Field Day Antennas with Good Performance and Isolation

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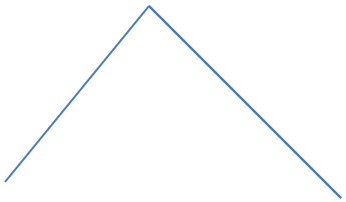
Three Antenna Clusters for HF Bands with Polarization Isolation

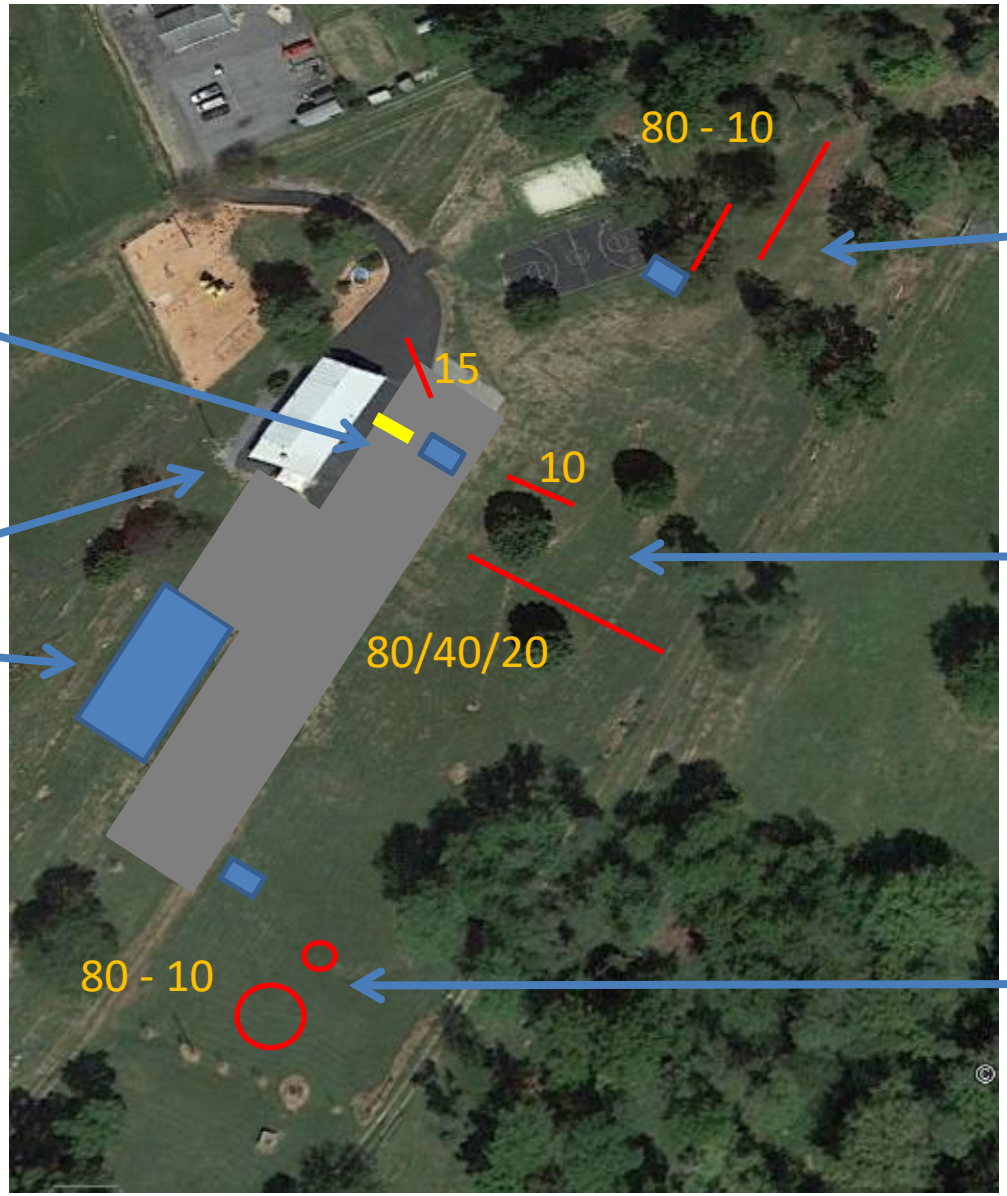
80/40/20/15/10
Trap dipole for **Digital**



80/40/20 wide-spaced fan
inverted vee for **Phone**

80/40 33’ whip
20/15/10 R5
Verticals for **CW**

ARA 6A antenna Layout for Field Day



Ramps for power and 20 meters phone coax

Metal buildings

Digital setup in gazebo with trap dipole & end fed antenna

Phone setup with 4 rigs in EmComm trailer and pavilion with 80/40/20 inverted vee and 10 & 15 meter dipoles

CW setup in CW trailer with vertical antennas

Antietam Radio Association FD Solutions

- Good performance resonant verticals, dipoles, inverted vees,….
- Low SWR friendly to rigs/triplexers/filters,….
- Target 70 dB isolation between rigs on the same band – Phone/Digital/CW
- 3 antenna clusters in different polarities for Phone/CW/digital
- Baluns and antenna isolators used to prevent coax line radiation
- Rigs located near their antennas
- Separate power sources or isolated power sources
- Band-pass filters
- Triplexer and shared inverted vee for 80/40/20 phone
- Same band signal separation filters
- High performance radios
- Setup, test and adjust on Friday before Field Day

Measured Isolation Results in the Field

- CW verticals to phone inverted vees and dipoles in cross polarization (only about 250 feet separation) - after adjustments in the field

	ARA Field Day Site	Open Field
– 80 meters	60 dB	~ 70 dB
– 40 meters	56 dB	~ 70 dB
– 20 meters	50 dB	~ 70 dB

- CW verticals to digital trap dipole in cross polarization (about 500 feet separation)
  - 80 meters 66 dB
  - 40 meters 69 dB
  - 20 meters 72 dB

Field Day Interference Issues

- CW to phone may be the most sensitive
- RX Overload
- TX noise and harmonics
- Same band and inter-band
- Radiation antenna coupling
- Conducted coupling – power cables, grounds,…
- Coax common mode
- Other interference – generators, PC’s, lights,….

