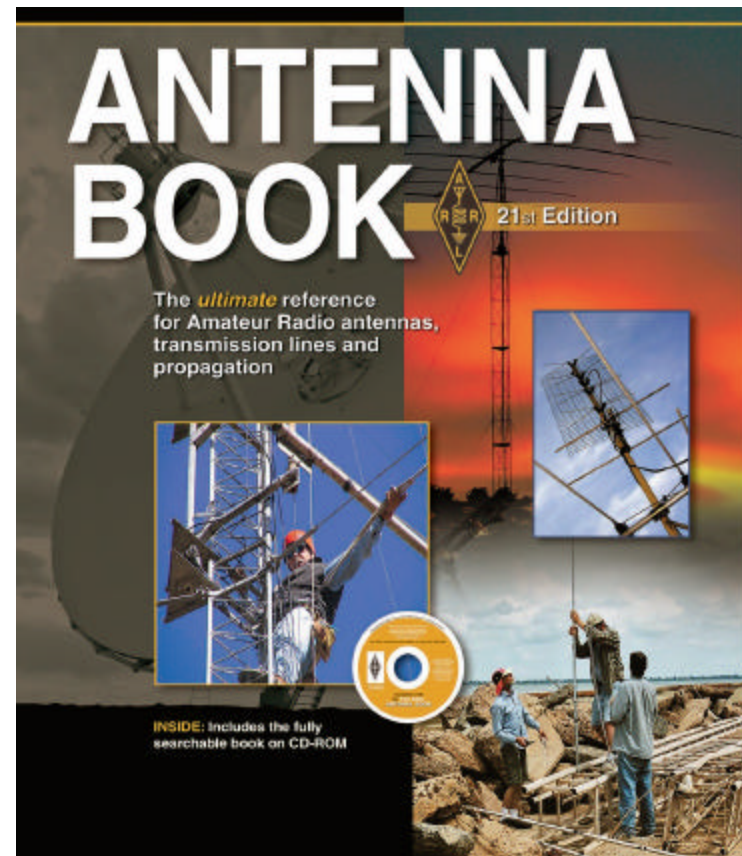




# What's New in the 21st Edition of *The ARRL Antenna Book?*

By R. Dean Straw, N6BV  
Senior Assistant Technical  
Editor, ARRL

Dayton, May 2007





## **What's New in the 21st Edition of *The ARRL Antenna Book?***

It's hard to imagine that this is the fifth Edition of *The ARRL Antenna Book* for which I've been Handling Editor! Goodness, how time flies.



## Changes in the 21<sup>st</sup> Edition

- About 20% of the book changed materially.
- The complete printed book is on the CD-ROM bundled with the book, just like the 20<sup>th</sup> Edition. Plus there are software programs and data on the CD-ROM.



## Changes in the 21<sup>st</sup> Edition

- I received tremendous help from the following contributors:
  - Roy Lewallen, W7EL – Chap 8, Multielement Arrays
  - Rudy Severns, N6LF -- Chap 27, Measurements



## Changes

Here are some examples of the kind of changes you'll find in the paper book.

As usual, you'll find lots of comparisons of antennas thanks to the latest computer modeling software.

Here are some highlights from Chapter 6, **Low-Frequency Antennas**.



# Chap 6, Low-Frequency Antennas

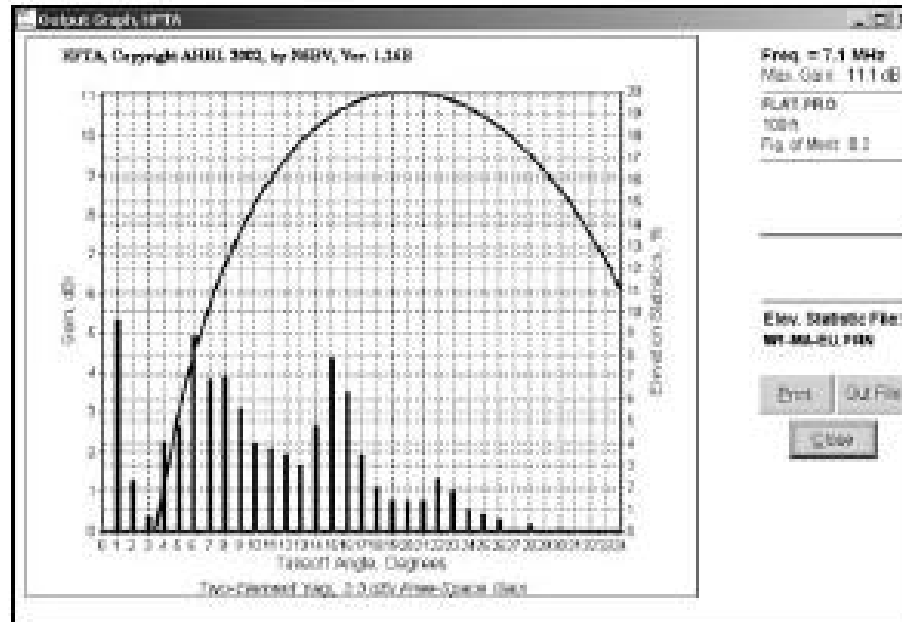


Fig 1—Screen capture from *HFTA* (HF Terrain Assessment) program showing elevation response for 100-foot high dipole over flat ground on 7.1 MHz, with bar-graph overlay of the statistical elevation angles needed over the whole 11-year solar cycle from New England (Boston) to all of Europe. Even a 100-foot high antenna cannot cover all the necessary angles.

The importance of low angles for low-band DXing.



# Chap 6, Low-Frequency Antennas

## NVIS

Q50512-Straw01

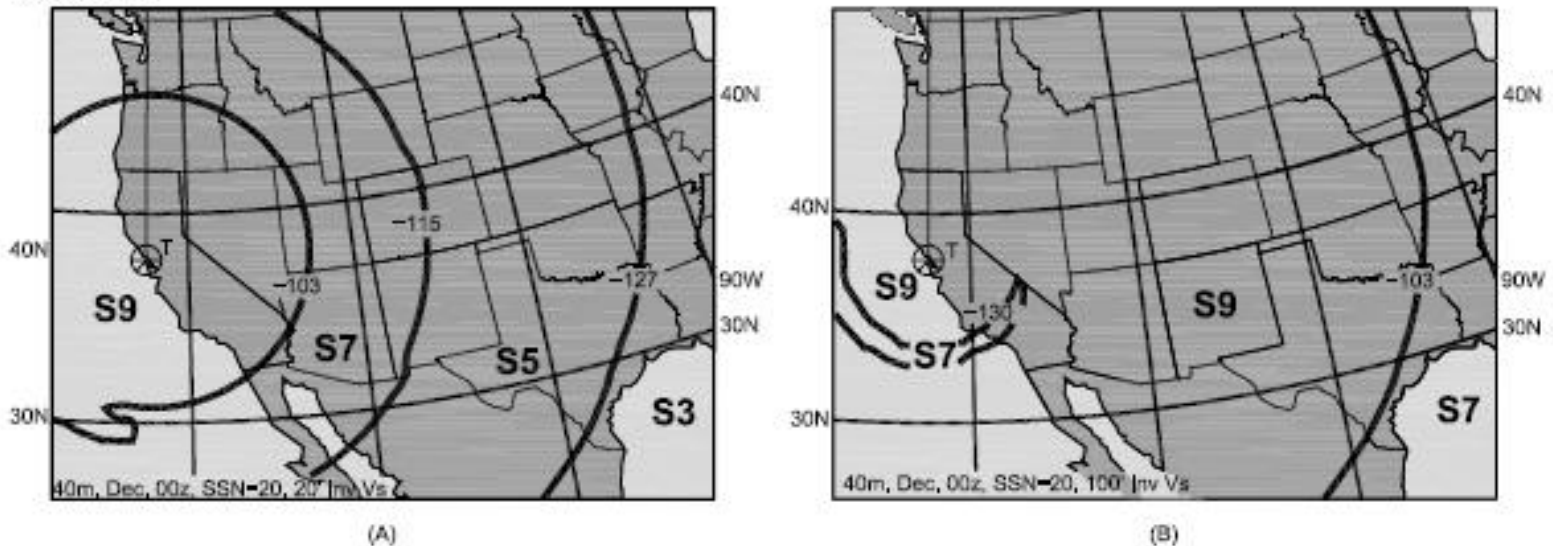


Fig 7—At A, Predicted 40 meter geographic coverage plot for a 100 W transmitter in December at 0000 UTC (near sunset), for a SSN (Smoothed Sunspot Number) of 20. The antennas used are 20 foot-high inverted V dipoles. At B, 40 meter coverage for same date and time, but for 100 foot-high flattop dipoles. Most of California is well covered with S9 signals in both cases, but there is more susceptibility in the higher dipole case to thunderstorm crashes coming from outside California, for example from Arizona or even Texas. Such noise can interfere with communications inside California.

More coverage of NVIS techniques.



