

We didn't start the fire

It was always burning Since the world's been turning

We didn't start the fire

No we didn't light it But we tried to fight it

Billy Joel - 1989

Effective Utilization of FT8 & MSK 144 for 6 Meter DX & Contesting

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Six Meter BBQ 2018
Austin, TX

First Some Rules About Rules

- We're not going to discuss or debate DXCC or contest rules. They are what they are....we follow them or change them
- We're not going to debate FT8 as a mode compared to CW, SSB, AM, Spark or two cans on a string
 - We will discuss how to implement it into an effective DX or contest strategy
- FT8 is simply a "Disruptive Technology"!

Disruptive Technology

- Technology that is new and constantly innovating that initially appeals to only a small group
- It disrupts by creating new users and challenging existing technology
- Examples
 - Email & social media transformed the way we communicate
 - Cell phones disrupted the telecom industry
 - Notebook computers & tablets created a mobile workforce
 - FT8 has transformed amateur digital communications

The “JT” Software Suite

- Is a FREE open source software
- Continues to evolve and improve (with no upgrade fee!!!)
- Enhanced the amateur radio experience of thousands
- Contains several digital modes
 - FT8, MSK144 and JT65 are the most popular
 - Let's discuss FT8 and MSK144

FT8

- Compared to the other so called *slow modes* (JT-65) FT8 is a few dB less sensitive but allows completion of QSO's four times faster
- Bandwidth is about $\frac{1}{4}$ of JT65
- Compared with *fast* digital modes FT8 is significantly more sensitive with a smaller bandwidth
- Offers multi-decoding over the full displayed passband

FT8

- T/R sequence is 15 seconds
- Message length is 75 bits + 12 bit CRC
- Modulation is 8-FSK, keying rate equals tone spacing of 6.25 Hz
- Occupied bandwidth is 50 Hz

MSK144

- Improved version of original FSK144
- MSK = Minimum Shift Keying
- Message frames of 144 bits & Modulation tone frequencies of 1000 Hz and 2000 Hz with a keying rate of 2000 baud
- [http://www.arrl.org/files/file/QEX_Next_Issue/SeptOct2017/Franke Taylor.pdf](http://www.arrl.org/files/file/QEX_Next_Issue/SeptOct2017/Franke_Taylor.pdf)

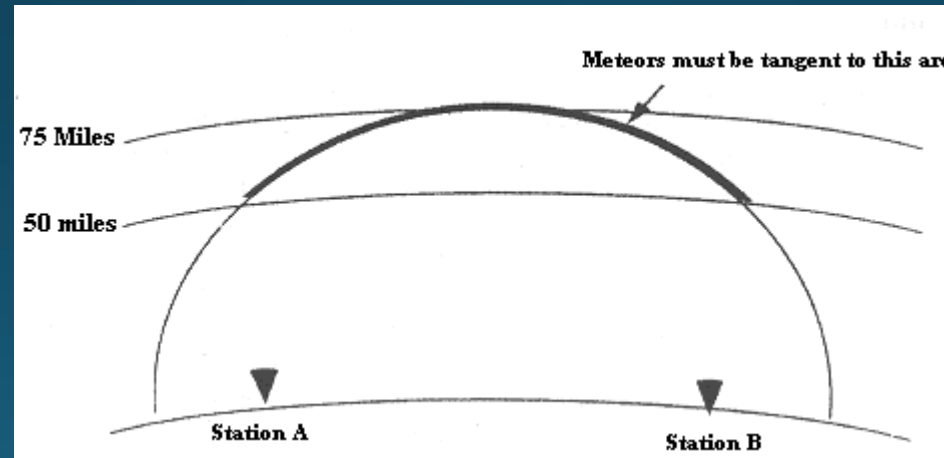
Meteor Scatter

- Meteor scatter is the reflection of radio waves from the ionized trails from meteors & space debris burning up in the upper atmosphere.
- The length of time of the ionization, or burst duration, is related to meteor velocity. An increase in relative velocity results in longer ionization times.
- Excellent for 6 meters & QSOs up to about 1,400 miles are possible and common
- Very Predictable Paths - Best times between midnight & approx. 9 AM

What Causes a “Meteor” Event?

- The earth is bombarded by a constant stream of small particles, that burn up and ionize a column of atoms in the E region at approximately 60 miles above the surface of the earth.

Reflection will occur when the trail is oriented as shown



What Causes a “Meteor” Event?

- Most particles entering the earth’s atmosphere are the size of a grain of sand resulting in ionization lasting only a fraction of a second
 - Too short to convey meaningful information via SSB or high speed CW.
- The digital modes of FSK₄₄₁ and MSK₁₄₄ were designed to compress a limited amount of information in a packet and transmit that packet in a very short period of time.
 - An MSK₁₄₄ the information packet has a transmission length 0.072 seconds and is repeated over and over again during the duration of the selected transmit interval of 5, 10, 15 or 30 seconds.

Meteor Scatter – The “*Old*” Days

- Used SSB with 15 Second sequences
- One station would run 1st & 3rd sequence, other station 2nd & 4th
- K5AND W5ZN K5AND W5ZN K5AND W5ZN
- K5AND W5ZN S2 K5AND W5ZN S2 K5AND W5ZN S2
- Roger S2 Roger S2 Roger S2 Roger S2
- Roger roger roger roger roger roger
- 73 73 73 73 73 73 73 73 73 73 73 73 73

Meteor Scatter – Coming of Age!

Original JT “FSK441” MS Mode

The screenshot displays the WSJT 6 software interface, titled "WSJT 6 by K1JT". The interface includes a menu bar (File, Setup, View, Mode, Decode, Save, Band, Help) and a main display area. The top part of the display shows a waterfall plot with a prominent signal at 11:04:00. Below the waterfall plot, a table displays the following data:

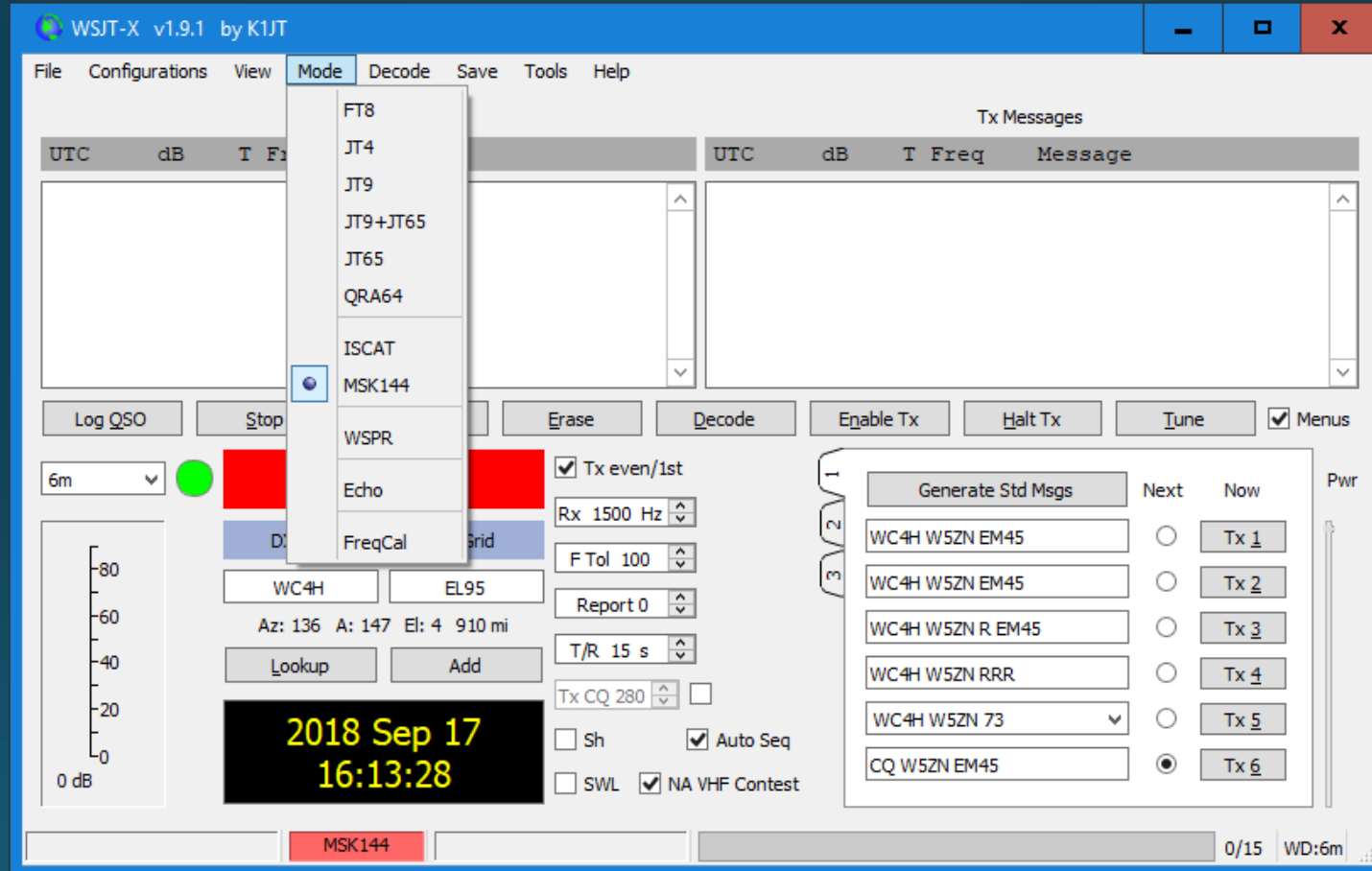
FileID	T	Width	dB	Rpt	DF	Time (s)	W8WVN_010809_110400	1	2	3
110400	18.5	780	10	26	-150	ZS0 TNX QSO TNX QSO TNX QSO TNX QSO TNX				

Below the table, there are several control buttons: Log QSO, Stop, Monitor, Save, Decode, Erase, Clear Avg, Include, Exclude, and TxStop. The interface also features a "To radio:" field with "W8WVN" and a "Grid:" field with "EM77bq". A digital clock displays "2006 Jul 31 18:33:36". The bottom status bar shows "1.0000 1.0000 FSK441 Freeze DF: 0 Rx noise: -2 dB TR Period: 30 s" and a "Receiving" indicator.

Meteor Scatter – Coming of Age!