Field Measurements of Antenna Isolation

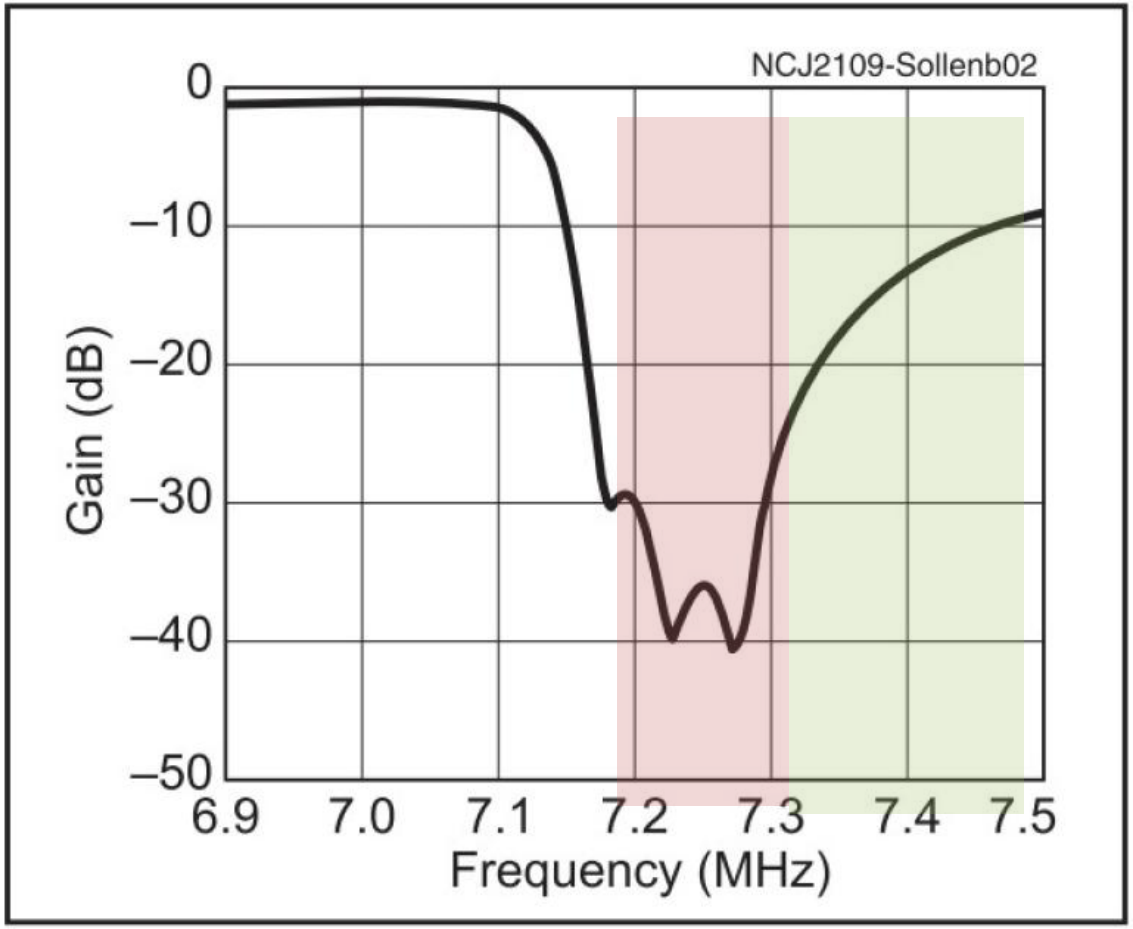
- Transmit a CW signal at 100 Watts using a memory keyer indicating “test” and call sign

- Use a small portable oscilloscope to measure the signal voltage on victim antennas for phone and digital - a scope is more sensitive to change than an “S” meter
- Insert a band-pass filter in front of the scope and terminate the victim antenna into a 50 Ohm resistor
- Antenna isolation probably varies a bit across the band which affects overload and noise interference differently

Field Antenna Adjustments to Maximize Isolation

- Very simple to adjust inverted vee legs - other types of adjustments many be possible
- Transmit CW signals from one set of antennas
- Move inverted vee leg in 2 dimensions to minimize the received signal voltage.
  - Possible to have one person “walk” the antenna leg in real time while a 2nd person operates the transmitter and a 3rd person measures the signal
  - Alternate between the 2 ends for 1 band
- For safety only move the victim antenna and not the TX active antenna which may have high voltages

40 Meters Ultra-Sharp Low-Loss CW Filter Measured Response



CW Phone

Suppresses TX noise in the 40 meter phone band when transmitting CW on 40 meters.

Protects CW RX from overload and spurious mixing products when transmitting on the phone band

See NCJ Nov-Dec 2021

Other techniques

- End-to-end dipoles
- Using Yagi's along a line that are placed side by side - works well for stations on the coasts
- Shared RX antenna placed as far as possible with good isolation from TX antennas
  - Usually combined with co-located rigs
  - TX antennas only need modest isolation
- QRP or lower power TX operation
- Disable RX preamps and RX attenuation

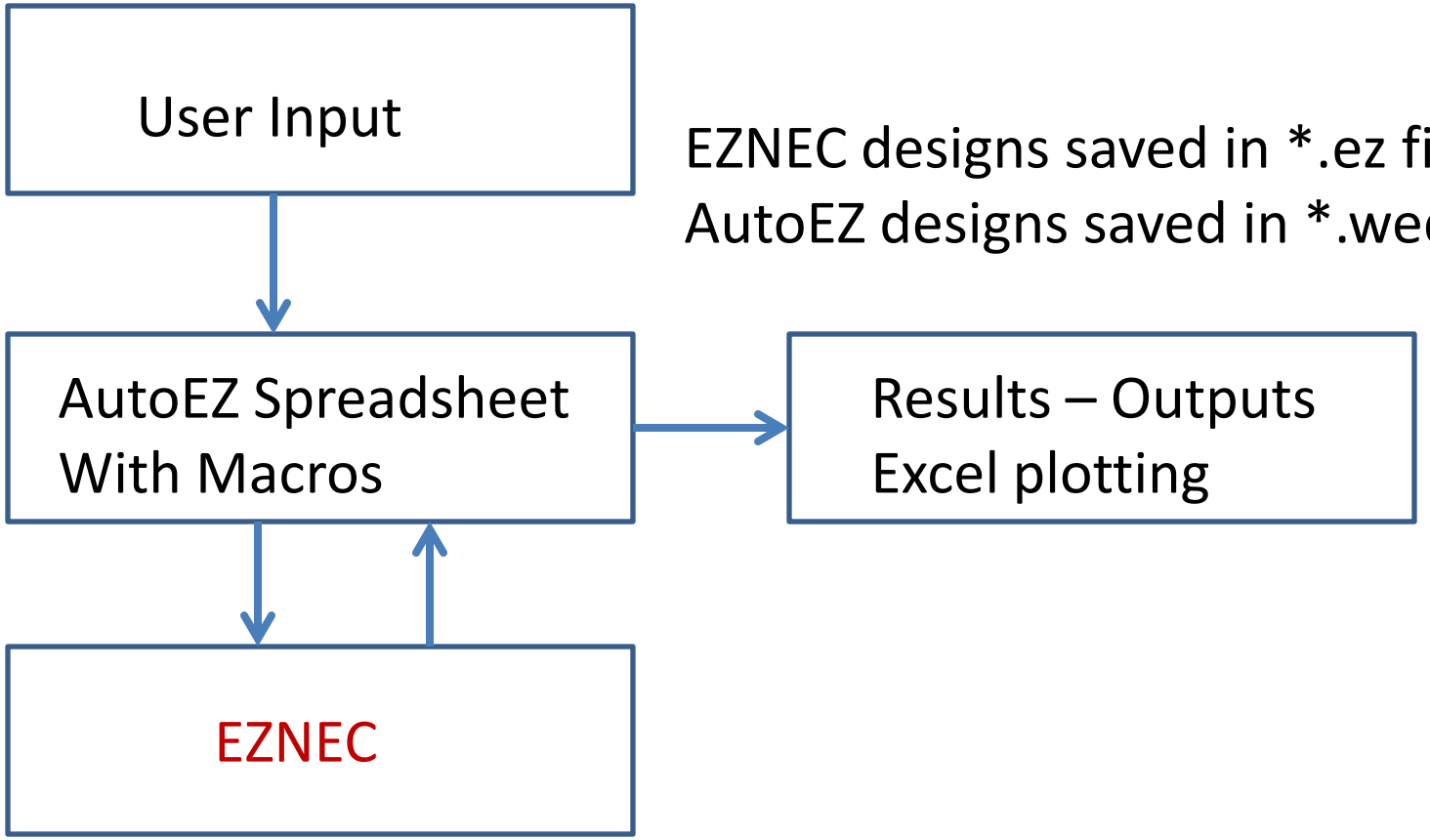
Things to Avoid to Achieve Good Antenna Isolation