# Chap 6, Low-Frequency Antennas

## NVIS

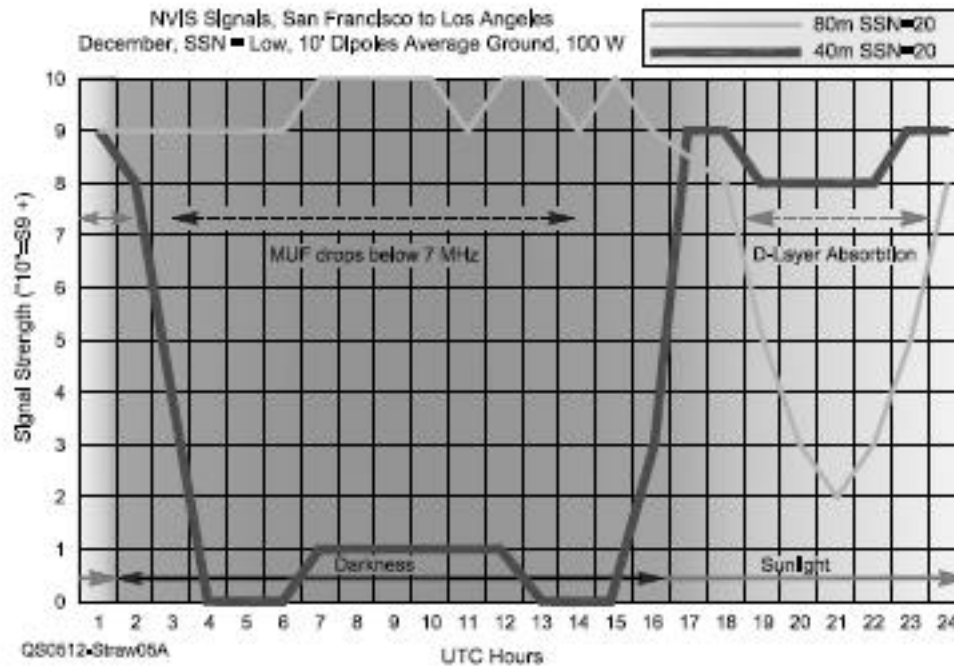


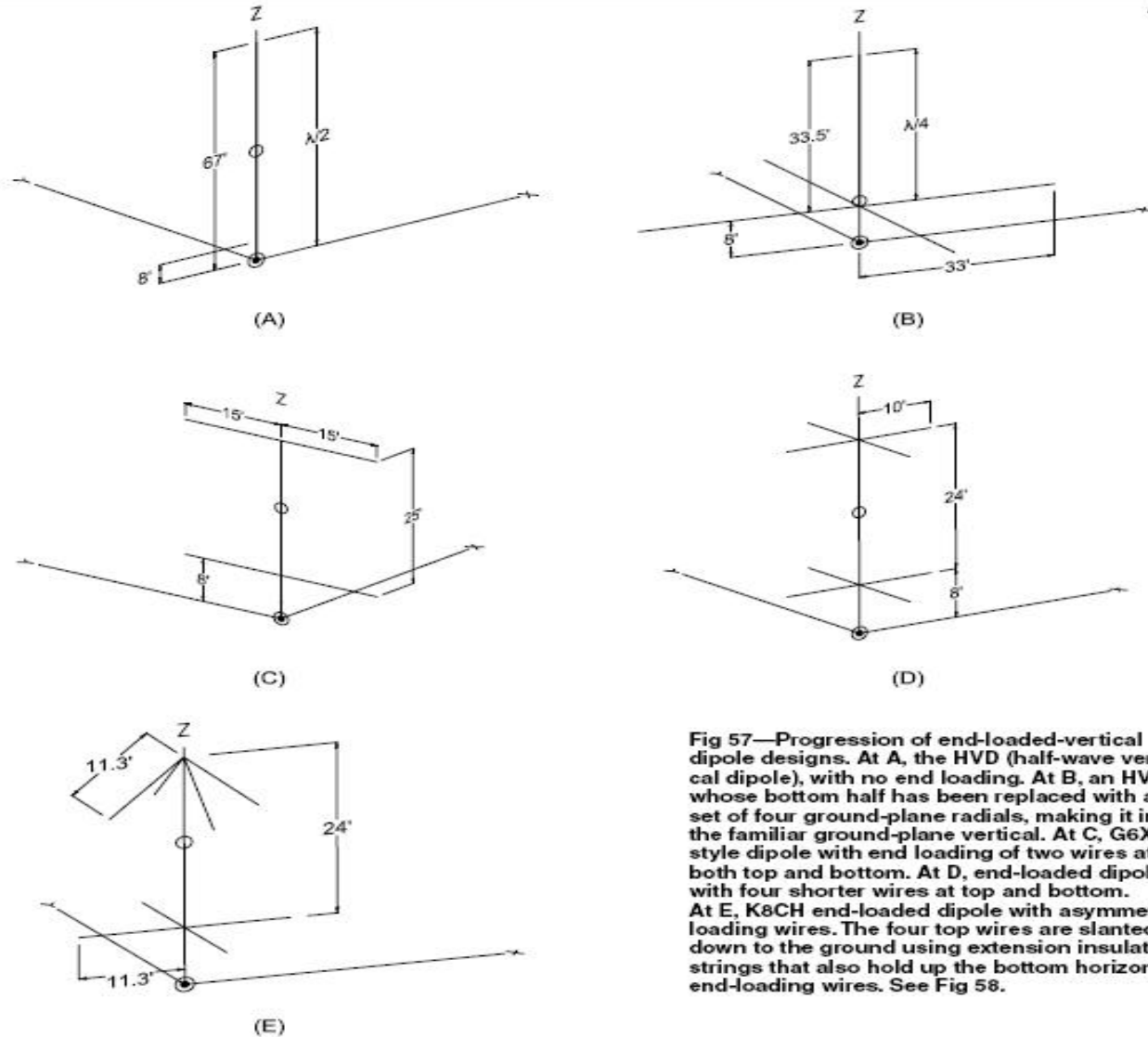
Fig 11—VOACAP calculations for a 350 mile path from San Francisco to Los Angeles, using 10 foot-high flattop dipoles. This plot shows the signal strength in S Units (“S10” = S9+10) for a worst-case month/SSN combination—winter solstice, in December, for a low level of solar activity (SSN = 20). The 40-meter signal drops to a very low level during the night because the MUF drops well below 7.2 MHz. The 80-meter signal drops in the afternoon because of D-layer absorption. For 24-hour communications on this path, the rule of thumb is to select 40 meters during the day and 80 meters during the night.

More coverage of NVIS techniques.





# Chap 6, Low-Frequency Antennas



Ant0208

Fig 57—Progression of end-loaded-vertical dipole designs. At A, the HVD (half-wave vertical dipole), with no end loading. At B, an HVD whose bottom half has been replaced with a set of four ground-plane radials, making it into the familiar ground-plane vertical. At C, G6XN-style dipole with end loading of two wires at both top and bottom. At D, end-loaded dipole with four shorter wires at top and bottom. At E, K8CH end-loaded dipole with asymmetric loading wires. The four top wires are slanted down to the ground using extension insulating strings that also hold up the bottom horizontal end-loading wires. See Fig 58.



## Chap 6, Low-Frequency Antennas

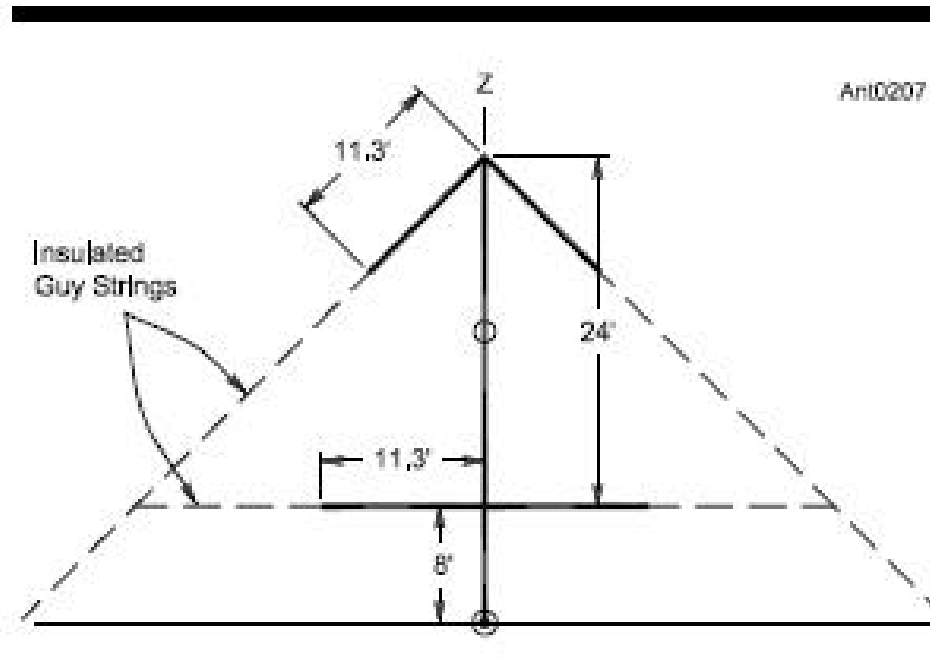


Fig 58—Layout of CVD made using #14 wire suspended from a tree branch.

A 40-meter CVD – Compact Vertical Dipole.