- Focused toward contest style operation that include:
 - a machine human interface that facilitates rapid population of QSO specific information
 - shorter TX and RX periods than FSK₄₄₁
 - auto sequencing that reduces human error and improves operator efficiency important considerations during contest operation

The New "JT" Software Suite



The New "JT" Software Suite

The screenshot displays the WSJT-X v1.9.1 software interface. The window title is "WSJT-X v1.9.1 by K1JT". The menu bar includes File, Configurations, View, Mode, Decode, Save, Tools, and Help. The interface is divided into several sections:

- Band Activity:** A table with columns UTC, dB, T Freq, and Message.
- Tx Messages:** A table with columns UTC, dB, T Freq, and Message.
- Control Buttons:** Log QSO, Stop, Monitor, Erase, Decode, Enable Tx, Halt Tx, Tune, and a checked Menus button.
- Frequency and Mode:** A dropdown menu set to "6m" and a green status indicator.
- Frequency Display:** A large red box showing "50.313 000".
- DX Call and Grid:** Fields for "WC4H" and "EL95".
- Location Data:** "Az: 136 A: 147 El: 4 910 mi".
- Lookup and Add:** Buttons for "Lookup" and "Add".
- Time Display:** A black box with yellow text showing "2018 Sep 17 16:14:00".
- Transmission Settings:** Checkboxes for "Tx even/1st", "Sh", "SWL", "Auto Seq", and "NA VHF Contest".
- Message Queue:** A list of messages with "Next" and "Now" columns. The "Now" column contains "Tx 1" through "Tx 6".
- Power and Status:** A "Pwr" slider and a status bar at the bottom showing "MSK144", "0/15", and "WD:5m".

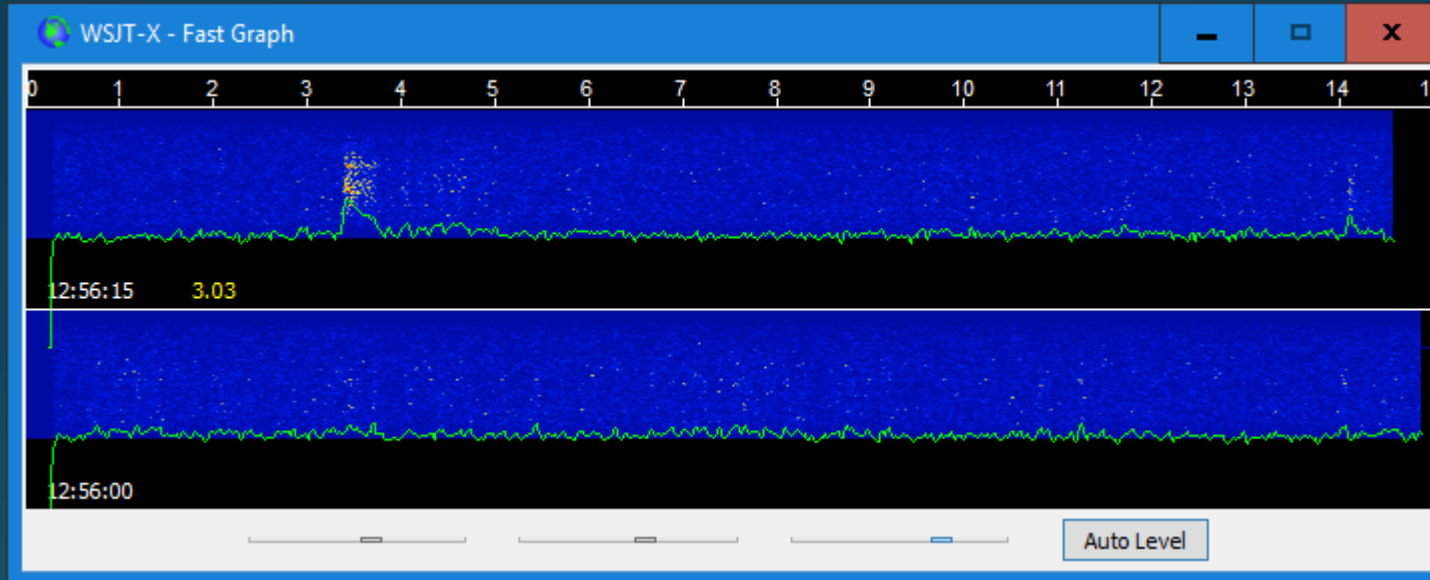
The New "JT" Software Suite

The screenshot displays the WSJT-X v1.9.1 software interface. At the top, the title bar reads "WSJT-X v1.9.1 by K1JT". Below it is a menu bar with options: File, Configurations, View, Mode, Decode, Save, Tools, Help.

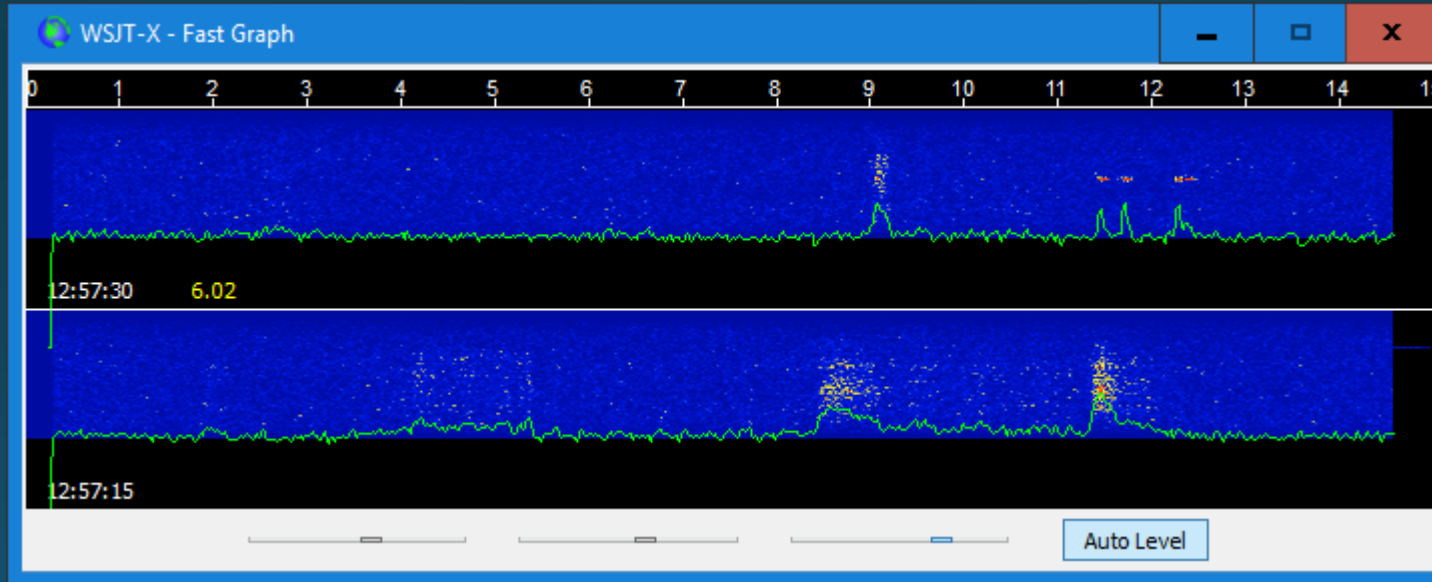
The main interface is divided into several sections:

- Band Activity:** A table with columns for UTC, dB, T, Freq, and Message. It lists several entries for K7CA AGON DN81 and K7CA AGON R-01.
- Tx Messages:** A table with columns for UTC, dB, T, Freq, and Message, currently empty.
- Control Panel:** Includes buttons for Log QSO, Stop, Monitor (highlighted in green), Erase, Decode, Enable Tx, Halt Tx, and Tune. A "Menus" checkbox is checked.
- Frequency and Mode:** Shows "6m" mode and a frequency of "50.260 000" in a red box. A green indicator light is on.
- Antenna and Azimuth:** Shows "WC4H" DX Call and "EL95" DX Grid. Azimuth is 136, Elevation is 147, distance is 910 mi.
- Transmit Settings:** Includes "Tx even/1st" (checked), "Rx 1500 Hz", "F Tol 100", "Report 0", "T/R 15 s", "Tx CQ 280", "Sh" (unchecked), "Auto Seq" (checked), "SWL" (unchecked), and "NA VHF Contest" (checked).
- Message Queue:** A list of messages with "Next" and "Now" buttons. The "Now" column has buttons labeled "Tx 1" through "Tx 6". The selected message is "CQ W5ZN EM45".
- Power and Status:** A power meter on the left shows "27 dB". A status bar at the bottom shows "Receiving 11%", "MSK144", and "8/15 WD:6m".

MSK144 "Fast Graph"



MSK144 "Fast Graph"



MSK144

WSJT-X v1.9.1 by K1JT

File Configurations View Mode Decode Save Tools Help

Band Activity

UTC	dB	T	Freq	Message
125695	0	1.1	1439	& K7CA AGON R+00
125715	1	4.2	1448	& CQ N5TM EL29
125715	3	8.6	1447	& K7CA AGON R+00
125715	5	11.5	1444	& K7CA AGON R+00
125715	6	11.5	1444	& K7CA AGON R+00
125730	4	9.1	1449	& CQ K9VSW DM76
125745	3	4.3	1449	& K7CA AGON R+00

Tx Messages

UTC	dB	T	Freq	Message
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Log QSO Stop Monitor Erase Decode Enable Tx Halt Tx Tune Menus

6m ● **50.260 000** Tx even/1st
Rx 1500 Hz F Tol 100 Report 0 T/R 15 s Tx CQ 280 Sh Auto Seq SWL NA VHF Contest