- Antennas with mixed horizontal and vertical polarizations
  - G5RV
  - Carolina Windom
  - Sloper antennas
- Environments with close and large metal reflectors or hilly terrain
- Unbalanced antenna connections – use baluns and RF chokes to avoid coaxial feed radiation
- Power and ground connections that may couple conducted RF energy between radios

Grounding for Field Day

- All power generators/supplies and rigs need a good earth ground for AC power safety and then for interference
- 2 approaches for interference
  - Space the rigs far apart with separate power sources and separate earth grounding
  - Co-locate rigs, power & grounding
- Bonding of grounds for co-located rigs & power is more important for interference than “RF grounding”
- There is no magic “RF ground”
- RFI filtering for AC power may be helpful

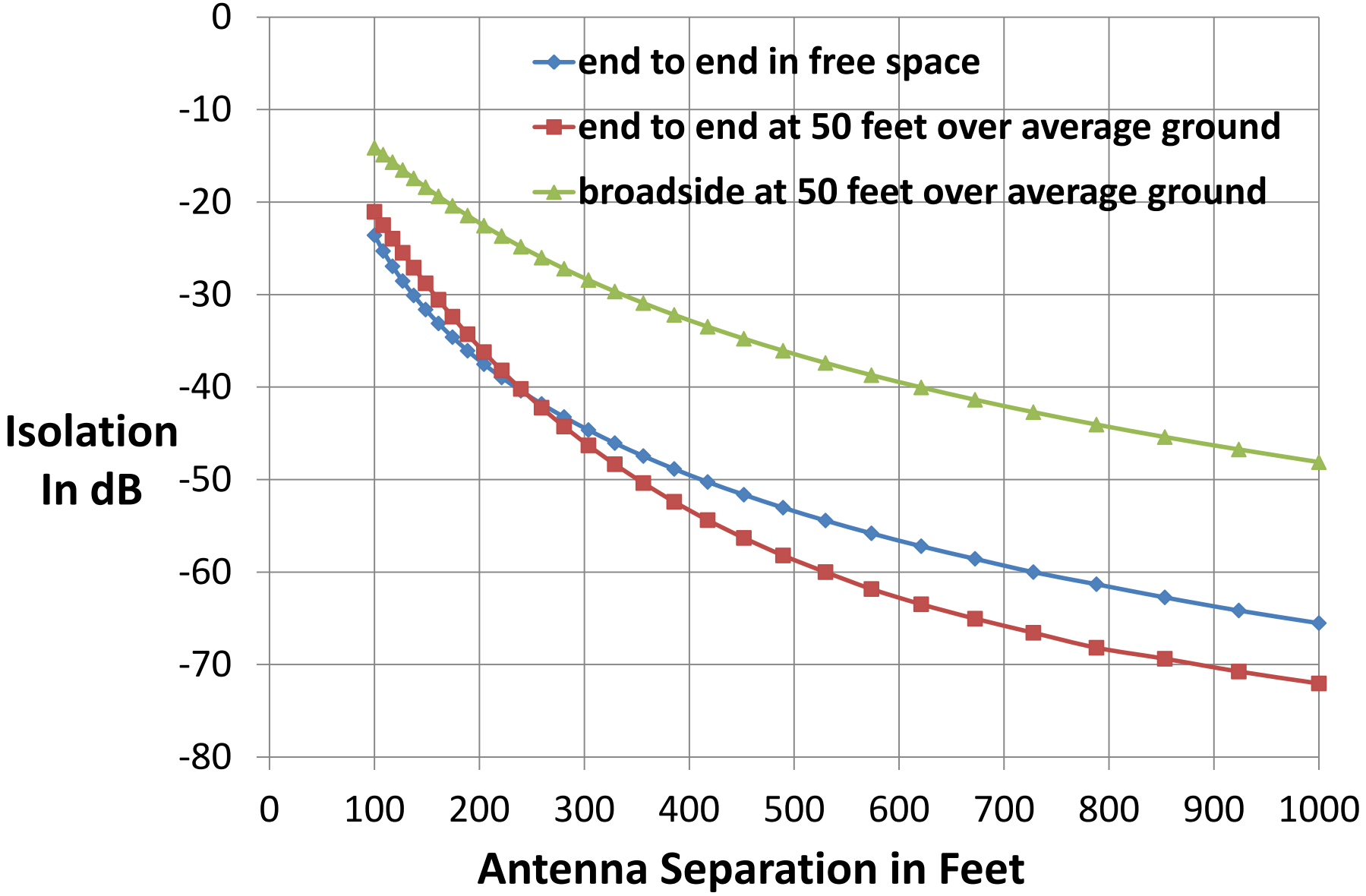
EZNEC & AutoEZ



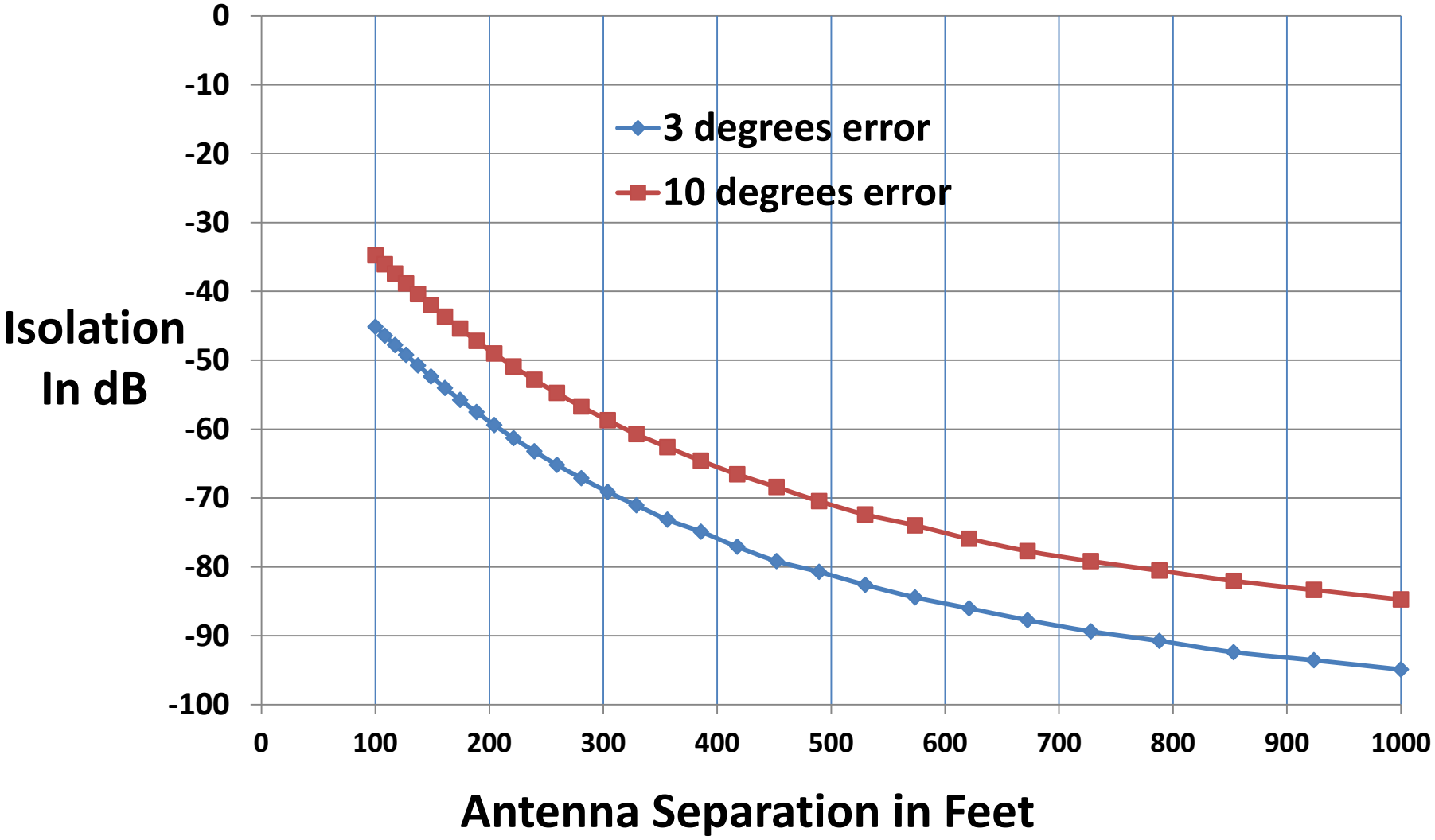
EZNEC designs saved in *.ez files
AutoEZ designs saved in *.weq files

Examples for Field Day
www.ka2c.com/field-day-interference/autoez/
www.ka2c.com/field-day-interference/eznec/

