malta
9IA-9JZ	Zambia (Republic of)
9KA-9KZ	Kuwait (State of)
9LA-9LZ	Sierra Leone
9MA-9MZ	Malaysia
9NA-9NZ	Nepal
9OA-9TZ	Democratic Republic of the Congo
9UA-9UZ	Burundi (Republic of)
9VA-9VZ	Singapore (Republic of)
9WA-9WZ	Malaysia
9XA-9XZ	Rwandese Republic
9YA-9ZZ	Trinidad and Tobago

<http://www.arrl.org/international-call-sign-series>

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3. Direwolf - software TNC - <https://packet-radio.net/direwolf>. See also github.
4. EchoLink - <https://secure.echolink.org/>. RF to internet to RF, so you can connect to hams around the world. Even better: your PC to internet to RF, so you can connect without even having a radio!
5. JS8CALL - <http://js8call.com/>
6. Mobilinkd - hardware TNC - <https://www.mobilinkd.com>
7. MMANA-GAL - antenna analysis software, <https://hamsoft.ca/pages/mmana-gal.php>
8. [Radio Reference](#) - frequency database and trunked radio system information
9. "RTL-SDR for Linux Quick Start Guide", 2nd ed. Ken Ranous, KA0SBL
10. WSJT-X - a collection of weak-signal protocols; multiplatform - <https://physics.princeton.edu//pulsar/K1JT/wsjttx.html>

Log Book

STATION CALLSIGN: _____

HF Log Sheet

PAGE ____ OF ____

DATE	UTC		FREQ	MODE	POWER	CALLSIGN	QTH	RST		COMMENTS
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HF Log Sheet

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HF Log Sheet

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