DX Call: WC4H DX Grid: EL95
Az: 136 A: 147 El: 4 910 mi
Lookup Add

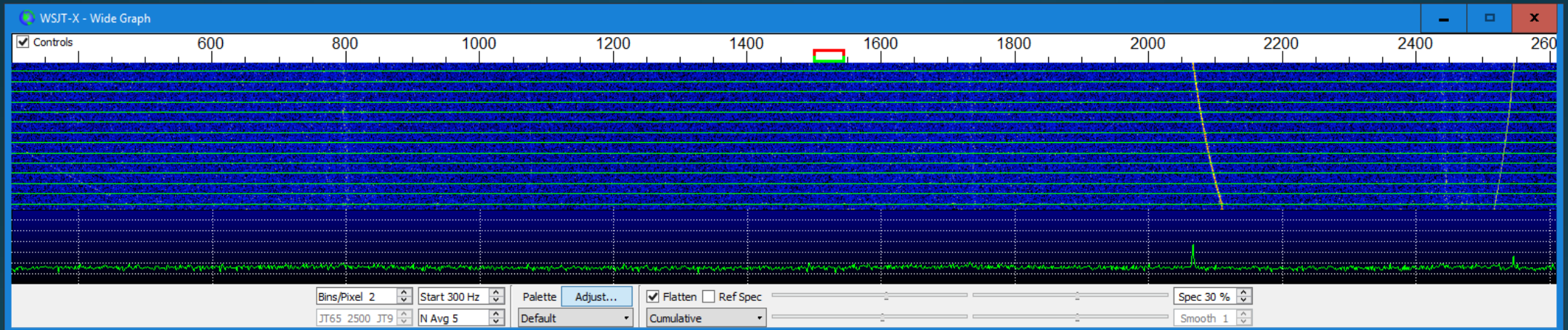
2018 Sep 01 12:58:00

Generate Std Msgs

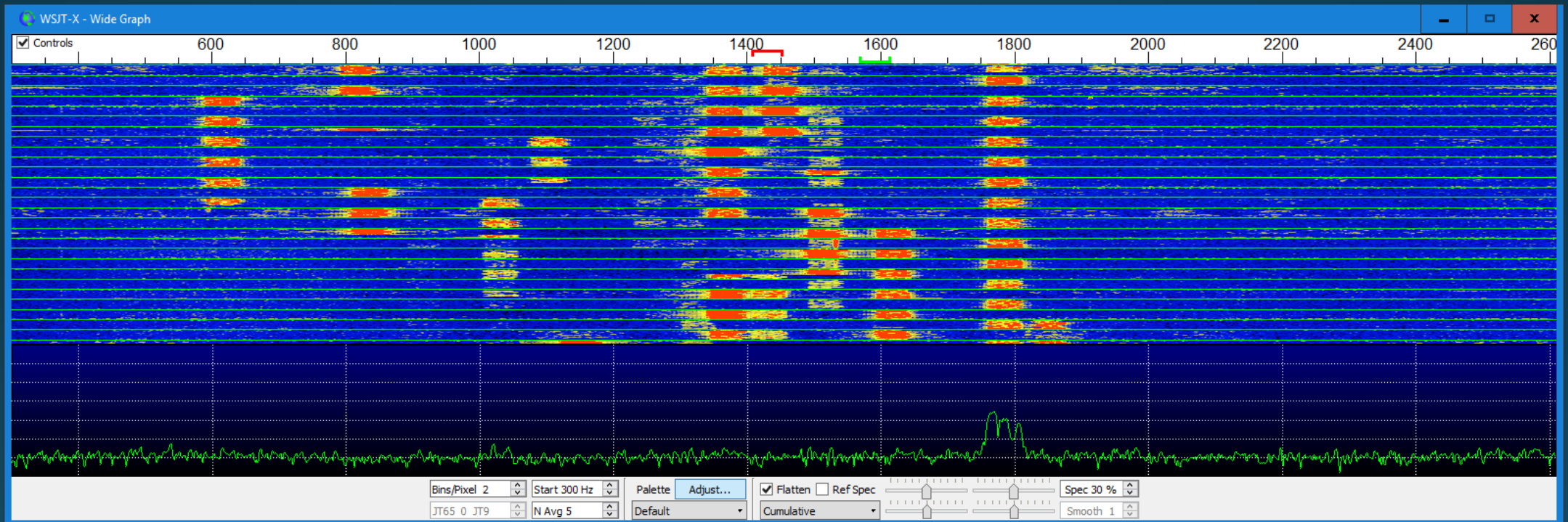
Next	Now
WC4H W5ZN EM45	<input type="radio"/> Tx 1
WC4H W5ZN EM45	<input type="radio"/> Tx 2
WC4H W5ZN R EM45	<input type="radio"/> Tx 3
WC4H W5ZN RRR	<input type="radio"/> Tx 4
WC4H W5ZN 73	<input type="radio"/> Tx 5
CQ W5ZN EM45	<input checked="" type="radio"/> Tx 6

Receiving 5% MSK144 0/15 WD:6m

FT8's "Wide Graph"



FT8's "Wide Graph"



FT8 Decoded Signals

WSJT-X v1.8.0 by K1JT

File Configurations View Mode Decode Save Tools Help

Band Activity

UTC	dB	DT	Freq	Message
005545	1	0.2	1764	~ AA0MZ N8NM -12
005545	6	-0.2	1105	~ CQ K6EID EM73
005545	0	-0.1	1404	~ 7 BND TNX 73
005545	-4	0.1	1496	~ OK7GU WX4G 73
005600	-6	0.1	921	~ M0HVU W1UJ FN42
005600	4	0.5	992	~ CQ AA7A DM52
005600	1	0.2	1315	~ N8NM AA0MZ R+05
005600	-2	0.4	1411	~ KB8OTK N2ADV 73

Rx Frequency

UTC	dB	DT	Freq	Message
005545	1	0.2	1764	~ AA0MZ N8NM -12
005600	4	0.5	992	~ CQ AA7A DM52
005628	Tx		992	~ AA7A W5ZN EM45

Log QSO Stop Monitor Erase Decode Enable Tx Halt Tx Tune Menus

60m **5.357 000** Tx even/1st

DX Call: AA7A DX Grid: DM52 Tx 992 Hz Rx 992 Hz Tx ← Rx Rx ← Tx

Az: 264 1693 km Hold Tx Freq

Lookup Add Report 4 Auto Seq Call 1st NA VHF Contest

2018 Apr 02 00:56:35

Generate Std Msgs

Next	Now
AA7A W5ZN EM45	<input checked="" type="radio"/> Tx 1
AA7A W5ZN +04	<input type="radio"/> Tx 2
AA7A W5ZN R+04	<input type="radio"/> Tx 3
AA7A W5ZN RRR	<input type="radio"/> Tx 4
AA7A W5ZN 73	<input type="radio"/> Tx 5
CQ W5ZN EM45	<input type="radio"/> Tx 6

Receiving FT8 Last Tx: AA7A W5ZN EM45 5/15 WD:6m

FT8 Decoded Signals

WSJT-X v1.8.0 by K1JT

File Configurations View Mode Decode Save Tools Help

Band Activity

UTC	dB	DT	Freq	Message
005630	-10	0.2	1648	~ CQ OK7GU JN69
005700	3	0.5	992	~ KB8OTK AA7A -01
005700	1	0.3	1411	~ CQ N2ADV FN23
005715	3	-0.1	986	~ AA7A KB8OTK R-15
005730	5	0.5	992	~ KB8OTK AA7A RR73
005730	-2	0.3	1411	~ CQ N2ADV FN23
005800	2	0.5	992	~ W5ZN AA7A +10
005800	2	0.4	1411	~ CQ N2ADV FN23

Rx Frequency

UTC	dB	DT	Freq	Message
005655	Tx		992	~ AA7A W5ZN EM45
005700	3	0.5	992	~ KB8OTK AA7A -01
005715	3	-0.1	986	~ AA7A KB8OTK R-15
005730	5	0.5	992	~ KB8OTK AA7A RR73
005746	Tx		992	~ AA7A W5ZN EM45
005800	2	0.5	992	~ W5ZN AA7A +10
005815	Tx		992	~ AA7A W5ZN R+02

Log QSO Stop Monitor Erase Decode Enable Tx Halt Tx Tune Menus

60m 5.357 000 Tx even/1st

DX Call AA7A DX Grid DM52 Tx 992 Hz Tx ← Rx Rx 992 Hz Rx ← Tx

Az: 264 1693 km Hold Tx Freq

Lookup Add Report 2 Auto Seq Call 1st NA VHF Contest

Generate Std Msgs Next Now Pwr

Message	Next	Now
AA7A W5ZN EM45	<input type="radio"/>	Tx 1
AA7A W5ZN +02	<input type="radio"/>	Tx 2
AA7A W5ZN R+02	<input checked="" type="radio"/>	Tx 3
AA7A W5ZN RRR	<input type="radio"/>	Tx 4
AA7A W5ZN 73	<input type="radio"/>	Tx 5
CQ W5ZN EM45	<input type="radio"/>	Tx 6

Tx: AA7A W5ZN R+02 FT8 Last Tx: AA7A W5ZN EM45 5/15 WD:6m

FT8 Decoded Signals

WSJT-X v1.8.0 by K1JT

File Configurations View Mode Decode Save Tools Help

Band Activity

UTC	dB	DT	Freq	Message
005700	1	0.3	1411	~ CQ N2ADV FN23
005715	3	-0.1	986	~ AA7A KB80TK R-15
005730	5	0.5	992	~ KB80TK AA7A RR73
005730	-2	0.3	1411	~ CQ N2ADV FN23
005800	2	0.5	992	~ W5ZN AA7A +10
005800	2	0.4	1411	~ CQ N2ADV FN23
005830	5	0.5	992	~ W5ZN AA7A RR73
005830	3	0.3	1411	~ CQ N2ADV FN23

Rx Frequency

UTC	dB	DT	Freq	Message
005715	3	-0.1	986	~ AA7A KB80TK R-15
005730	5	0.5	992	~ KB80TK AA7A RR73
005746	Tx		992	~ AA7A W5ZN EM45
005800	2	0.5	992	~ W5ZN AA7A +10
005815	Tx		992	~ AA7A W5ZN R+02
005830	5	0.5	992	~ W5ZN AA7A RR73
005845	Tx		992	~ AA7A W5ZN 73

Log QSO Stop Monitor Erase Decode Enable Tx Halt Tx Tune Menus

60m **5.357 000** Tx even/1st

DX Call: AA7A DX Grid: DM52 Tx 992 Hz Tx ← Rx Rx 992 Hz Rx ← Tx

Az: 264 1693 km Hold Tx Freq

Lookup Add Report 5 Auto Seq Call 1st NA VHF Contest

2018 Apr 02 00:58:45

Generate Std Msgs Next Now Pwr

AA7A W5ZN EM45	<input type="radio"/>	Tx 1
AA7A W5ZN +05	<input type="radio"/>	Tx 2
AA7A W5ZN R+05	<input type="radio"/>	Tx 3
AA7A W5ZN RRR	<input type="radio"/>	Tx 4
AA7A W5ZN 73	<input checked="" type="radio"/>	Tx 5
CQ W5ZN EM45	<input type="radio"/>	Tx 6

Tx: AA7A W5ZN 73 FT8 Last Tx: AA7A W5ZN R+02 0/15 WD:6m

6 Meter Applications

- Working DX on 6 meters
 - 4X, 9K2, S01, Tons of EU, JA, BY, HL
- VHF Contests
 - New stations are now on 6 meters - 12 in Arkansas alone
 - SO2R for 6 meters?