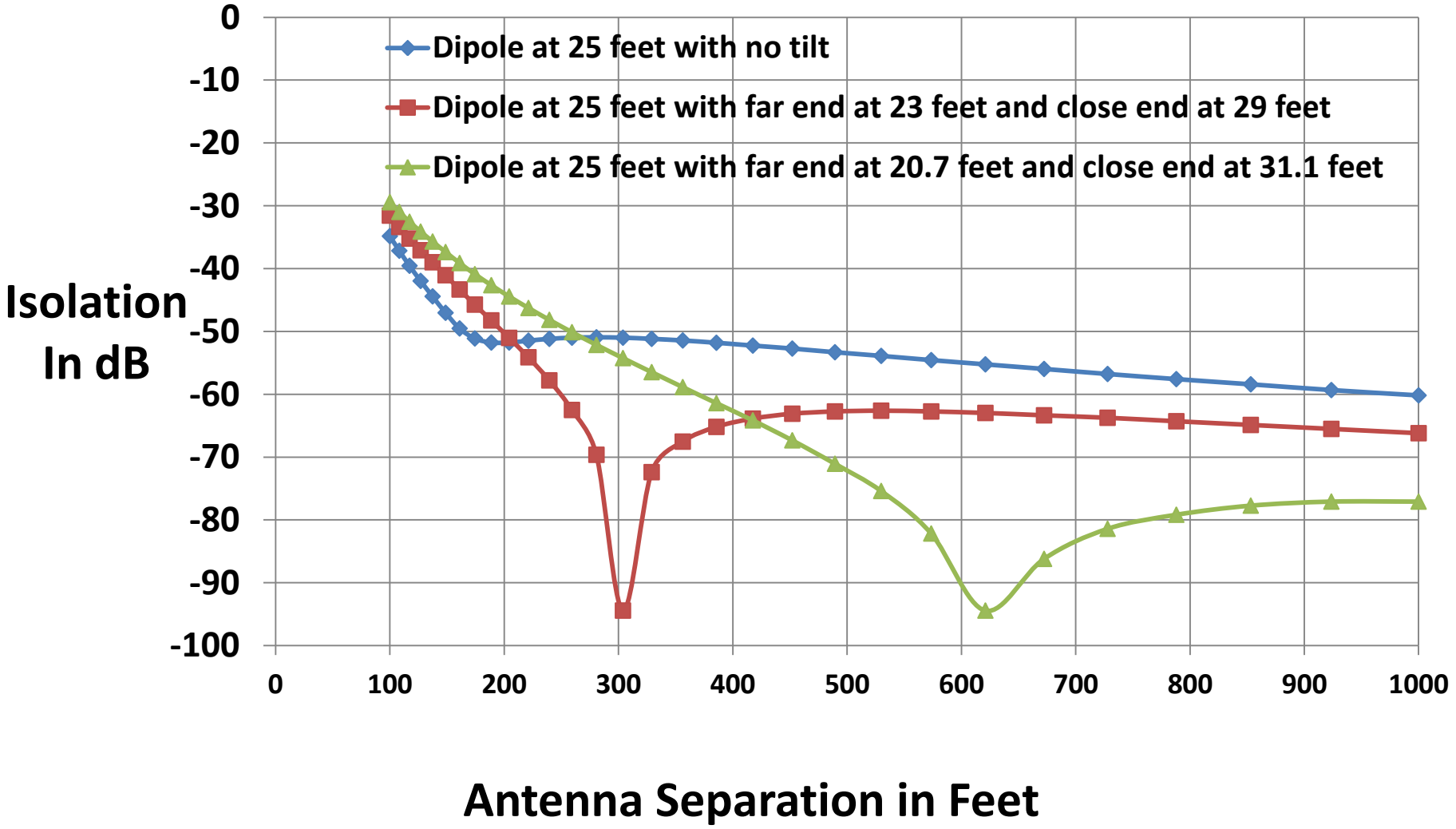
40 Meter Dipoles



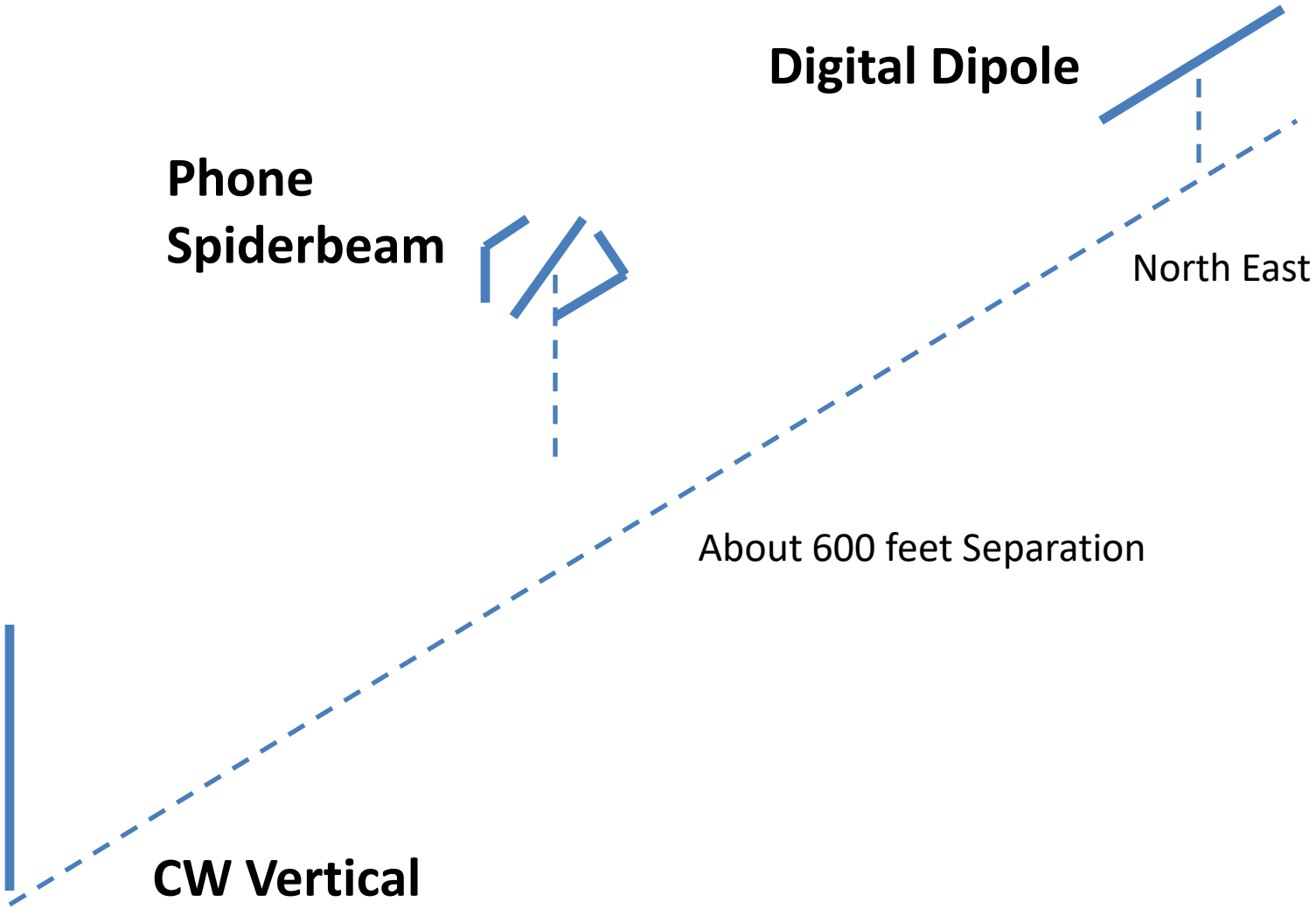
40 Meter Dipoles in Cross-Polarization