# Chap 6, Low-Frequency Antennas

**Table 9**  
**Variations on a Vertical Center-Fed Dipole**

<i>Name</i>	<i>Style Fig 57</i>	<i>Vertical Length feet</i>	<i>Spoke Length feet</i>	<i>Min. Ht feet</i>	<i>Max. Gain dBi</i>	<i>2:1 SWR kHz</i>	<i>Hairpin Coil <math>\mu H</math></i>	<i>Center Load <math>\mu H</math></i>
<b>20 Meters</b>								
GP	B	17.53	16.53	8	0.29	400	—	—
CVD 1	C	13	7.57	8	0.12	625	—	—
CVD 2	D	12	5.1	8	0.00	550	0.68	0.68
CVD 3	E	12.15	5.6	8	-0.01	450	0.5	0.5
<b>30 Meters</b>								
GP	B	24.54	23.14	8	0.04	400	—	—
CVD 1	E	24	5.33	8	-0.2	500	—	—
CVD 2	E	17	7.60	8	-0.36	400	0.82	0.82
<b>40 Meters</b>								
HVD	A	66	—	8	0.13	450	—	—
GP 1	B	35	33	8	-0.12	325	—	—
GP 2	B	34.5	33	2	-0.37	400	—	—
CVD 1	C	25	15	8	-0.42	450	—	—
CVD 2	C	24	15	2	-1.09	400	—	—
CVD 3	D	24	10	8	-0.55	425	—	0.25
CVD 4	D	24	5	8	-0.85	225	—	8.7
CVD 5	D	16	8	8	-1.18	175	0.94	6.8
CVD 6	E	24	11.3	8	-0.59	250	—	—
<b>80 Meters</b>								
HVD	A	135	—	8	0.19	225	—	—
GP	B	65.5	61	8	0.11	200	—	—
CVD 1	C	48.3	30	8	-0.27	200	—	—
CVD 2	E	46.5	21.9	8	-0.50	150	—	—

The CVD – Compact Vertical Dipole.



Some examples from Chapter 8,  
**Multielement Arrays** with  
special *EZNEC-ARRL* and  
*ArrayFeed1* software by Roy  
Lewallen, W7EL



# Chap 8, Multielement Arrays

**EZNEC-ARRL v. 4.0**

File Edit Options Outputs Setups View Utilities Help

**4-Square With Ideal Currents**

- File: ARRL\_4Square\_Example.EZ
- Frequency: 7.15 MHz
- Wavelength: 137.562 ft
- Wires: 4 Wires, 80 segments
- Sources: 4 Sources
- Loads: 4 Loads
- Trans Lines: 0 Lines
- Ground Type: Real/MININEC
- Ground Descrip: 1 Medium (0.005, 13)
- Wire Loss: Zero
- Units: Feet
- Plot Type: Azimuth
- Elevation Angle: 23 Deg.
- Step Size: 1 Deg.
- Ref Level: 0 dBi
- Alt SWR Z0: 75 ohms
- Desc Options

**2D Plot: 4-Square With Ideal Currents**

File Edit View Options Reset

**Total Field**

7.15 MHz

Azimuth Plot	Cursor Bear	45.0 deg.
Elevation Angle	Gain	3.53 dBi
Outer Ring		0.0 dBmax

Slice Max Gain: 3.53 dBi @ Bearing = 45.0 deg.  
Front/Back: 25.71 dB  
Beamwidth: 99.4 deg.; -3dB @ 355.3, 94.7 deg.  
Sidelobe Gain: -22.17 dBi @ Bearing = 225.0 deg.  
Front/Sidelobe: 25.71 dB

**View Antenna: 4-Square With Ideal Currents**

File Edit View Options Reset

Zoom: [Vertical Sliders]  
Display: [Reset]  
Current: [Reset]  
Move Image: [X, Y, Z Sliders]  
[Reset]  
 Center Ant Image  
No wires selected

**Source Data**

File Edit Search Format

**EZNEC-ARRL ver. 4.0**

4-Square With Ideal Currents 4/17/2007 3:28:07 PM

----- SOURCE DATA -----

Frequency = 7.15 MHz

**Source 1** Voltage = 61.08 V. at -44.01 deg.  
Current = 2.678 A. at 0.0 deg.  
Impedance = 16.4 - J 15.85 ohms  
Power = 117.7 watts  
SWR (50 ohm system) = 3.387 (75 ohm system) = 4.786

**Source 2** Voltage = 162.5 V. at -108.69 deg.  
Current = 2.678 A. at -90.0 deg.  
Impedance = 57.47 - J 19.44 ohms  
Power = 412.2 watts  
SWR (50 ohm system) = 1.471 (75 ohm system) = 1.486

**Source 3** Voltage = 162.5 V. at -108.69 deg.  
Current = 2.678 A. at -90.0 deg.

Windows taskbar: Start, Cebr..., Wind..., Adob..., Inbo..., Micro..., 4 Co..., 3:28 PM

*EZNEC-ARRL* updated by Roy Lewallen, W7EL



# Chap 8, Multielement Arrays

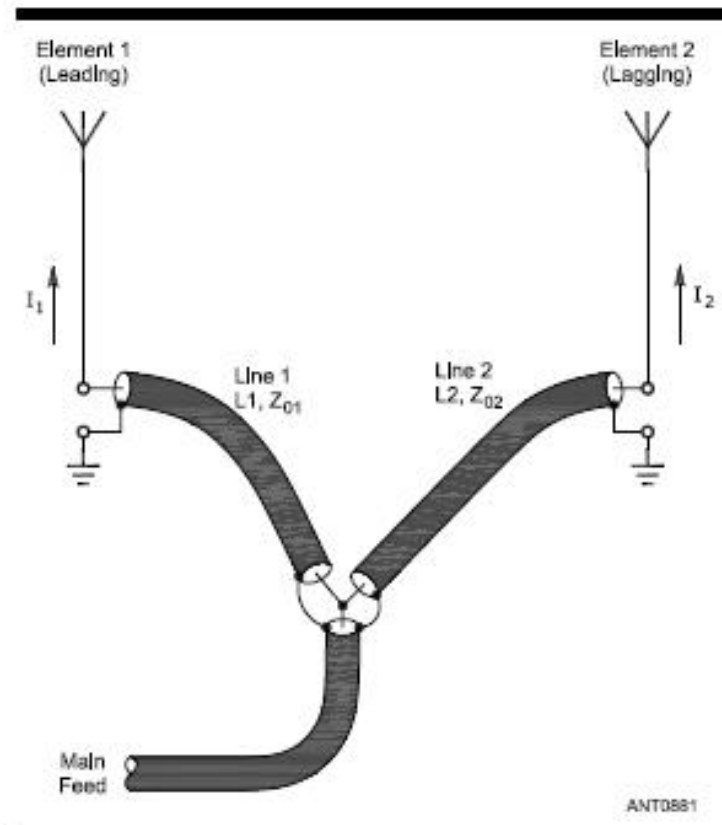


Fig 16—"Simplest" feed system for 2-element array. No matching or phasing network is used here, only transmission lines.

"Simplest" feed system, 2-element phased array.

# Chap 8, Multielement Arrays



**W7EL Arrayfeed1**

**Array Type**

- Two Element
- Four Square
- 4 Element Rectangle

**Feed System Type**

- "Simplest"
- L Network

**Inputs**

Enter Frequency MHz

Enter feedpoint impedances

Element	R ohms	X ohms
Leading Element	<input type="text" value="37.53"/>	<input type="text" value="-19.1"/>
Lagging Element	<input type="text" value="69.97"/>	<input type="text" value="18.5"/>

Choose line impedances

Line 1 Z0  ohms

Line 2 Z0  ohms

Choose lagging:leading I mag, phase

Mag  Phase  deg

**Physical Lengths**

Velocity Factor

Units

- Meters
- Millimeters
- Feet
- Inches
- Wavelengths

1/4 wavelength

1/2 wavelength

3/4 wavelength

**Solutions**

	Electrical Length, Degrees	
	1st Soln	2nd Soln
Line 1	<input type="text" value="70.49"/>	<input type="text" value="129.93"/>
Line 2	<input type="text" value="156.81"/>	<input type="text" value="184.31"/>
Zin	<input type="text" value="34.67 + j13.51"/>	<input type="text" value="50.64 - j1.52"/>

1st Solution    2nd Solution

Line 1	<input type="text" value="17.777"/>	<input type="text" value="32.768"/>
Line 2	<input type="text" value="39.546"/>	<input type="text" value="46.483"/>

Calc Zin

**Diagram:** A schematic diagram showing a 'Main feed' at the bottom center. Two lines, 'Line 1' and 'Line 2', branch out from the feed. 'Line 1' leads to a 'Leading element' antenna, and 'Line 2' leads to a 'Lagging element' antenna. Both antennas are represented by vertical lines with a horizontal top bar.