Single Operator 2 Radio

- Used for several years in HF contesting
- Some VHF contest multi-ops utilize two radios on one band
- Only a few Single Ops utilize it for VHF contesting on one band
 - Obviously a VHF operator must use more than one radio
- Basic principle is very simple:
 - Use one radio as a “run” radio to call CQ
 - Use a second radio to search for multipliers
- Not applicable to 144 MHz and up
- 50 MHz presents a golden opportunity for this technique

Single Operator 2 Radio



Single Operator 2 Radio

- Remember during VHF contests we can utilize any mode
 - Exception – FM Only category
- On 50 MHz we must now monitor a wide frequency range
 - CW starting at 50.080 MHz
 - SSB at 50.110 (50.125) MHz and up to above 50.200 MHz
 - And now FT8 at 50.313 MHz

First Some Basics

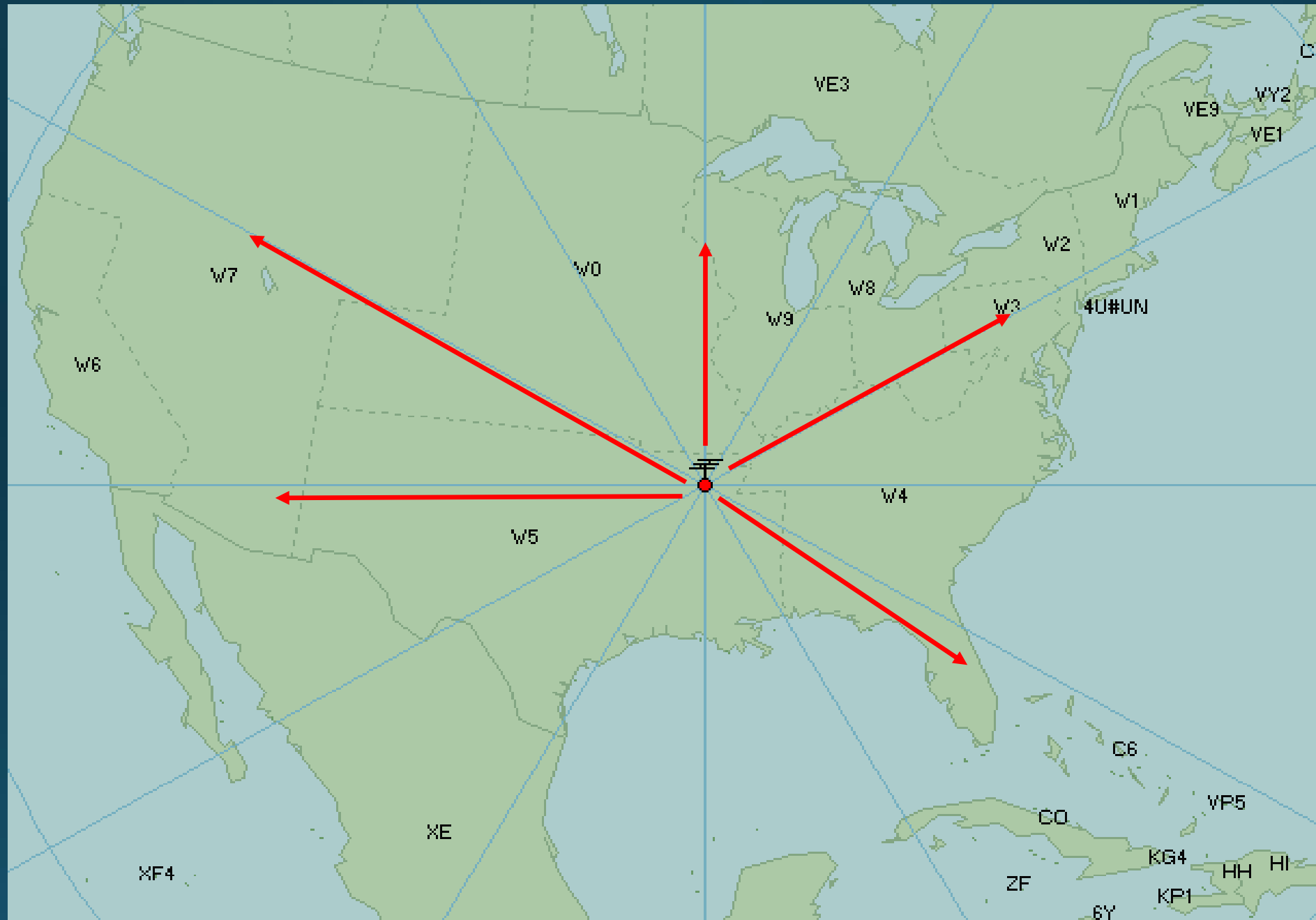
- “2 Radio is just that, 2 radios
 - Don’t have to be the same make/model, just need to cover 6 meters
- You will need a separate antenna
 - Or a way to feed your antenna system to two radios with proper interlocks
- Antennas is a topic within itself however some review is warranted

6 Meter Antenna Basics

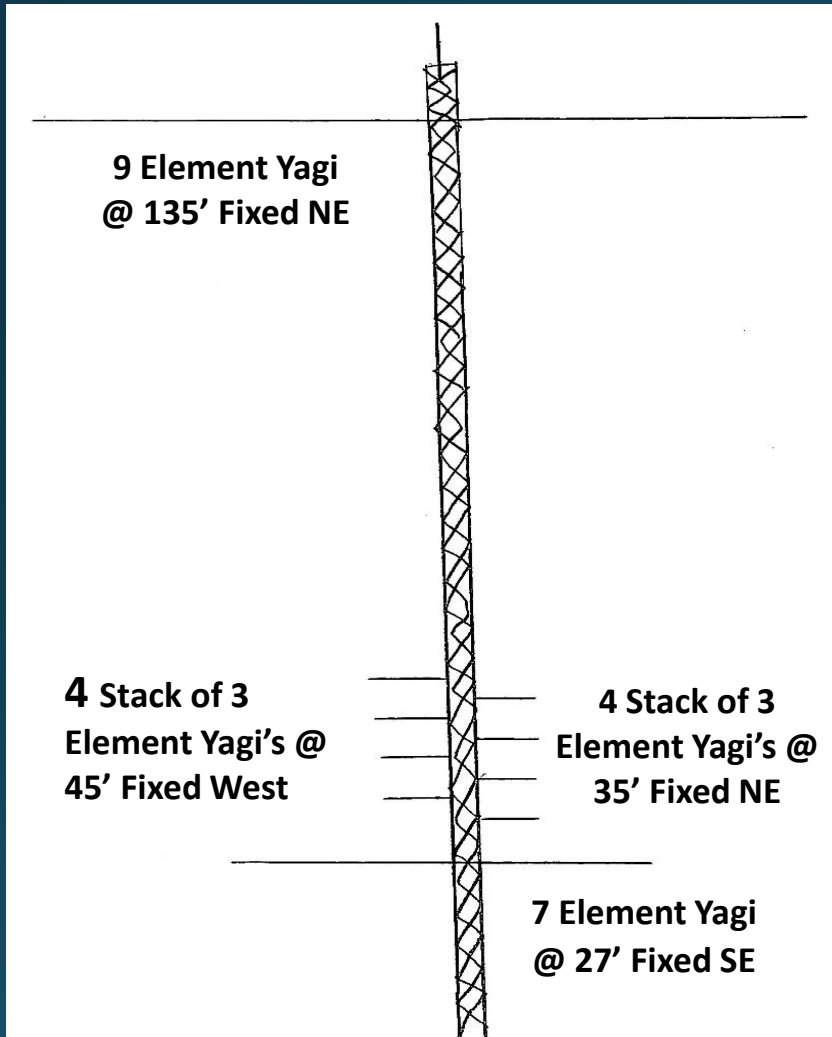
- Become familiar with the various propagation modes you will experience in a VHF contest
 - We'll focus on Sporadic E here
- The old amateur wives tale is "BIGGER and HIGHER is BETTER!!"
 - How do you know???
- An effective 6 meter antenna for Sporadic E only needs to be around 25 to 40 feet high, with 35 feet optimum for single hop E out to around 1,000 miles or so.
- 35 feet places the antenna around 1.5λ above the ground

6 Meter Antenna Basics

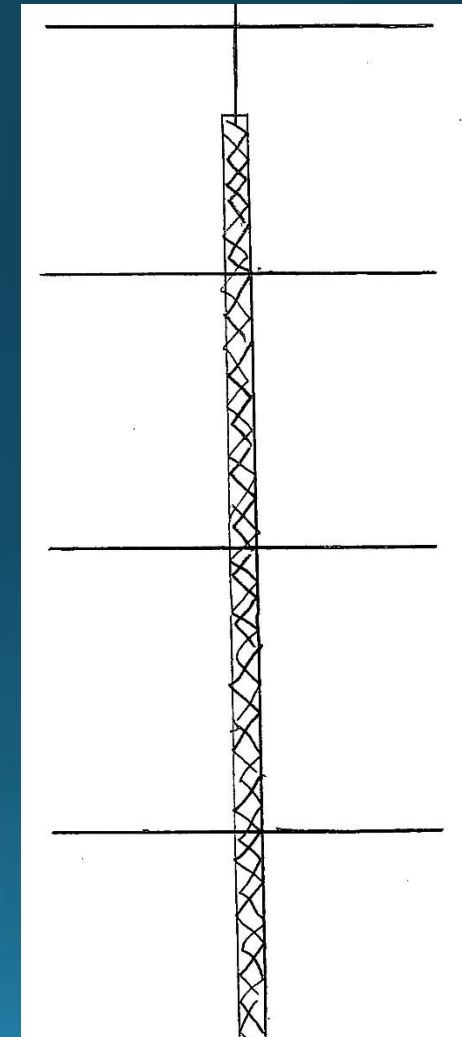
- You do NOT need a monster antenna with a 50 foot boom.
 - While you will have more gain you will have a very narrow beamwidth
- You will achieve outstanding results with a small Yagi at low height
- Better, use four 3 element antennas spaced around 10-12 feet and stacked vertically centered around 35 feet fixed toward a high QSO direction
 - Provides almost 70 degree E Plane beamwidth