at 25 Feet with Location Error



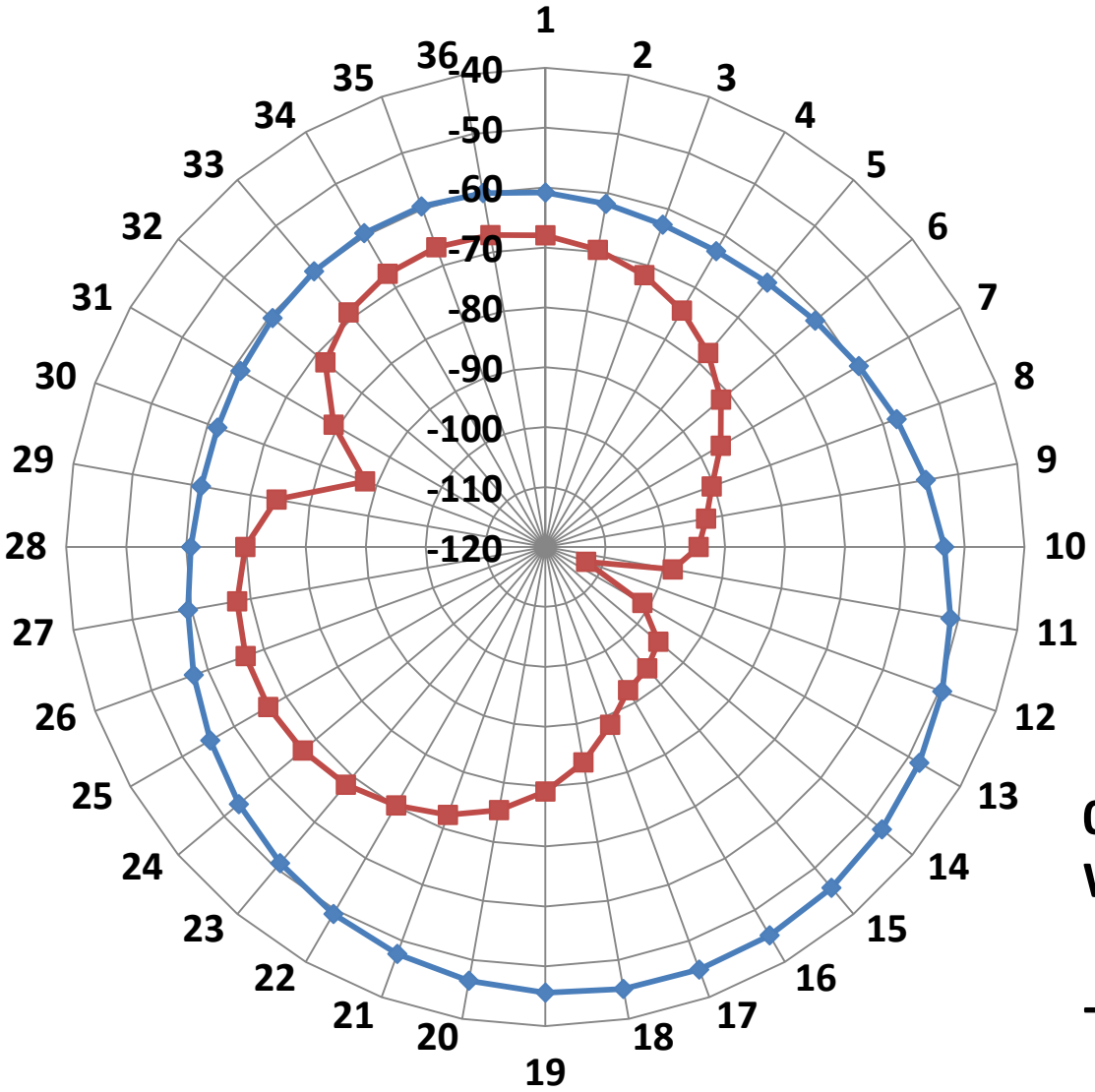
40 Meters Dipole end to end to a Vertical with Tilt