*Arrayfeed1* and "simplest" feed system



# Chap 8, Multielement Arrays

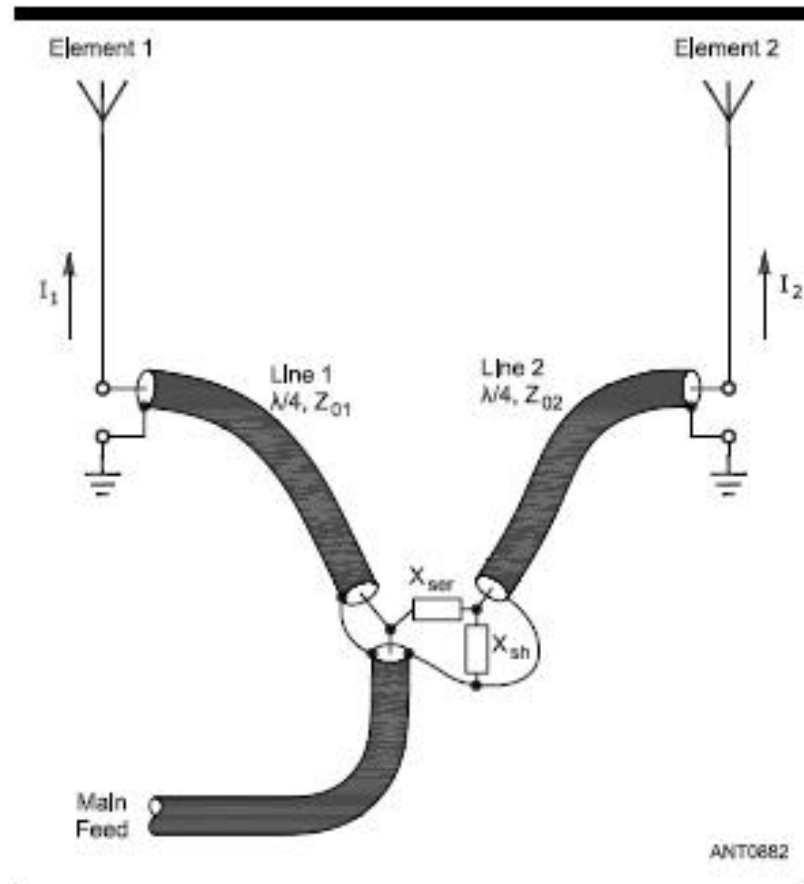


Fig 17— The addition of a simple L-network to Fig 16 allows you to easily adjust feeding of element pairs at other relative phase angles and/or magnitude ratios.

L-Network feed system for 2-element phased array



# Chap 8, Multielement Arrays



**W7EL Arrayfeed1**

Array Type

Two Element  
 Four Square  
 4 Element Rectangle

Feed System Type

"Simplest"  
 L Network

Lines marked \* are all the same length and  $Z_0$ , and either 1/4 or 3/4 W/L long.

Inputs

Enter Frequency MHz

Enter feedpoint impedances

Element	R ohms	X ohms
Leading Element	<input type="text" value="16.4"/>	<input type="text" value="-15.85"/>
Side Elements	<input type="text" value="57.47"/>	<input type="text" value="-19.44"/>
Lagging Element	<input type="text" value="77.81"/>	<input type="text" value="54.8"/>

Choose line impedances

Line 1  $Z_0$   ohms  
 Line 2  $Z_0$   ohms

Choose  $Z_0$  of 1/4 or 3/4 wavelength lines

ohms

Middle: leading l mag, phase

Mag 1  Phase  deg

Physical Lengths

Velocity Factor

Units

Meters  
 Millimeters  
 Feet  
 Inches  
 Wavelengths

1/4 wavelength   
 1/2 wavelength   
 3/4 wavelength

Solutions

	Electrical Length, Degrees	
	1st Soln	2nd Soln
Line 1	<input type="text" value="23.88"/>	<input type="text" value="137.92"/>
Line 2	<input type="text" value="164.90"/>	<input type="text" value="213.36"/>
$Z_{in}$	<input type="text" value="11.24 + j0.23"/>	<input type="text" value="36.47 + j7.88"/>

1st Solution    2nd Solution

Line 1	<input type="text" value="7.483"/>	<input type="text" value="43.214"/>
Line 2	<input type="text" value="51.668"/>	<input type="text" value="66.855"/>

Buttons: Help, Clear Entries, Find Solutions,  Calc  $Z_{in}$

*Arrayfeed1* and "simplest" feed system for Four Square



Chapter 14,  
**Direction-Finding Antennas**



# Chap 14, Direction-Finding Antennas

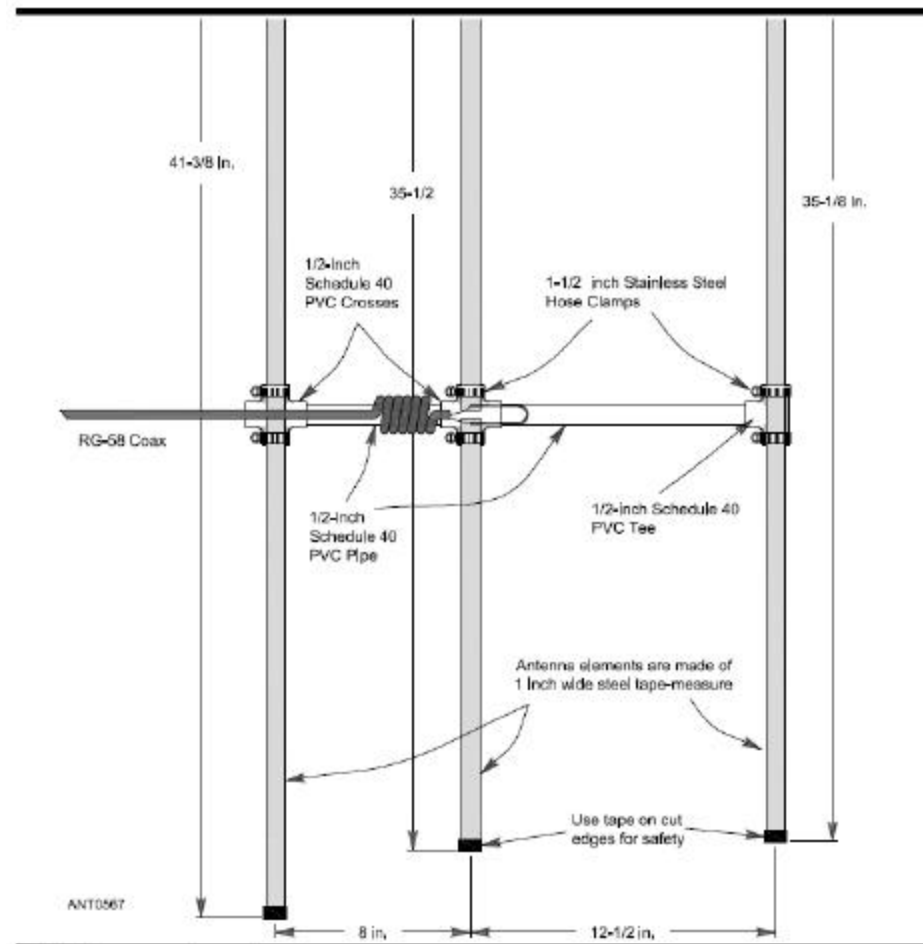


Fig 44—Tape-measure beam dimensions.

## A Tape-Measure Beam for RDFing



Chapter 16,  
**Mobile and Maritime Antennas**



## Chap 16, Mobile Antennas



Fig 23—The completed Screwdriver antenna mounted on KO4TV's truck rear bumper. (Photo courtesy of Gary Pearce, KN4AQ.)

The “Screwdriver” mobile antenna



Chapter 23,  
**Radio Wave Propagation**



# Chap 23, Radio Wave Propagation

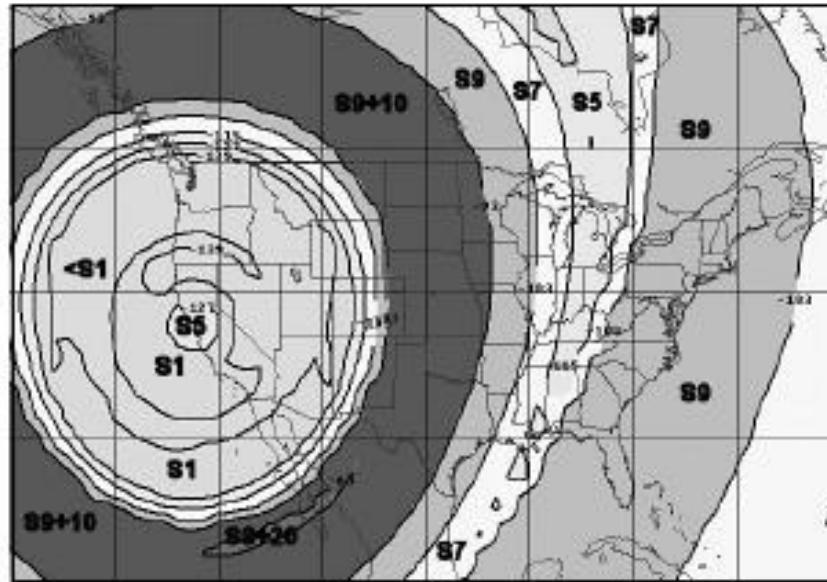


Fig 26—Modified VOAAREA plot for 21.2 MHz from San Francisco to the rest of the US, annotated with signal levels in S units, as well as signal contours in dBW (dB below a watt). Antennas are assumed to be 3-element Yagis at 55 feet above flat ground; the transmitter power is 1500 W; the month is November with SSN = 50, a moderate level of solar activity, at 22 UTC. The most obvious feature is the large “skip zone” centered on the transmitter in San Francisco, extending almost a  $\frac{1}{3}$  of the distance across the US.