W5ZN 50 MHz Antennas



200 ft

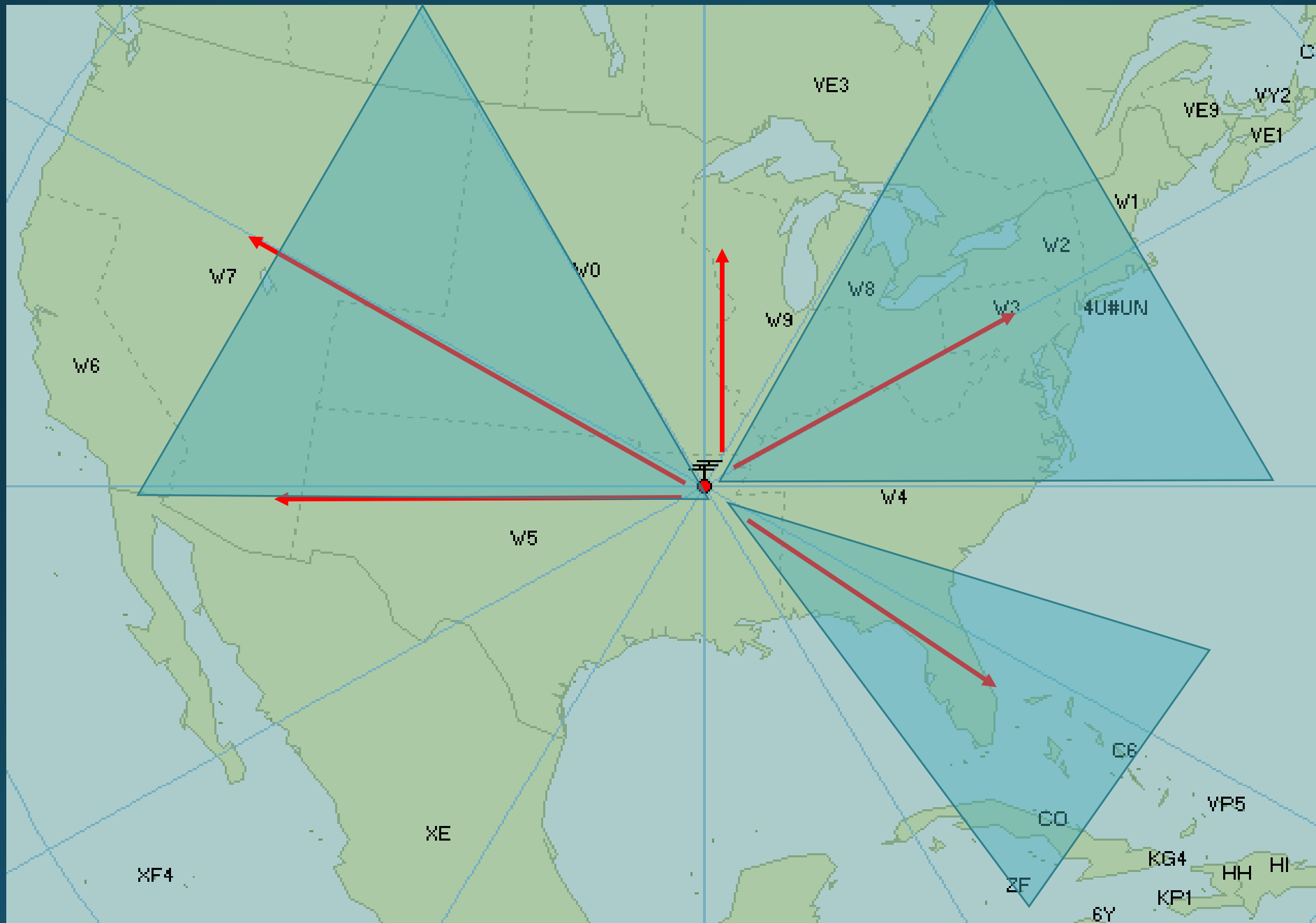


7 Element Yagi
@ 102' Rotatable

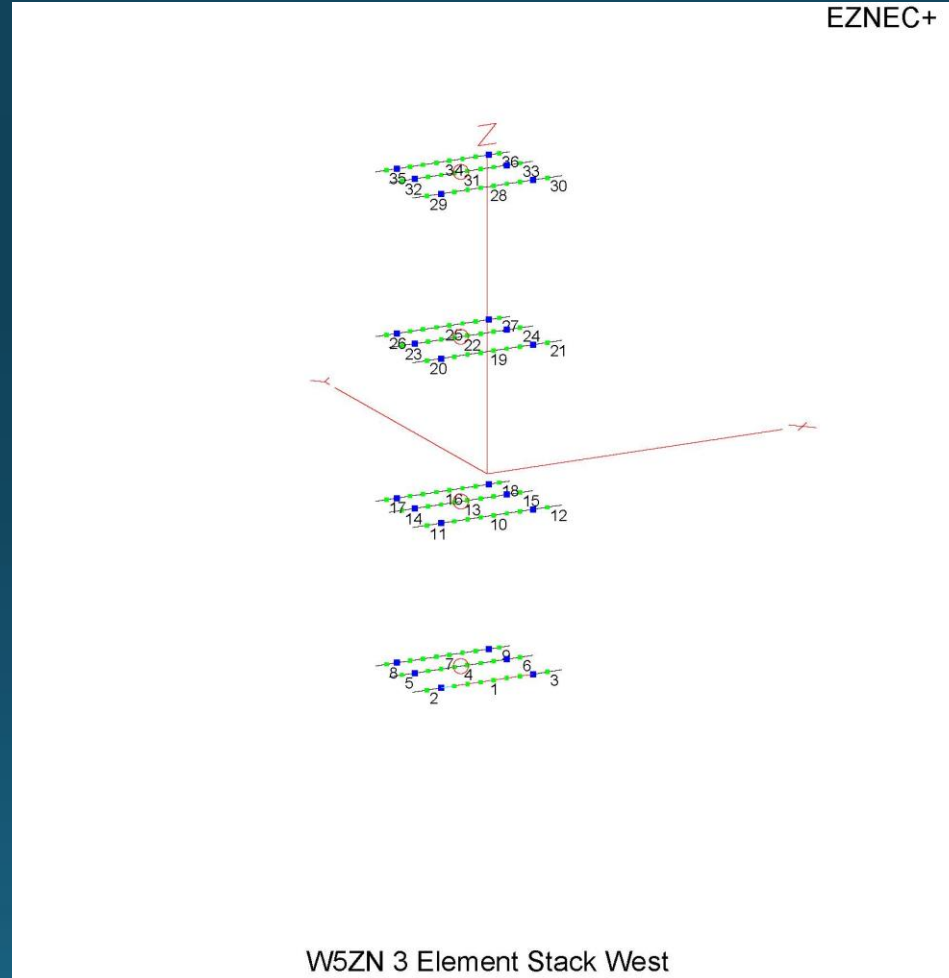
7 Element Yagi
@ 77' Rotatable

7 Element Yagi
@ 52' Rotatable

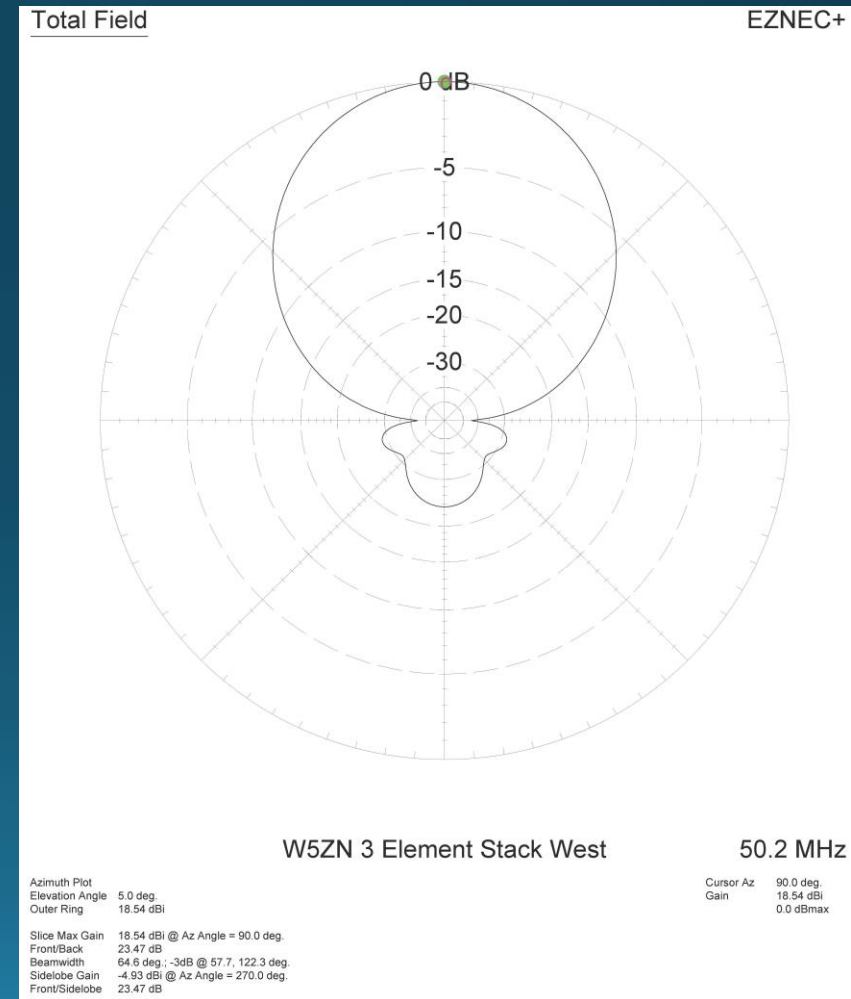
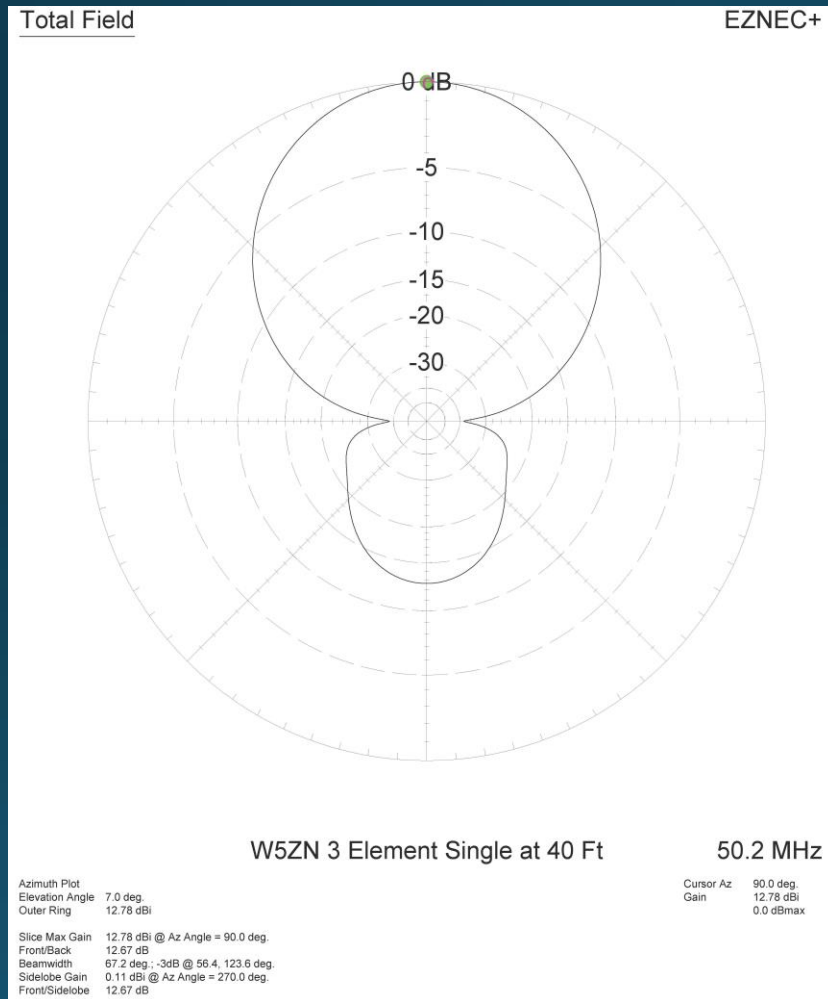
7 Element Yagi
@ 27' Fixed NE