Adding A Spiderbeam for 20/15/10 phone in 2022 Facing West for ARA



Spiderbeam for Phone rotating to Dipole for Digital Station and Vertical for CW



Dipole for digital

Vertical for CW

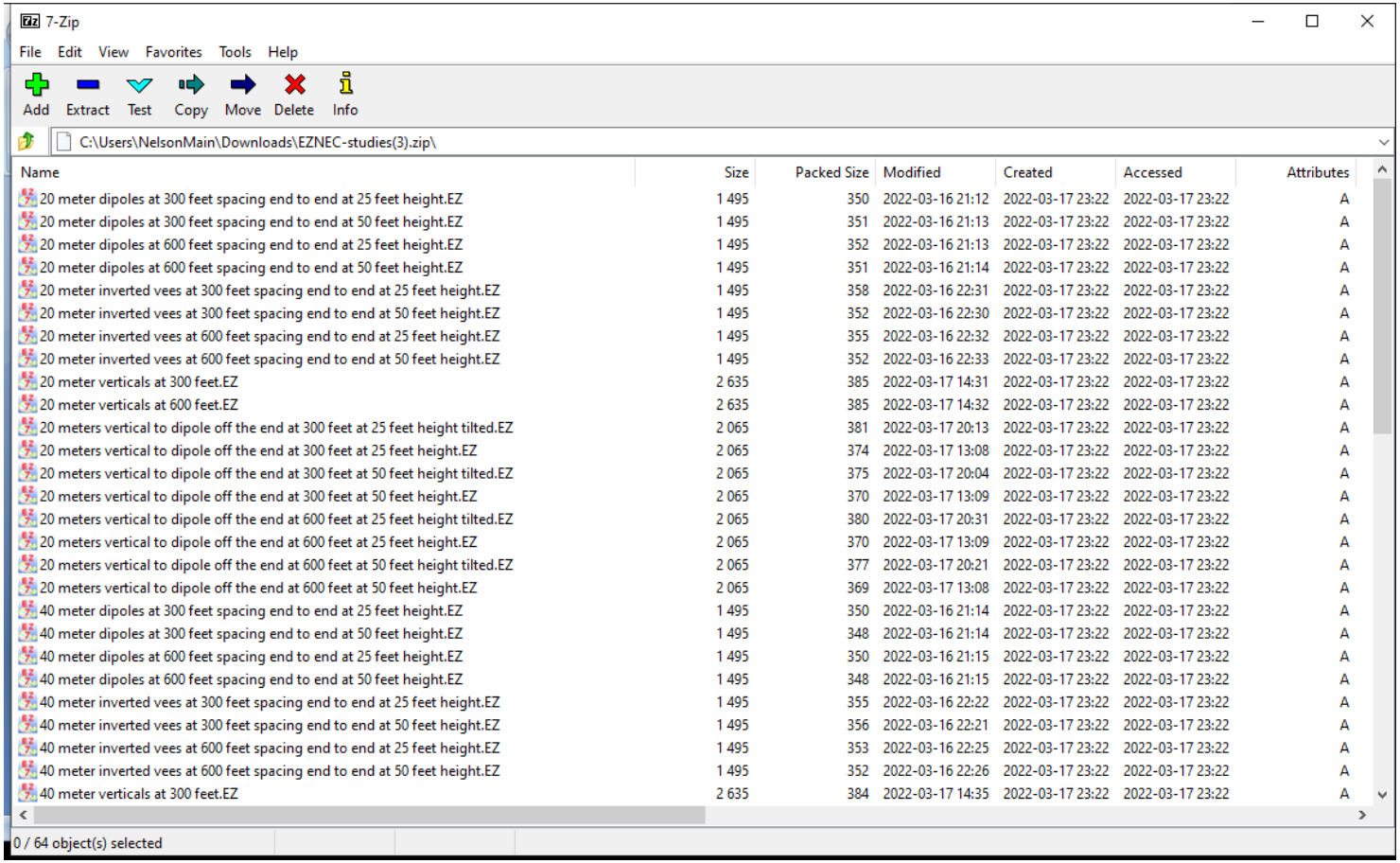
0 to 360 degree rotations
With “1” facing due west

-120 to -40 dB Isolation

Environment with Metal Reflectors, Uneven Ground,….

