

# Two Simple Antennas for HF

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# Who Is K9LA?

- Novice license (WN9AVT) in October 1961
- General (WA9AVT) in May 1962 Extra in 1977
- BSEE/MSEE out of Purdue
- Joined Motorola (Schaumburg, IL) in April 1974
  - RF design engineer solid state RF power amplifiers
  - Met many hams there K9JU, K9KA, K1VX (all in TN) and many others



one of my early QSLs

- Transferred to Ft Worth, TX with Motorola in April 1979
- Moved back north in July 1988 with Magnavox (now Raytheon) in Ft Wayne, IN
- Enjoy propagation, DXing, contesting, playing with antennas and vintage equipment
- Wife is Vicky AE9YL that helps!
- I'm retired from Raytheon and currently the Central Division Vice Director

# Agenda

- What we're <u>not</u> going to cover
- Vertical antenna
  - Performance on 20m/15m/10m in a contest
- Dipole/inverted-vee antenna
  - Performance on 40m/20m in a contest
  - Performance on 160m in a contest
- Comments about antenna modeling

### This Is Not . . .

... a presentation about the following types of antennas



#### This is about what you can do with two simple antennas for HF

### Vertical



my Hustler 4BTV (4BTV means 4-band trap vertical) 40m, 20m, 15m, 10m

#### **Common Perception: A vertical radiates equally poor in all directions**

# Patterns of a 4BTV Vertical (from 4nec2)

- Azimuth pattern should be omni-directional
- Could be modified by metal structure of appropriate length
- Elevation pattern depends on number of radials and ground



#### How Does the 4BTV Perform in the Real-World?

- ARRL DX CW contest February 2002 from Ft Wayne, IN
  - Smoothed sunspot number = 115 (around the max of Cycle 23)
- 100 Watts to the 4BTV on our single-story garage roof
  - Two radials for each band (only did 20m, 15m and 10m)
- No amplifier, no PacketCluster
- Friday evening 7 to 10PM
  - 42 countries worked best was 9H1ZA on 20m
- Saturday 8 to 11AM, 1 to 4PM, 7 to 10PM
  - 41 more countries 83 total best was YBØGJS on 20m, JY9NX on 15m, OD5/OK1MU and VR2BG on 10m

### **4BTV Performance Continued**

- Sunday 6 hours in four sessions
  - 8 more countries worked total 91 best A45XR and EX2X on 10m
- Couldn't work TK on 10m and EA9, 3A, YI on 20m pileups too big
- Most contacts were <u>not</u> one call and in the log
- Could have worked W and VE, so 93 countries for an 18 hour weekend effort – all by tuning the band with 100 Watts to a vertical

Lots of DX can be worked with 100 Watts and a simple vertical (it helps when the Sun cooperates)

### Dipole



# Works on the fundamental and approximately three times the fundamental

40m/15m, 160m/60m, 80m/30m

#### **Common Perception: A dipole at low height is a cloud-warmer**

### Patterns of a Half-Wave Dipole



- 20m dipole at 66 feet (1  $\lambda$ ) •
- null off the ends •
- max gain +7.44 dBi at 15° .



- 20m dipole at 8 feet (0.125  $\lambda$ ) ٠
- pretty much omni-directional
- gain -5.0 dBi at 15° ٠

#### At 15° elevation, low dipole about 2 S-units weaker than the high dipole

on height above ground

Red is azimuth

Blue is elevation

# Dipole Needs Two Supports

- Cousin of a dipole is an inverted-vee
- Only needs one support
- Performance is similar to a dipole



Try to keep the angle between the down-sloping wires greater than 90°

### How Does the Inverted-Vee Perform?

- 40m/20m inverted-vee with apex at 40ft
- ARRL DX CW contest February 2009 from Ft Wayne, IN
  - Smoothed sunspot number = 1.9 (solar minimum!)
- Vintage equipment: Viking Ranger II (about 50 Watts out) and Drake 2-B
  - No amplifier, no PacketCluster
- Ended up with 79 countries

Again, lots of DX can be worked with low power (50 Watts) and a simple antenna (inverted-vee) at a reasonable height



# My 160m Inverted-Vee

- Comparison to a vertical over average ground with an adequate number of radials
- Inverted-vee down about 2 S-units at low elevation angles
- May not be first in a pileup but you can still work other stations – including DX



### More Inverted-Vee Performance – 160m

- ARRL 160m contest Dec 2019 from Ft Wayne, IN
  - 1000 Watts and a SAL-20 (Shared Apex Loop, 20ft baseline) for receive
- 160m inverted-vee with apex at 45ft with bent ends
- Worked 49 states
  - Missed Alaska but was heard there -
- Worked some western EU and Carib
- Amplifier really helps on 160m



#### Again, lots of QSOs with a "cloud-warmer" antenna

# Modeling Antennas

- I use 4nec2 from Arie Voors <u>https://www.qsl.net/4nec2/</u> it's free!
- 4nec2 uses the Numerical Electromagnetics Code (NEC) to simulate wire and surface antennas
- Comes with the NEC-2 engine
  - Has some limitations, but is adequate for most Amateur Radio scenarios
- The NEC-4 engine remains proprietary
  - Requires you to buy a license and then you have to pay for the software
  - Can bury wires and connect wires to lossy ground
    - Good for modeling Beverages and verticals

If modeled results seem too good to be true, they probably are too good to be true!

### Some Models







#### **Radio Moscow 40m Antenna**



#### 4 rows (30/99/168/236ft) 4 dipoles in each row

| Hor plane       | -150 | 1 1      | 150 | -19 < dBi < 19.6  |
|-----------------|------|----------|-----|-------------------|
| Ver plane       | 165  | <u> </u> | 165 | -122 < dBi < 19.6 |
| Theta=80, Phi=0 | -105 | -180     | 105 | Max gain The:80   |

19.6 dBi gain

# Summary

- Simple antenna can provide lots of contacts and lots of fun but you have to get on the air and stay in the chair!
  - If necessary, bend the dipole/inverted-vee to fit in your allotted space
- I believe operating skill is just as important as the antenna
  - Maybe even more important (think WRTC events)
  - Work on techniques to work someone quickly
- CW has an advantage over SSB
- JT65 has an advantage over my ability to copy CW (about 13 dB)
- FT8 has an advantage over my ability to copy CW (about 9 dB)
- FT4 has an advantage over my ability to copy CW (about 4 dB)

Each subsequent digital mode trades sensitivity for speed to make QSO