Stack of Four 3 element Yagi's



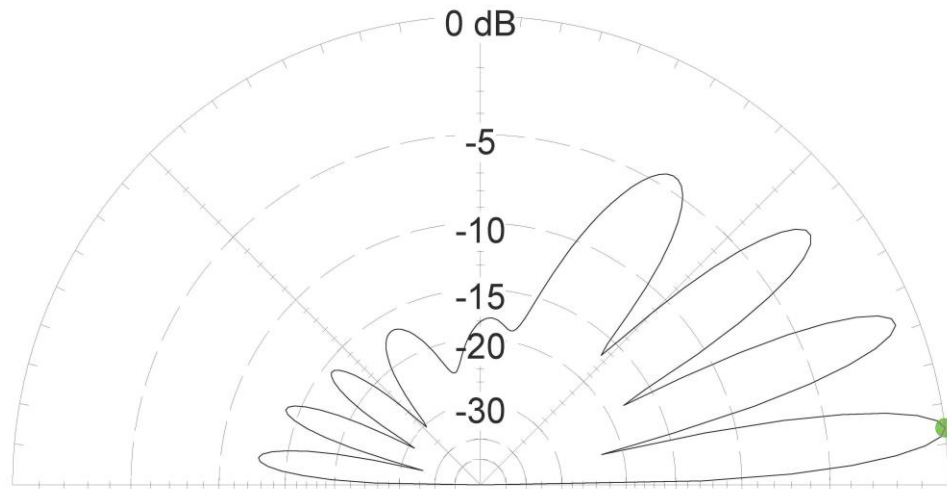
Single 3 element Yagi



Stack of Four 3 element Yagi's

Total Field

EZNEC+



W5ZN 3 Element Single at 40 Ft

50.2 MHz

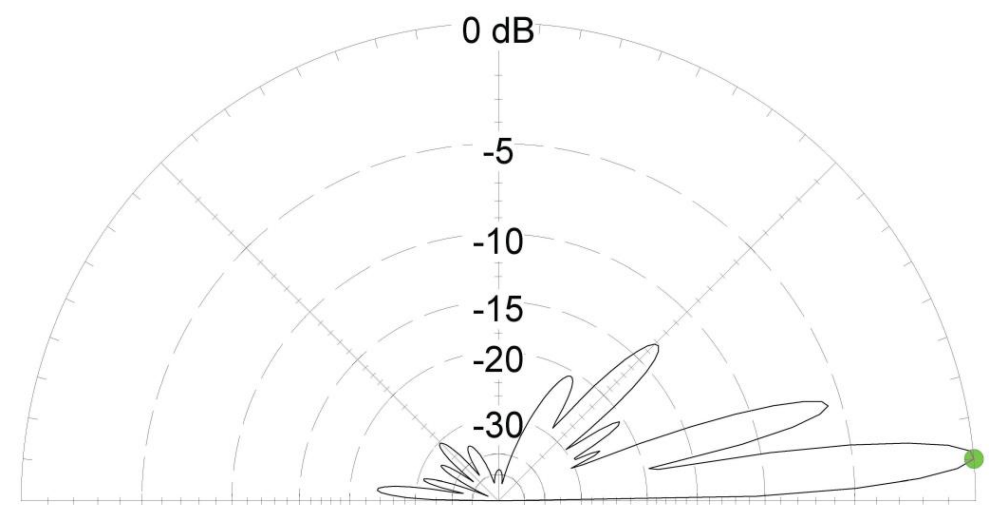
Elevation Plot
Azimuth Angle 90.0 deg.
Outer Ring 12.78 dBi

Cursor Elev 7.0 deg.
Gain 12.78 dBi
0.0 dBmax

Slice Max Gain 12.78 dBi @ Elev Angle = 7.0 deg.
Beamwidth 6.9 deg.; -3dB @ 3.5, 10.4 deg.
Sidelobe Gain 11.9 dBi @ Elev Angle = 21.0 deg.
Front/Sidelobe 0.88 dB

Total Field

EZNEC+



W5ZN 3 Element Stack West

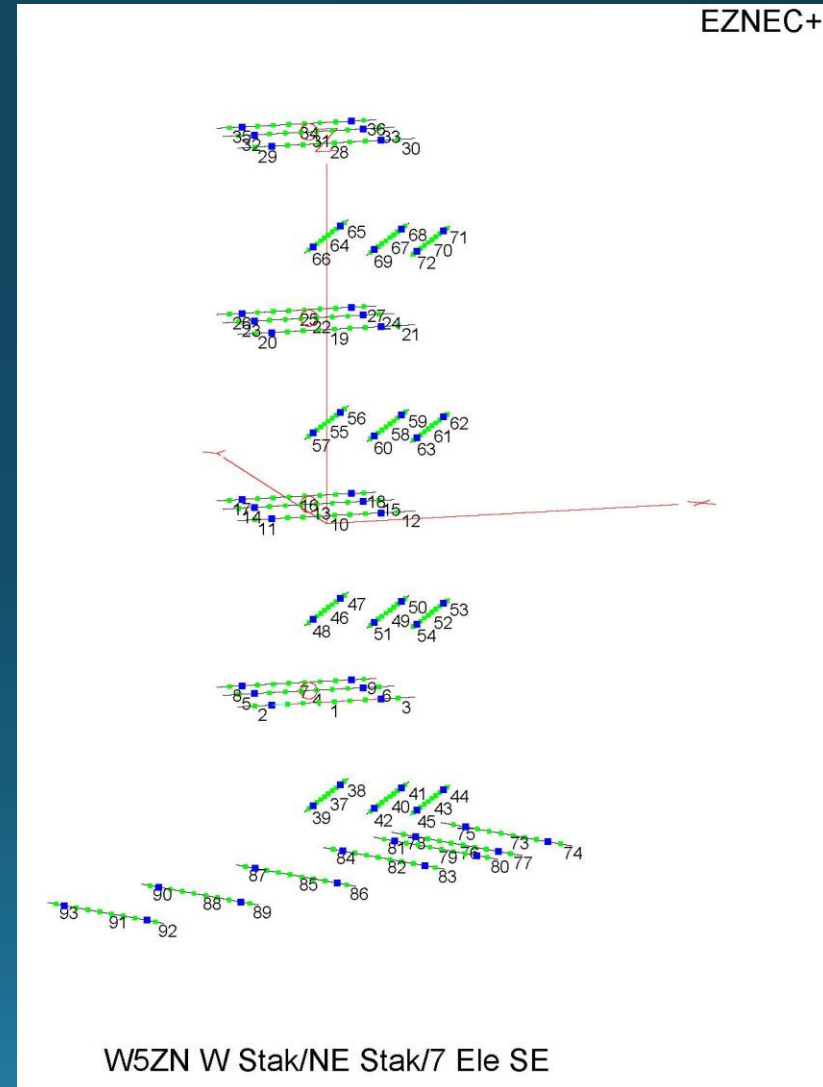
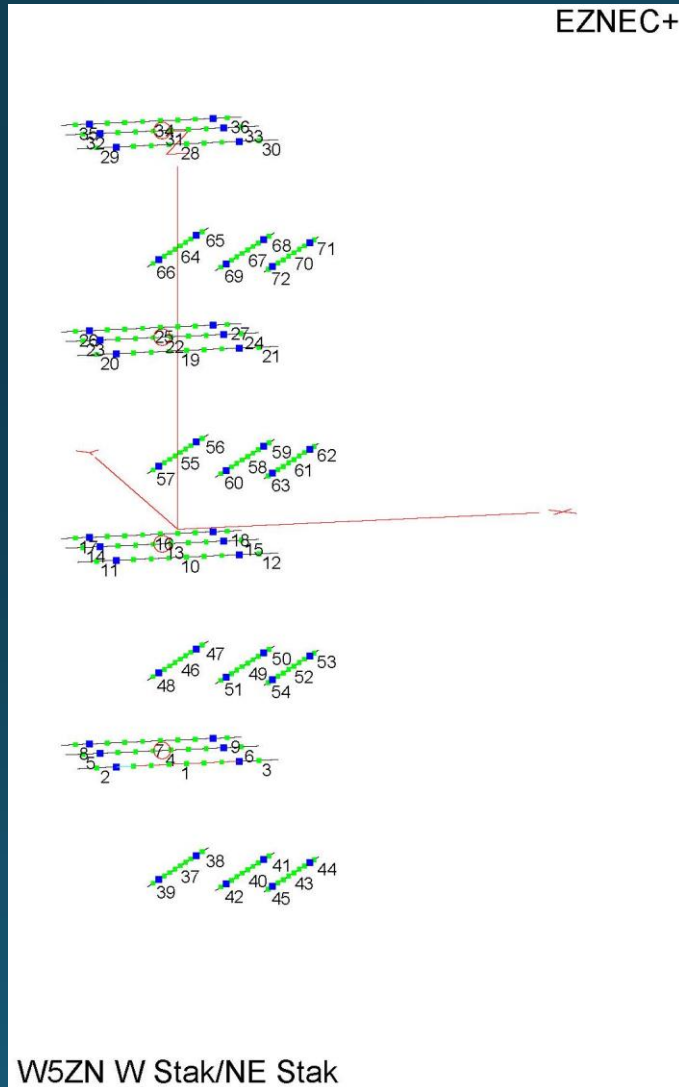
50.2 MHz