Details on the concept of a “Skip Zone”



Chapter 27,  
**Antennas & Transmission Line  
Measurements**

New coverage on Vector Network  
Analyzers (VNAs) by Rudy  
Severns, N6LF





# Software Included with the 21st Edition of *The ARRL Antenna Book*

## ***Windows Software:***

***TLW – Transmission Line for Windows***

***YW – Yagis for Windows***

***HFTA – HF Terrain Assessment***

***MicroDEM (by Peter Guth, US Naval Academy)***

***Geo Alert Wizard—ARRL (by Jim Tabor, KU5S)***

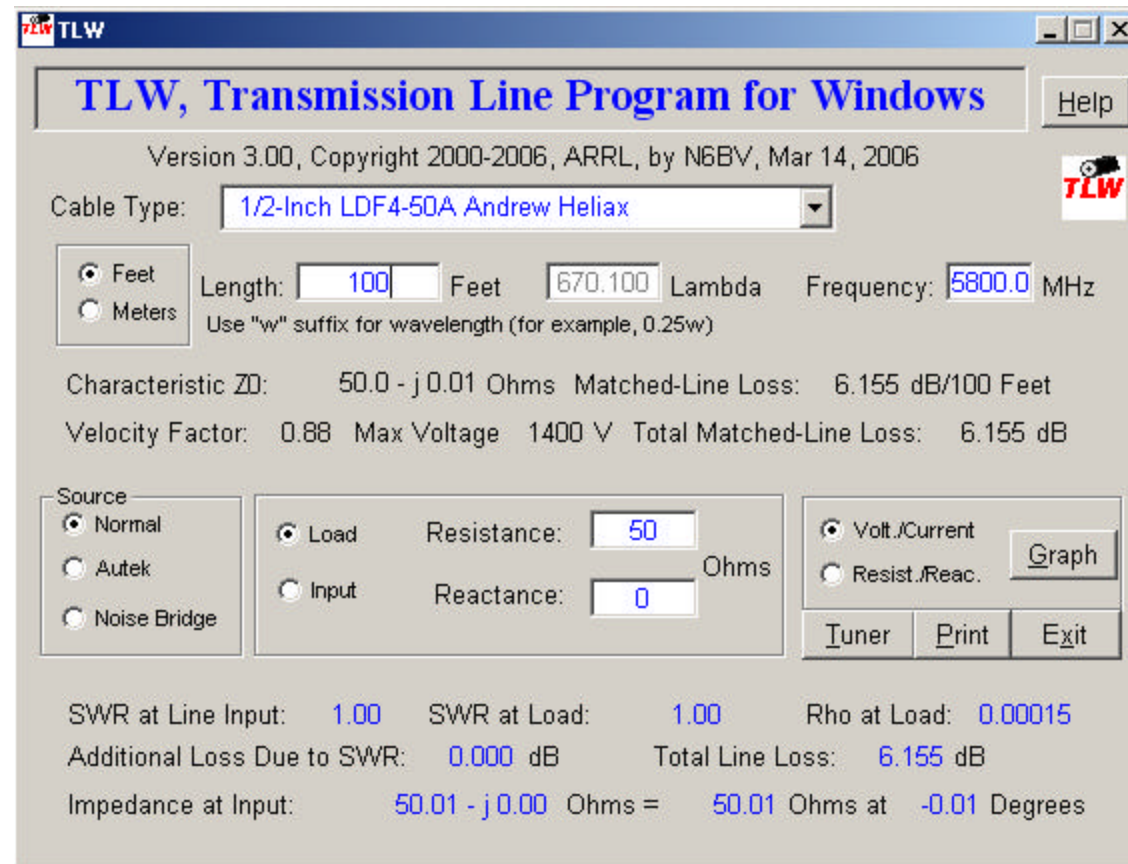
***Range-Bearing***

***ArrayFeed1 (by Roy Lewallen, W7EL)***

***EZNEC-ARRL v. 4 (by Roy Lewallen, W7EL)***



# Software Included with the 21st Edition of *The ARRL Antenna Book*



Now covers up to 6 GHz



# Software Included with the 21st Edition of *The ARRL Antenna Book*

**High-Pass L-Network**

RG-213 (Belden 8267)      Length: 100 feet      Frequency: 3.8 MHz  
At load: 42 - j 20 ohms = 46.5 ohms, at -25.5 degrees      Load SWR = 1.57  
Eff. Q = 0.7      1.5:1 SWR BW = Large, 2:1 SWR BW = Large  
Estimated power lost in tuner for 1500 W input: 6 W (0.02 dB = 0.4% lost)  
Transmission-line loss = 0.43 dB. Total loss = 0.45 dB. Power into load = 1351.8 W

At 1500 W:	L1	C2
Unloaded Q	200	1000
Reactance	71.029	-18.409
Peak Voltage	387 V	174 V
RMS Current	3.9 A	6.7 A
Est. Pwr Diss.	5 W	1 W
RMS Vin:	273.86 V at -26.35 deg.	RMS Vout: 226.21 V at 0.00 deg.

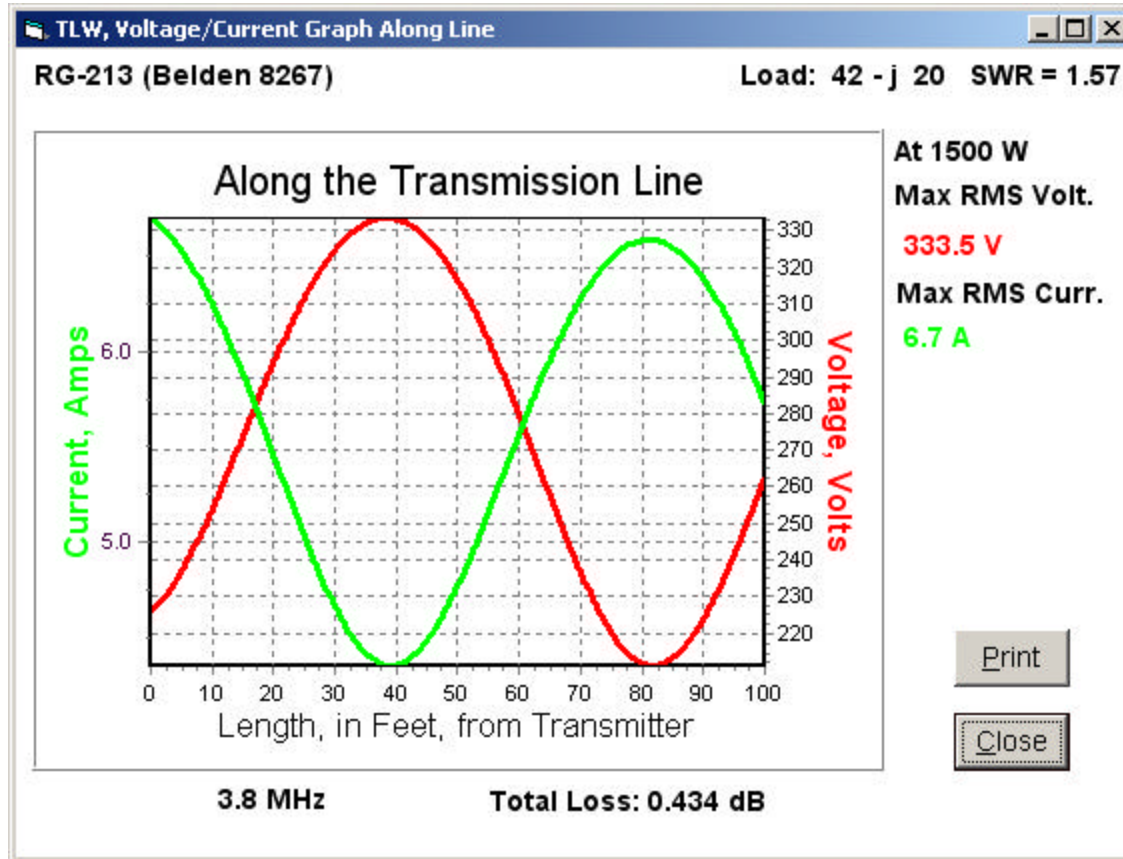
50.0 Ohms      2275.1 pF      C2      33.51 - j 4.98 Ohms  
L1      CStray  
2.97 uH      10 pF

Print  
Main Screen  
Cancel

Tuner calculations in *TLW*



# Software Included with the 21st Edition of *The ARRL Antenna Book*




Voltage/Current along the line in *TLW*



# Software Included with the 21st Edition of *The ARRL Antenna Book*

**HFTA (HF Terrain Assessment)**

**HFTA, HF Terrain Assessment**  **Help**

Version 1.04, Copyright 2003-2004, ARRL, by N6BV, Mar. 02, 2004

**Frequency:**  MHz

**Diffraction:ON** **Options**

	<b>Terrain Files:</b>	<b>Ant. Type</b>	<b>Heights</b>	
1:	FLAT.PRO	3-Ele.	30	feet
2:	FLAT.PRO	Dipole	8	feet
3:	FLAT.PRO	3-Ele.	100	feet
4:				feet