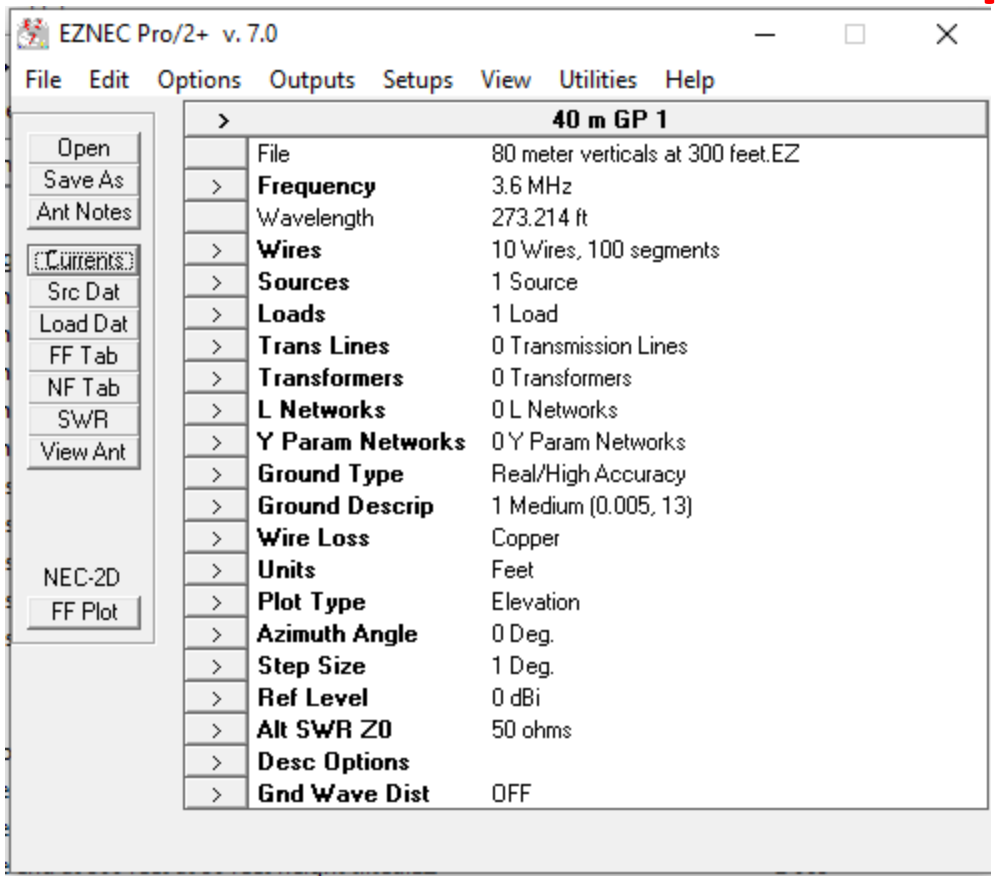
- Metal reflectors such as metal buildings
  - ARA Field Day site includes several metal buildings
  - Isolation was considerably less than in an open field
- Uneven ground, trees,…
- Adjustment of Inverted vee legs can significantly improve isolation
  - ARA adjusted inverted vee legs on phone antennas to improve isolation with CW verticals
  - 50 to 60 dB of isolation was achieved with adjustments which is short of the 70 dB goal (close to 70 dB was achieved for tests in an open field)
- An open flat field site is best for good antenna isolation for Field Day

Get Started on Field Day EZNEC Studies by Loading examples from www.ka2c.com/eznec-studies/



Field Day antenna isolation examples include: dipoles, inverted vees, verticals and A3S Yagis

80 Meter Verticals Spaced 300 feet



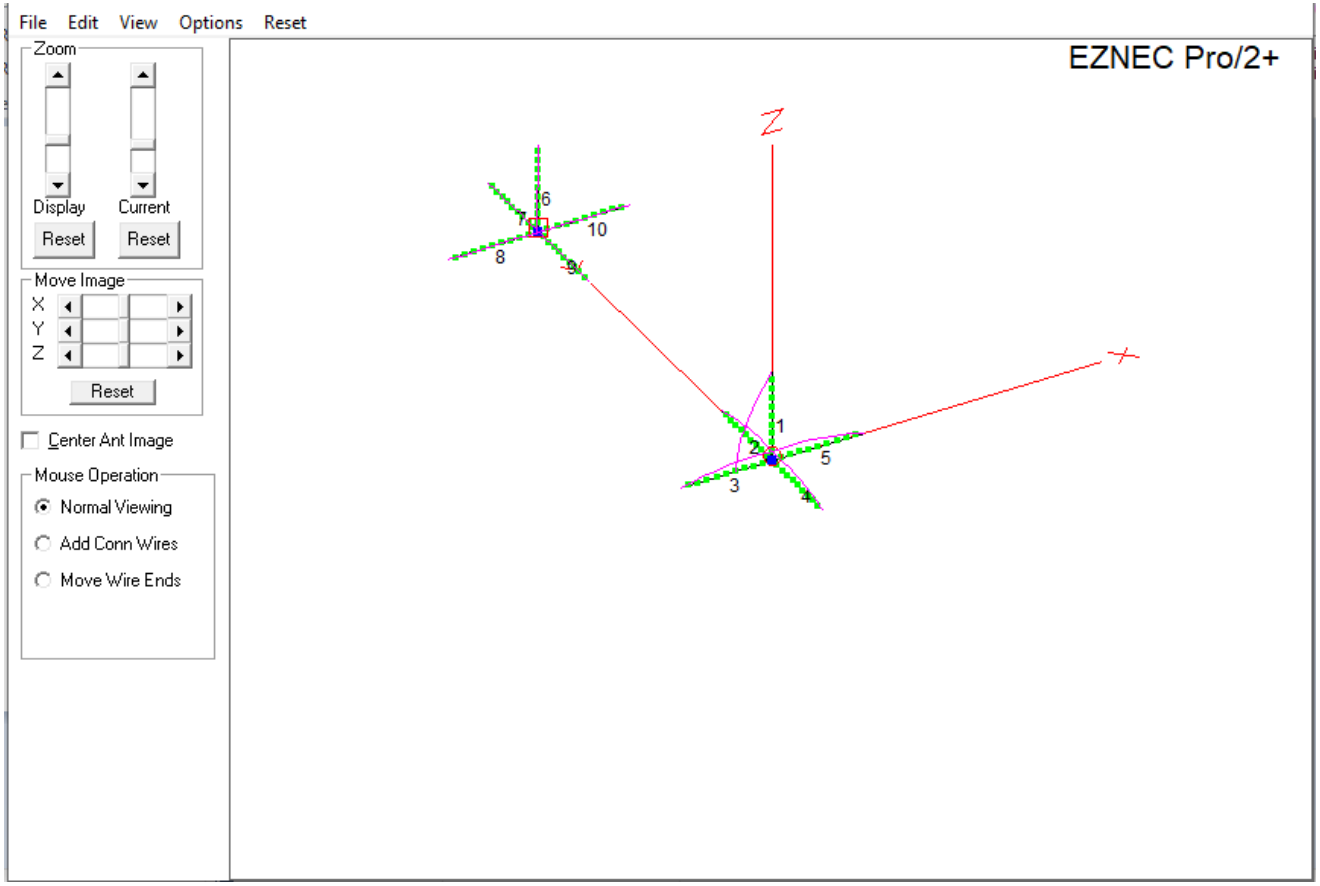
1 source or TX signal
on the TX antenna
at 1 Amp and 50 Ohms

1 load of 50 Ohms
on the victim antenna
– current there is used
to determine isolation