Elevation Plot
Azimuth Angle 90.0 deg.
Outer Ring 18.54 dBi

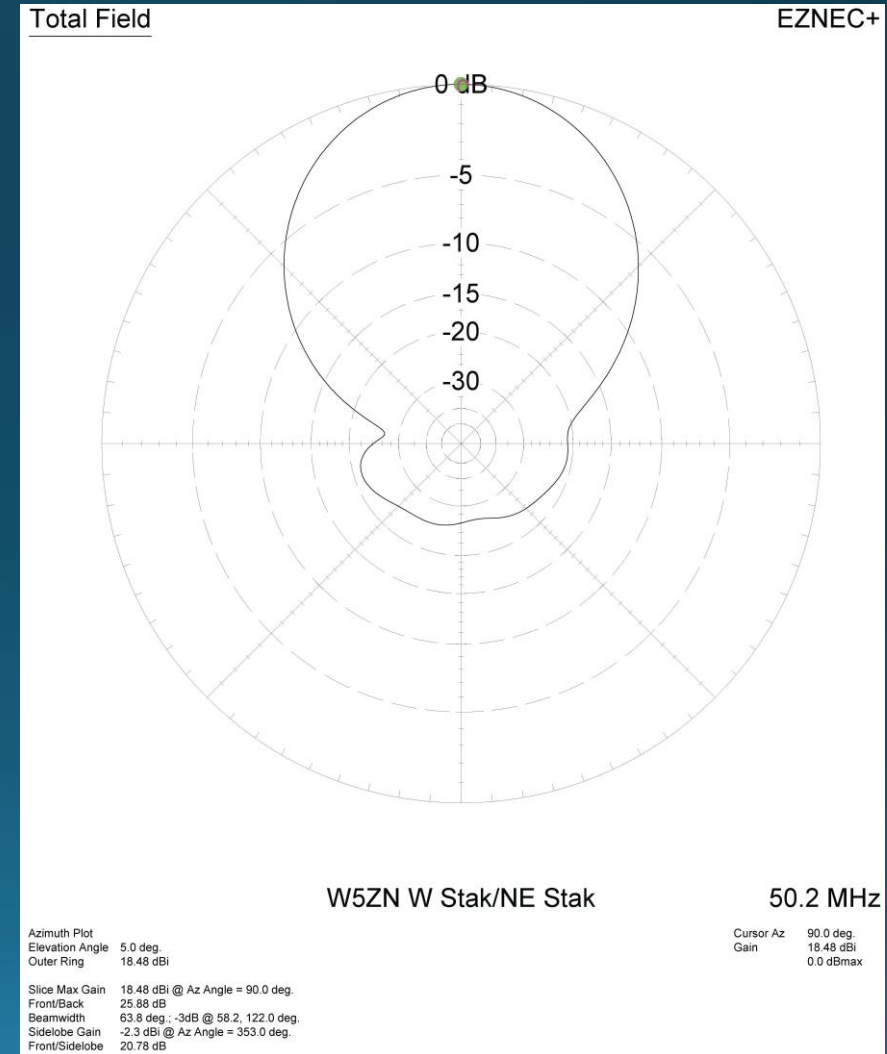
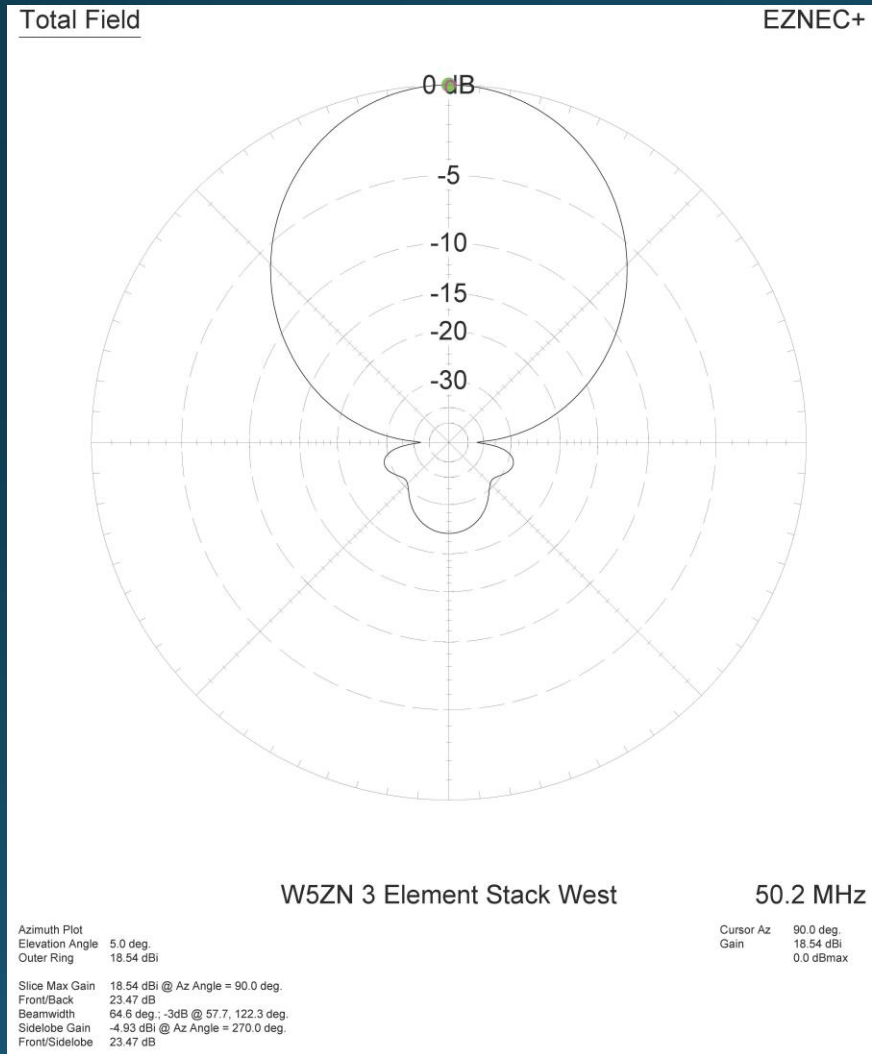
Cursor Elev 5.0 deg.
Gain 18.54 dBi
0.0 dBmax

Slice Max Gain 18.54 dBi @ Elev Angle = 5.0 deg.
Beamwidth 5.5 deg.; -3dB @ 2.7, 8.2 deg.
Sidelobe Gain 12.87 dBi @ Elev Angle = 16.0 deg.
Front/Sidelobe 5.67 dB

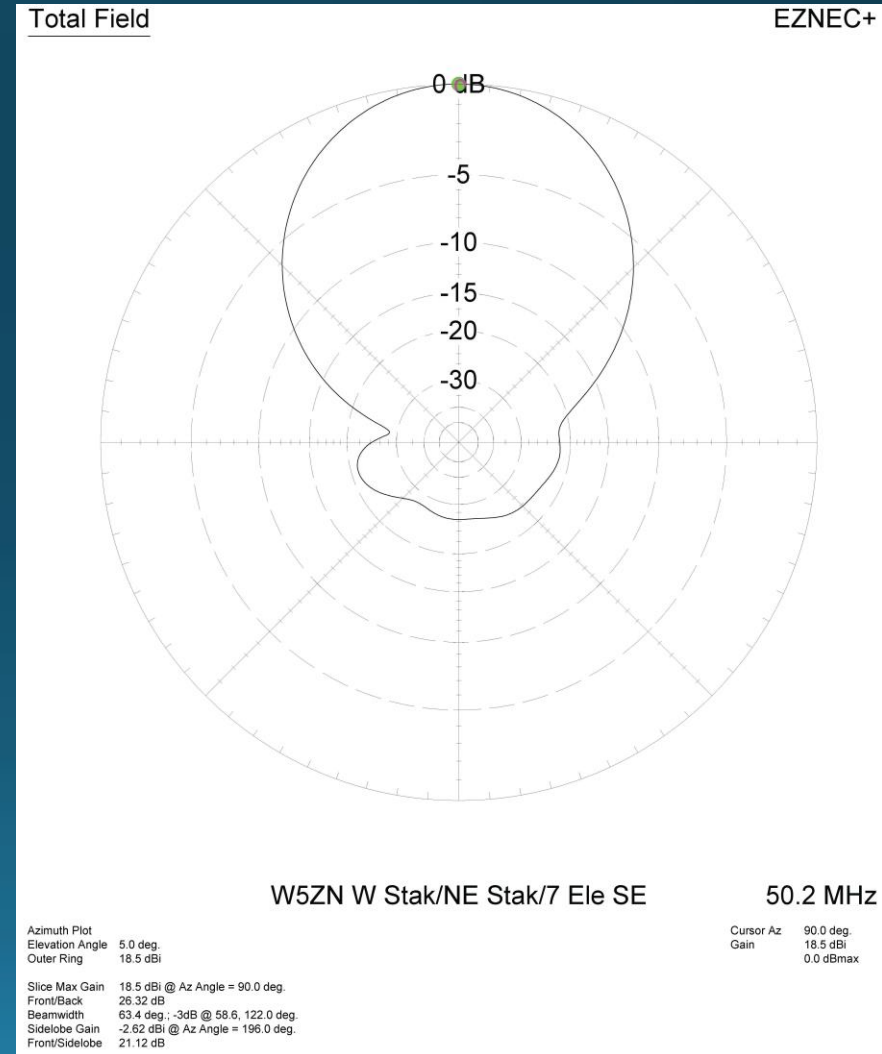
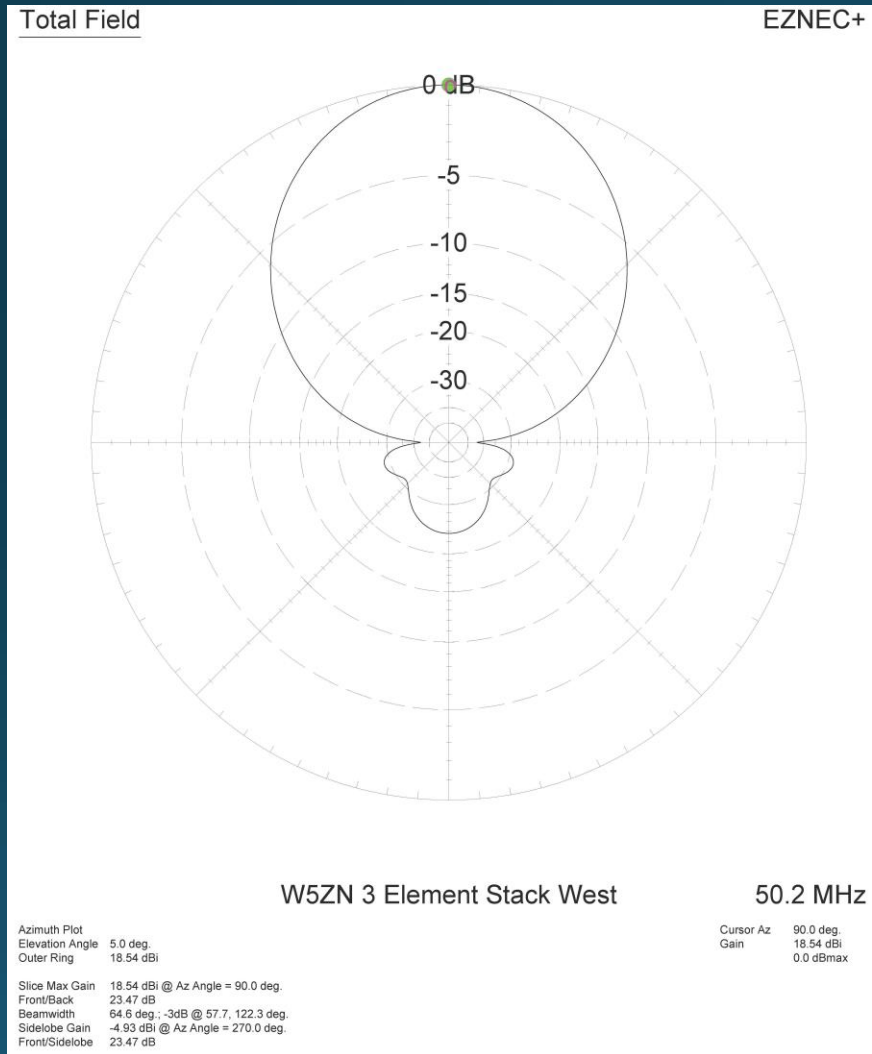
Stack of Four 3 element Yagi's