Terrain 1  
 Terrain 2  Show Ants.  
 Terrain 3  
 Terrain 4 **Plot Terrain**

**Elevation File:** Elevation file:

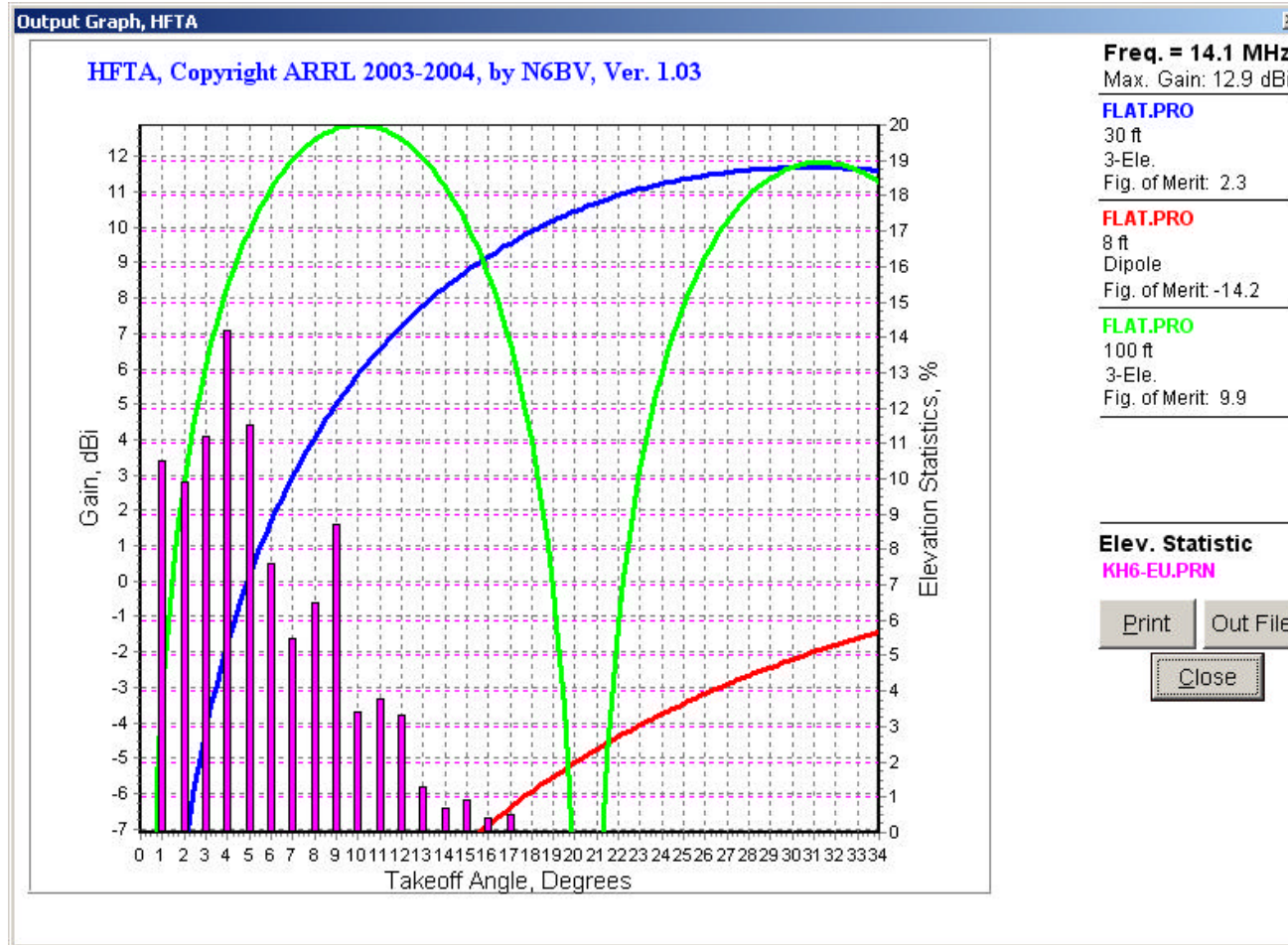
Max. Elev. Angle  
 20 deg.  
 25 deg.  
 34 deg.

**Compute!** **Exit**

*HFTA* for Terrain Assessment



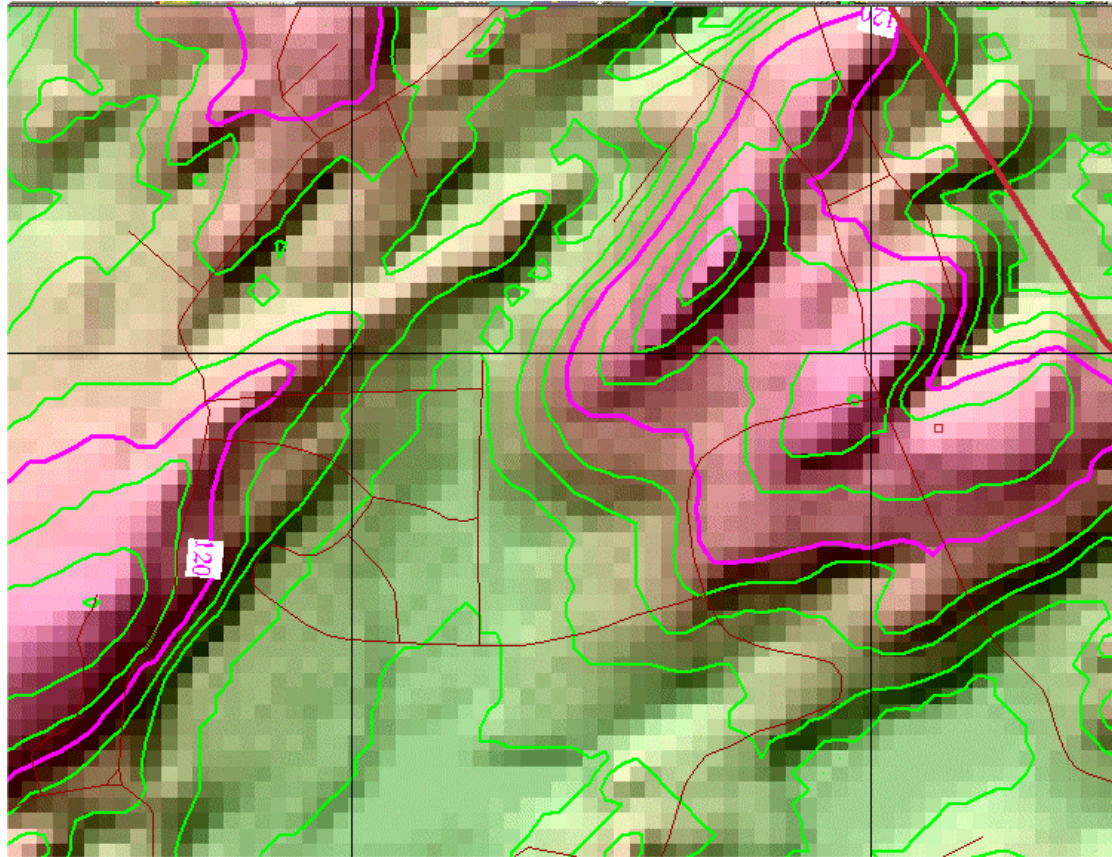
# Software Included with the 21st Edition of *The ARRL Antenna Book*



*HFTA* for Terrain Assessment



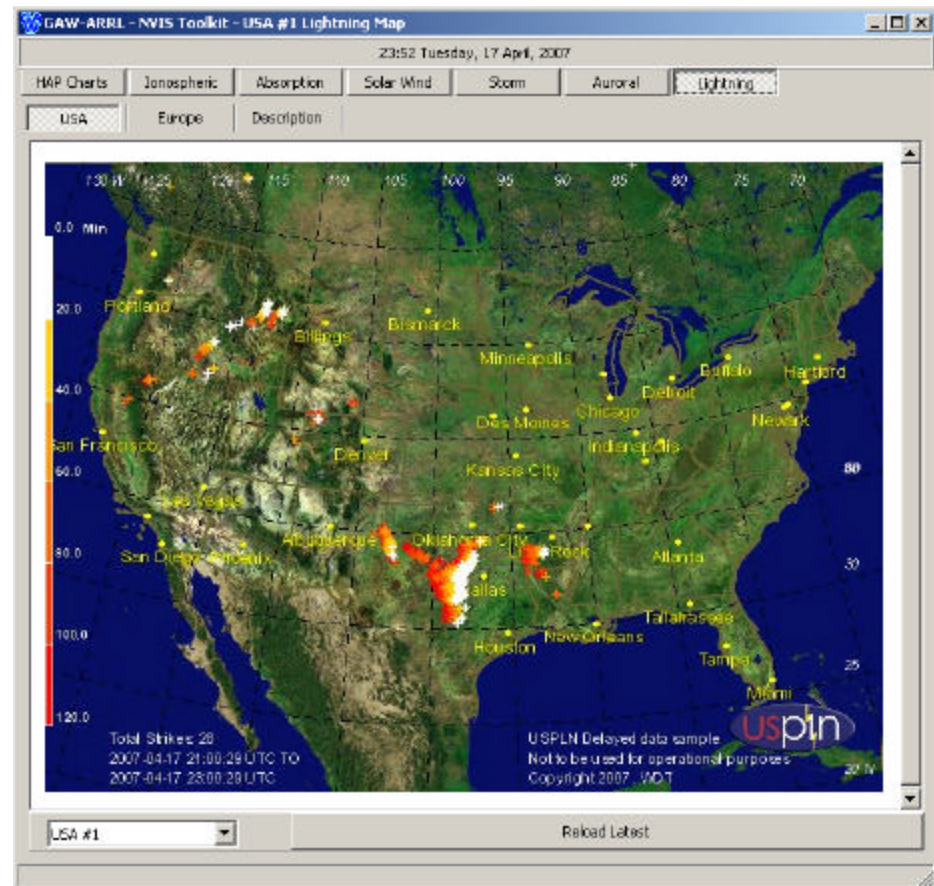
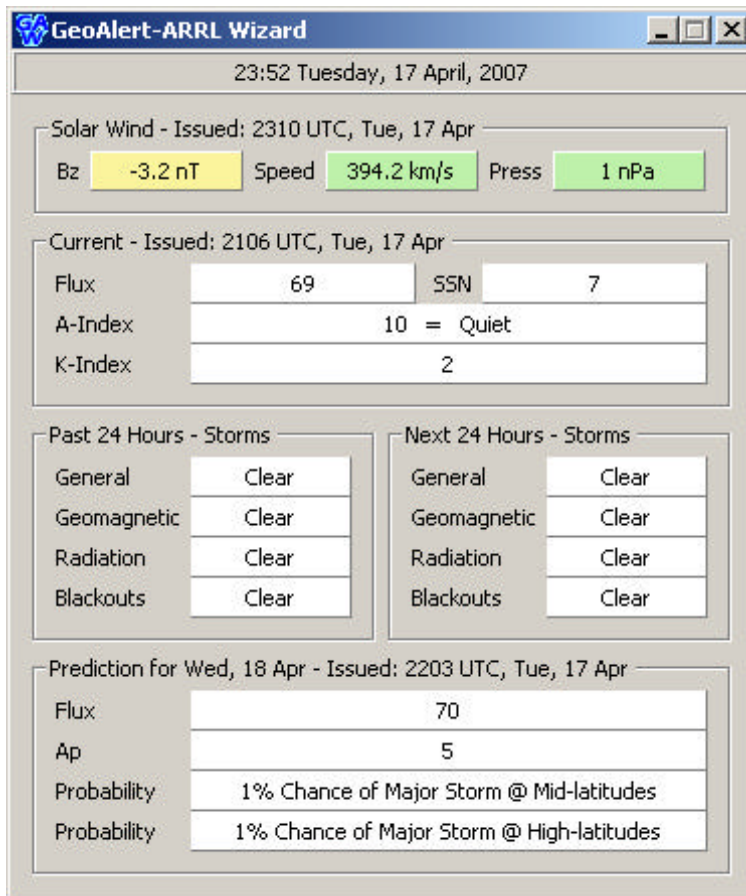
## Software Included with the 21st Edition of *The ARRL Antenna Book*