Frequency is set to 3.6 MHz

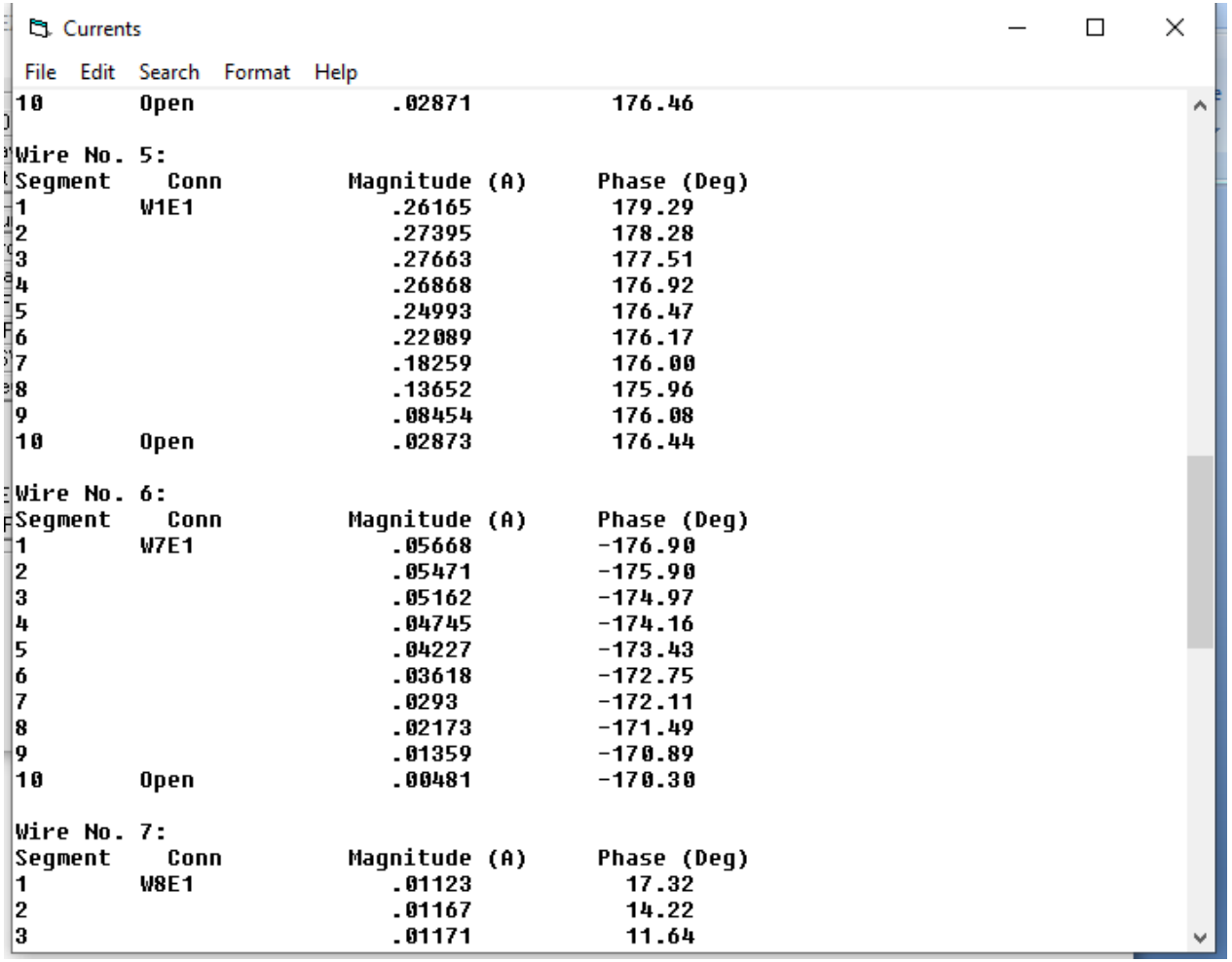
Move Antennas by opening “wires”
Then open “wire”
-“Move Wires XYZ” can move an entire antenna
-“Rotate Wires” can rotate an entire antenna
- Individual wires can be shortened, moved,…..

“View Ant”



Examine the antenna wires visually to help confirm correct definitions. Sources and loads can be seen as well as the wires.

Reading Isolation Results



Currents

File Edit Search Format Help

```
10        Open              .02871          176.46

Wire No. 5:
Segment     Conn          Magnitude (A)     Phase (Deg)
1         W1E1              .26165          179.29
2                           .27395          178.28
3                           .27663          177.51
4                           .26868          176.92
5                           .24993          176.47
6                           .22089          176.17
7                           .18259          176.00
8                           .13652          175.96
9                           .08454          176.08
10        Open              .02873          176.44

Wire No. 6:
Segment     Conn          Magnitude (A)     Phase (Deg)
1         W7E1              .05668         -176.90
2                           .05471         -175.90
3                           .05162         -174.97
4                           .04745         -174.16
5                           .04227         -173.43
6                           .03618         -172.75
7                           .0293          -172.11
8                           .02173         -171.49
9                           .01359         -170.89
10        Open              .00481         -170.30

Wire No. 7:
Segment     Conn          Magnitude (A)     Phase (Deg)
1         W8E1              .01123           17.32
2                           .01167           14.22
3                           .01171           11.64
```

TX vertical is wire 1
4 radial wires 2-5

Victim vertical is wire 6
4 radial wires 7-10

TX current at wire 1
is 1 Amp - each 1 of
4 radials carry ¼ of the
TX current or 0.25 Amp

Victim vertical current
in wire 6 is .05668 Amp

Isolation is about 26 dB

EZNEC and AutoEZ

- Download and install EZNEC and AutoEZ
- See presentations/videos/web-pages/manuals on usage
- Many sample antennas available from ARRL on the Internet and with the Antenna Handbook
  - Define active antenna
  - Define victim antennas
- Isolation is determined from the current in the victim antenna at the load (typically 50 Ohms)
- Launch EZNEC and then AutoEZ with macros enabled
- Examples and details on procedures for antenna isolation modeling found at: www.ka2c.com/field-day-interference/
- Basic knowledge of antennas needed
- Basic usage of Excel needed with AutoEZ

Conclusions

- EZNEC and AutoEZ are great tools to model antenna systems for Field Day for good performance and isolation
- Managing and eliminating Field Day interference is a multiple faceted problem with antenna isolation playing a key role
- Non-ideal/uniform RF environment will limit isolation achieved by antenna orientation
- Same band filters can compensate for limits on antenna isolation
- Field Day operation without phone/CW/digital interference is a pleasure

References/Resources

- https://www.eznec.com/
- https://www.ac6la.com/autoez.html
- http://www.ka2c.com/field-day-interference/
- Mitigating Field Day Multistation Interference -- Part 1 & 2, Milliken, Barrett, KC9CHG and Toman, Tim, N9TO, Sept & Nov 2010 – NCJ
- https://www.kkn.net/dayton2009/W3AO_2009.pdf
- https://www.kkn.net/dayton2009/Dayton_FD_W2RDX.pdf
- https://www.contestuniversity.com/wp-content/uploads/2021/05/Transceiver-Performance-for-the-HF-Contest-and-DX-Operator-CTU-2021-NC0B.pdf
- Grounding and Bonding for the Radio Amateur, H. Ward Silver - N0AX, ARRL
- Filters for Separating Same-Band Signals, Nov 2021, NCJ
- Field Day Interference Management, May 2022, NCJ