Stack of Four 3 element Yagi's



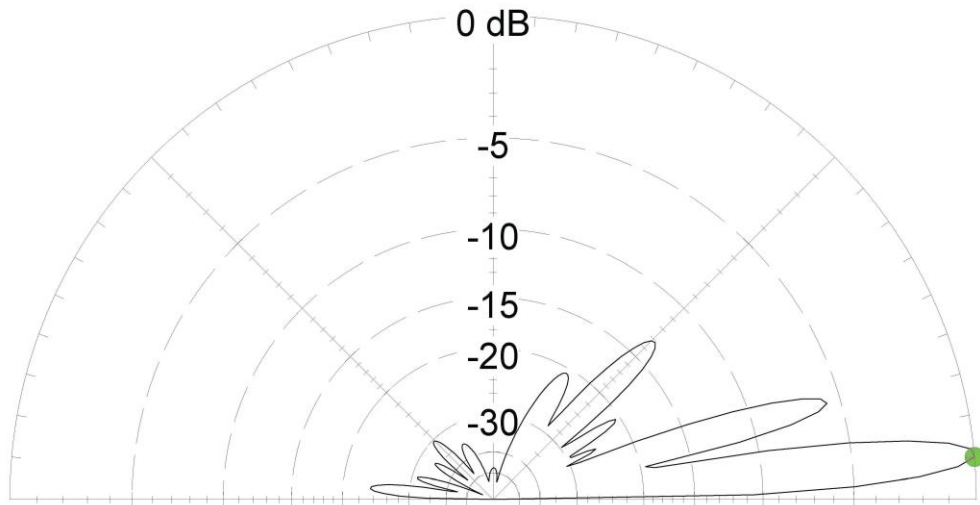
Stack of Four 3 element Yagi's



Stack of Four 3 element Yagi's

Total Field

EZNEC+



W5ZN 3 Element Stack West

50.2 MHz

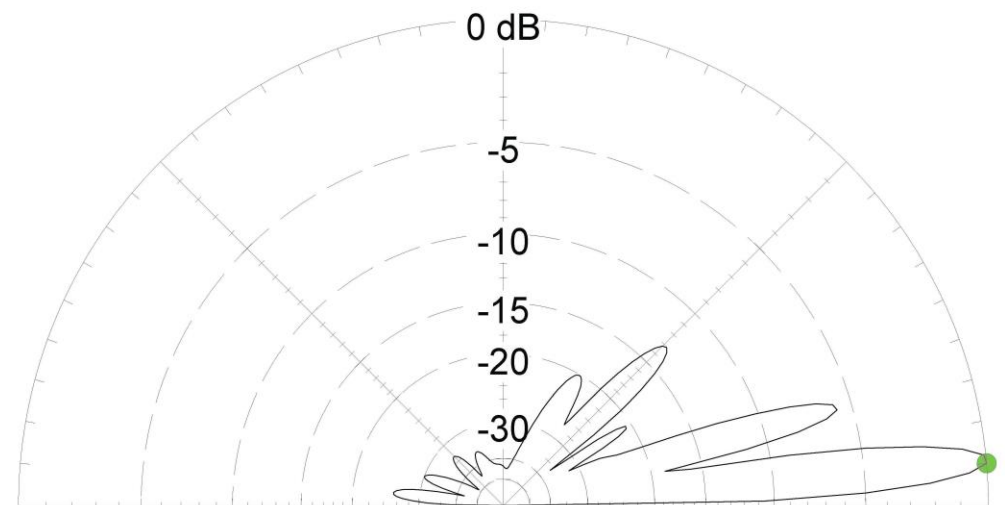
Elevation Plot
Azimuth Angle 90.0 deg.
Outer Ring 18.54 dBi

Cursor Elev 5.0 deg.
Gain 18.54 dBi
0.0 dBmax

Slice Max Gain 18.54 dBi @ Elev Angle = 5.0 deg.
Beamwidth 5.5 deg.; -3dB @ 2.7, 8.2 deg.
Sidelobe Gain 12.87 dBi @ Elev Angle = 16.0 deg.
Front/Sidelobe 5.67 dB

Total Field

EZNEC+



W5ZN W Stak/NE Stak

50.2 MHz

Elevation Plot
Azimuth Angle 90.0 deg.
Outer Ring 18.48 dBi

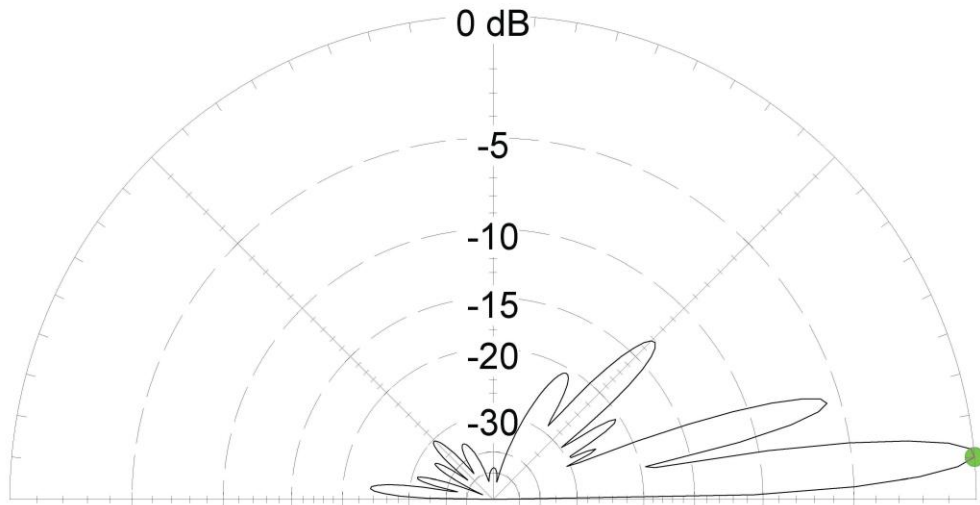
Cursor Elev 5.0 deg.
Gain 18.48 dBi
0.0 dBmax

Slice Max Gain 18.48 dBi @ Elev Angle = 5.0 deg.
Beamwidth 5.6 deg.; -3dB @ 2.7, 8.3 deg.
Sidelobe Gain 12.74 dBi @ Elev Angle = 16.0 deg.
Front/Sidelobe 5.74 dB

Stack of Four 3 element Yagi's

Total Field

EZNEC+



W5ZN 3 Element Stack West

50.2 MHz

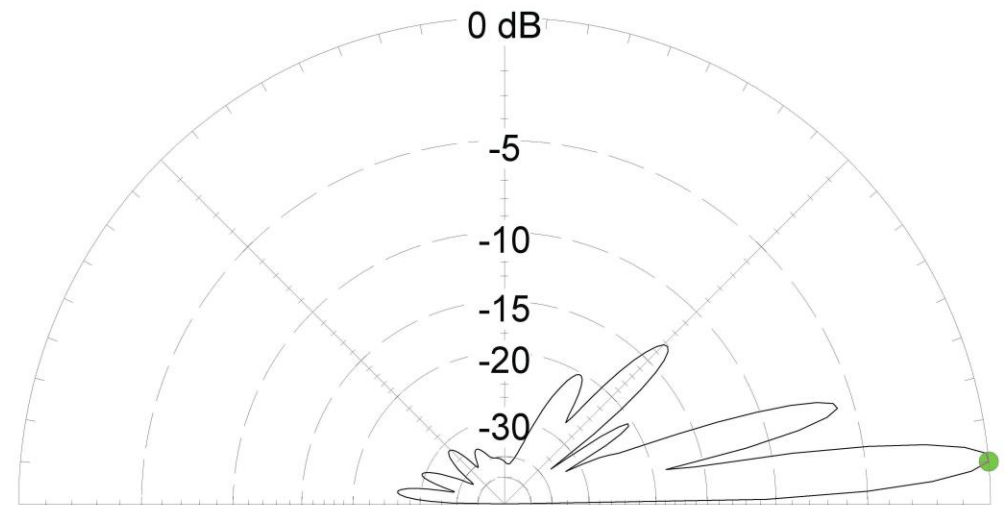
Elevation Plot
Azimuth Angle 90.0 deg.
Outer Ring 18.54 dBi

Cursor Elev 5.0 deg.
Gain 18.54 dBi
0.0 dBmax

Slice Max Gain 18.54 dBi @ Elev Angle = 5.0 deg.
Beamwidth 5.5 deg.; -3dB @ 2.7, 8.2 deg.
Sidelobe Gain 12.87 dBi @ Elev Angle = 16.0 deg.
Front/Sidelobe 5.67 dB

Total Field

EZNEC+



W5ZN W Stak/NE Stak/7 Ele SE

50.2 MHz

Elevation Plot
Azimuth Angle 90.0 deg.
Outer Ring 18.5 dBi

Cursor Elev 5.0 deg.
Gain 18.5 dBi
0.0 dBmax

Slice Max Gain 18.5 dBi @ Elev Angle = 5.0 deg.
Beamwidth 5.6 deg.; -3dB @ 2.7, 8.3 deg.
Sidelobe Gain 12.68 dBi @ Elev Angle = 16.0 deg.
Front/Sidelobe 5.82 dB

The SO2R Technique for 6 Meters

- Dedicate one radio as your main run radio in the CW and SSB portion of the band
 - Utilize this radio effectively and continually during your time on 6 meters and make as many Q's as possible
- Use the second radio to monitor 50.313 MHz (or 50.323 for EU).
 - During times when you decode a CQ from a station you have not worked stop CQ'ing on the "run" radio and work the station on the second radio
- **WARNING CAUTION STOP IT!!!!**
 - Do not, repeat NOT leave a good strong run on SSB or CW
 - You will simply miss many more QSO opportunities on SSB & CW

The SO2R Technique for 6 Meters

- If there is no FT8 activity on 50.313 then use the second radio to scan the SSB/CW portion for new multipliers
- Sometime during the night Sporadic E and other modes will die
- Stations will move to meteor scatter on 50.260 MHz
 - Move your run radio here while maintaining the second on 50.313

2018 June VHF Contest

W5ZN worked the following on 6 meters:

<u>Mode</u>	<u>QSO's</u>	<u>Grids</u>
SSB	662	106
CW	5	5
<u>FT8</u>	<u>67</u>	<u>48</u>
Total	734	159

The SO2R Technique for 6 Meters

Practice your technique *BEFORE* the contest

You will create a disaster if you don't and most likely
blow up something

W5ZN's FT8 Contest Conclusions

- FT8 is an excellent addition to your contest mode arsenal
- Several new stations are on the band as a result of FT8
 - More QSO's and/or Multipliers!!
- FT8 is not a primary mode to focus your contest effort on