*MicroDEM*, showing N6BV/1 in New Hampshire



# Software Included with the 21st Edition of *The ARRL Antenna Book*



*Geo Alert Wizard*—ARRL queries the Internet for geophysical data





# Software Included with the 21st Edition of *The ARRL Antenna Book*

Range/Bearing Program  
Ver. 1.0, Sep. 19, 2005, by R. Dean Straw, N6BV, Copyright 2005 ARRL

Position 1

Latitude:  N  S  
Deg. Min. Sec.  
37 38 21.000000

Longitude:  W  E  
122 24 33.000000

Decimal:  Deg.  Min.  Sec.

Clear

Position 2

Latitude:  N  S  
Deg. Min. Sec.  
38 38.350000

Longitude:  W  E  
122 24.550000

Decimal:  Deg.  Min.  Sec.

Clear

Range/Bearing

Range: 60 0 degrees

Units for Range:  feet  meters  stat. miles  naut. miles  km

R/B from positions  
 Position from R/B

Compute

Clear Exit

*Range-Bearing* – great for converting DMS to D, or DM, or latitude/longitude positions to Range/Bearings for *HFTA*



# Software Included with the 21st Edition of *The ARRL Antenna Book*

## DOS Software:

*SCALE* for scaling Yagis to other frequencies/tapers

*AAT* -- Analyze Antenna Tuner

*LPDA* (by Roger Cox, WB0DGF)

*MOBILE* (by Leon Braskamp, AA6GL)

*GAMMA*



# Software Included with the 21st Edition of *The ARRL Antenna Book*

**MOBILE** [Auto] [Icons] [A]

**A** Location: bumper mt.    **B** on compact auto    **AA6GL**  
7/94

**1** Base length: 6 ft.    **3** Top length: 3 ft.  
**2** Diameter: .875 in.    **4** Diameter: .188 in.

**5** Frequency: 7.2 MHz

**Performance**

Radiation efficiency : 30 %  
Rel. radiated power : -5.2 dB  
Feed-point impedance : 13 ohms  
Bandwidth for 2:1 SWR : 59 kHz

**Coil Data**

Inductance: 49.1  $\mu$ H  
**6** Wire size: 14 AWG  
**7** Diameter: 3 in.  
Length: 4.5 in.  
Turns: 35.9  
**8** Pitch: 8 t/in.  
**9** Spacing: .95 dia.  
Coil 'Q': 530

Item to change, **E**xtend, **S**ave, or **Q**uit >

To change coil diameter in .25 inch steps: **↓** smaller or **↑** larger



# Propagation-Prediction Tables

## Detailed Propagation Tables

### USA

W1B Boston, MA  
W2A Albany, NY  
W2N Buffalo, NY  
W3D Washington, DC  
W3P Pittsburg, PA  
W4A Montgomery, AL  
W4F Miami, FL  
W4G Atlanta, GA  
W4K Louisville, KY  
W4N Raleigh, NC  
W4T Memphis, TN  
W5A Little Rock, AR  
W5H Houston, TX  
W5L New Orleans, LA  
W5M Jackson, MS  
W5N Albuquerque, NM  
W5O Oklahoma City, OK  
W5T Dallas, TX  
W6L Los Angeles, CA  
W6S San Francisco, CA  
W7A Phoenix, AZ  
W7I Boise, ID  
W7M Helena, MT  
W7N Las Vegas, NV  
W7O Portland, OR  
W7U Salt Lake City, UT  
W7W Seattle, WA  
W7Y Cheyenne, WY  
W8M Detroit, MI  
W8O Cincinnati, OH  
W8W Charleston, WV  
W9C Chicago, IL  
W9I Indianapolis, IN  
W9W Milwaukee, WI  
W0C Denver, CO  
W0D Bismarck, ND  
W0I Kansas City, MO  
W0K Middle of US, KS  
W0M St. Louis, MO

W0N Omaha, NE  
W0S Pierre, SD  
**Other, North America**  
6Y Kingston, Jamaica  
HP Panama City, Panama  
J3 Grenada  
KL7 Anchorage, Alaska  
KP2 Virgin Islands  
TI San Jose, Costa Rica  
V3 Belmopan, Belize  
VE1 Halifax, Nova Scotia  
VE2 Montreal, Quebec  
VE3 Toronto, Ontario  
VE4 Winnipeg, Manitoba  
VE5 Regina, Saskatchewan  
VE6 Calgary, Alberta  
VE7 Vancouver, BC  
VE8 Yellowknife, NWT  
VO1 St. John's, NFL  
VP2 Anguilla  
VP5 Turks & Caicos  
VP9 Bermuda  
XE1 Mexico City, Mexico  
ZF Cayman Island

### Europe

CT Lisbon, Portugal  
DL Bonn, Germany  
EA Madrid, Spain  
EI Dublin, Ireland  
ER Kishinev, Moldava  
F Paris, France  
G London, England  
I Rome, Italy  
JW Svalbard  
OH Helsinki, Finland  
OK Prague, Czech Republic  
ON Brussels, Belgium  
OZ Copenhagen, Denmark  
S5 Slovenia

SP Warsaw, Poland  
SV Athens, Greece  
TF Reykjavik, Iceland  
UA3 Moscow, Russia  
UA6 Rostov, Russia  
UR Kiev, Ukraine  
YO Bucharest, Romania  
YU Belgrade, Yugoslavia  
**South America**  
8P Barbados  
CE Santiago, Chile  
CP La Paz, Bolivia  
FY Cayenne, French Guiana  
HC Quito, Ecuador  
HC8 Galapagos Islands  
HK Bogota, Columbia  
LU Buenos Aires, Argentina  
OA Lima, Peru  
P4 Aruba  
PY1 Rio de Janeiro, Brazil  
PY0 Fernando de Noronha  
YV Caracas, Venezuela  
YV0 Aves Island  
ZP Asuncion, Paraguay

### Asia

1S Spratly Islands  
3W Ho Chi Minh City, Vietnam  
4J Baku, Azerbaijan  
4S Columbo, Sri Lanka  
4X Jerusalem, Israel  
9N Katmandu, Nepal  
AP Karachi, Pakistan  
BS7 Scarborough Reef  
BY1 Beijing, China  
BY4 Shanghai, China  
BY0 Lhasa, China  
HS Bangkok, Thailand  
HZ Riyadh, Saudi Arabia  
JA1 Tokyo, Japan

JA3 Osaka, Japan  
JA8 Sapporo, Japan  
JT Ulan Bator, Mongolia  
TA Ankara, Turkey  
UA9 Perm, Russia  
UA0 Khabarovsk, Russia  
UN Alma-Ata, Kazakh  
VR2 Hong Kong  
VU New Delhi, India  
VU4 Andaman Islands  
XZ Rangoon, Myanmar

### Oceania

3D2 Fiji Islands  
3Y Peter I  
DU Manila, Philippines  
FO Tahiti  
H4 Honiara, Solomon Islands  
KH0 Saipan, Mariana Islands  
KH6 Honolulu, Hawaii  
KH7K Kure  
KH8 American Samoa  
V7 Kwajalein, Marshall Islands  
VK2 Sydney, Australia  
VK4 Brisbane, Australia  
VK6 Perth, Australia  
VK8 Darwin, Australia  
VK9 Cocos-Keeling Island  
YB Jakarta, Indonesia  
YJ Vanuatu  
ZL1 Auckland, New Zealand  
ZL3 Christchurch, New Zealand

### Africa

3B7 St Brandon  
3B9 Rodrigues  
3C Bata, Equatorial Guinea  
5N Lagos, Nigeria  
5R Antananarivo, Madagascar  
5U Niamey, Niger Republic  
5Z Nairobi, Kenya

170 QTHs around the world



# Propagation-Prediction Tables

6W Dakar, Senegal  
7Q Longwe, Malawi  
7X Algiers, Algeria  
9J Lusaka, Zambia  
9L Freetown, Sierra Leone

9X Kigali, Rwanda  
C5 The Gambia  
C9 Maputo, Mozambique  
CN Casablanca, Morocco  
D2 Luanda, Angola

EA8 Canary Islands  
**FT5X Kerguelen**  
J2 Djibouti  
ST Khartoum, Sudan  
SU Cairo, Egypt

T5 Mogadisho, Somalia  
VQ9 Chagos, Diego Garcia  
XT Burkina Faso  
ZS1 Capetown, So. Africa  
ZS6 Johannesburg, So. Africa

170 QTHs around the world



# Summary Propagation-Predictions

Nov., Morocco (Casablanca), for SSN = Very High, Sigs in S-Units. By N6BV, ARRL.

UTC	80 Meters						40 Meters						20 Meters						15 Meters						10 Meters						UTC						
	EU	FE	SA	AF	AS	OC	NA	EU	FE	SA	AF	AS	OC	NA	EU	FE	SA	AF	AS	OC	NA	EU	FE	SA	AF	AS	OC	NA	EU	FE		SA	AF	AS	OC	NA	
0	9+	-	9	9+	9	-	9+	9+	8	9+	9+	9+	-	9+	9	9+	9+	9+	9+	9+	9+	9+	-	8	9+	9+	3	9+	-	-	4*	9+	9	-	6	-	0
1	9+	-	9	9+	9	-	9+	9+	7	9+	9+	9+	-	9+	9	9+	9+	9+	9+	9	8	-	7	9+	9+	-	9+	-	-	2*	9+	8	-	7	-	1	
2	9+	-	8	9+	9	-	9+	9+	-	9+	9+	9+	-	9+	9	9	9+	9+	9+	8	9	-	4	9+	9+	-	8	-	-	1*	9+	8	-	-	-	2	
3	9+	-	8	9+	9	-	9+	9+	-	9+	9+	9+	5	9+	8	9	9+	9+	9+	9	9	9+	-	-	9+	9+	-	-	-	-	8	5	-	-	-	3	
4	9+	-	9	9+	6	-	9+	9+	-	9+	9+	9+	7	9+	5	5	9+	9+	8	9	9+	-	-	9	8	-	-	-	-	-	-	5	-	-	-	4	
5	9+	-	9	9+	2	5	9+	9+	-	9+	9+	9	8	9+	6	5	9+	9+	9+	4	9+	-	-	-	6	1	1	-	-	-	5	-	-	-	5		
6	9+	-	9+	9+	-	5	9+	9+	-	9+	9+	5	9	9+	9+	8	8	9+	9+	4	6	-	8	1*	8	9+	7	-	-	2	-	7	2	6	-	6	
7	9+	-	9	9+	-	-	9+	9+	3	9+	9+	3	8	9+	9+	9	9+	9+	9	7	9	9+	9	4	9+	9+	8	-	-	9	-	7	9+	9	-	7	
8	9	-	7	9+	-	-	9	9+	2	9+	9+	1	7	9+	9+	9	9+	9	9+	9+	9+	9+	9+	9+	8	-	9	9	8	9+	9+	9	-	8			
9	4	-	3	9+	-	-	6	9	-	9	9+	-	-	9	9+	9	9+	9	9+	9	9	9+	9	9+	9+	9+	9+	4	9+	9	9	9+	9	-	9		
10	-	-	-	9+	-	-	1	9	-	5	9+	-	-	8	9+	9	9+	9	9	9	9+	9+	9	9+	9+	9+	7	9+	9	9	9+	9	9	1	10		
11	-	-	-	9+	-	-	-	8	-	1	9+	-	-	5	9+	8	9	9+	8	7	9+	9+	9	9+	9+	9	9	9	9+	9	9	9	9	8	11		
12	-	-	-	9+	-	-	-	7	-	-	9+	-	-	1	9+	8	8	9	9	8	9	9+	9	9+	9+	9	9	9+	9+	9	9	9	9	9	12		
13	-	-	-	9+	-	-	-	7	-	-	9+	-	-	-	9+	8	2	9+	9	8	9	9+	9	9	9+	9	9+	9	9+	9	9	2	9	9	13		
14	-	-	-	9+	-	-	-	8	-	-	9+	4	-	-	9+	9	3	9+	9+	9	9	9+	9	9	9+	9	9+	9	9+	9	2	9	9	9+	14		
15	2	-	-	9+	-	-	-	9	-	-	9+	7	-	2	9+	9	5	9+	9+	9	9+	9+	9	9+	9+	9+	9+	9+	9	9	9	9	9	9	15		
16	9	-	-	9+	2	-	-	9+	7	-	9+	9	4	4	9+	9+	8	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9	9	1	9	8	9+	16		
17	9+	-	-	9+	6	-	-	9+	8	-	9+	9	8	7	9+	9+	9	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	6	9	9	6*	8	7	9+	17
18	9+	7	-	9+	8	3	2	9+	9	1	9+	9+	9	8	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	-	9	9	1	4*	9	9	18	
19	9+	7	-	9+	8	6	6	9+	9	5	9+	9+	9	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	-	9	9	9	2*	4	9	19	
20	9+	8	1	9+	9	6	8	9+	9	8	9+	9+	9	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9	9	9	-	7	9	4	-	3*	4	20		
21	9+	8	6	9+	9	6	9	9+	9	9	9+	9+	9	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9	8	9	-	1	9	8	-	3*	2*	21		
22	9+	7	8	9+	9	1	9+	9+	9	9+	9+	9+	9	9+	9	9+	9+	9+	9+	9+	9+	9+	9+	9+	9	7	-	6	9	9	-	4*	2*	22			
23	9+	8	9	9+	9	-	9+	9+	9	9+	9+	9+	8	9+	9	9+	9+	9+	9+	9+	9+	9+	9+	9	9	-	-	4	9	9	-	4*	1*	23			



# Detailed Propagation Predictions

10 Meters: Nov., Morocco (Casablanca), for SSN = Very High, Sigs in S-Units. By N6BV, AI

Zone	UTC -->																								
	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
KL7 = 01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	4	-	-	-	-	-	
VO2 = 02	-	-	-	-	-	-	-	-	-	-	1	8	1	2	3	3	1	3	4	5	1*	-	-	-	-
W6 = 03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	9	9	9	4	-	-	-	-	
W0 = 04	-	-	-	-	-	-	-	-	-	-	-	-	8	9	9+	9+	9+	9	8	1	-	-	-	-	
W3 = 05	-	-	-	-	-	-	-	-	-	-	-	-	9	9	9+	9	9	9	8	3*	2*	2*	1*	-	
XE1 = 06	-	-	-	-	-	-	-	-	-	-	-	-	1	9	9	9	9	9	9	4	-	-	-	-	
TI = 07	-	-	-	-	-	-	-	-	-	-	-	2	9	9	9	9	9	9	9	9	6	1	-	-	
VP2 = 08	-	-	-	-	-	-	-	-	-	8	9+	9+	9	9	9	9	9	9+	9+	9+	8	1	-	-	
P4 = 09	-	-	-	-	-	-	-	-	-	-	-	9+	9+	9	9	9	9+	9+	9+	9	6	-	-	-	
HC = 10	1	-	-	-	-	-	-	-	-	-	-	7	9	9	9	9	9	9	9+	9	6	4	-	-	
PY1 = 11	9+	9	8	8	-	-	-	-	9	9	9	9	9	9	9	9	9	9	9+	9+	9+	9+	9+	9+	
CE = 12	9+	9+	9	6	-	-	-	8	9	9	9	8	8	8	8	8	9	9	9+	9+	9+	9+	9+	9+	
LU = 13	9+	9+	9+	8	-	-	-	-	2	9	9	9	9	9	9	9	9	9	9+	9+	9+	9+	9+	9+	
G = 14	-	-	-	-	-	-	-	7	9+	9+	9+	9+	9+	9+	9+	9+	9+	6	-	-	-	-	-	-	
I = 15	-	-	-	-	-	-	-	9	9+	9+	9+	5	6	6	6	9+	5	1	-	-	-	-	-	-	
UA3 = 16	-	-	-	-	-	-	-	6	9+	9+	9+	9+	9+	9+	6	-	-	-	-	-	-	-	-	-	
UN = 17	-	-	-	-	-	-	7	8	9	9	8	8	6	8	-	-	-	-	-	-	-	-	-	-	
UA9 = 18	-	-	-	-	-	-	4	9	9	9	9	8	7	1	-	-	-	-	-	-	-	-	-	-	
UA0 = 19	2*	2*	1*	-	-	-	-	9	9	5	-	-	-	-	-	-	-	-	-	-	-	-	2*	-	
4X = 20	1	-	-	-	-	7	2	9+	9+	9+	2	2	4	9+	9+	2*	1*	-	9	8	7	4	1	-	
HZ = 21	-	-	-	-	-	-	9+	9+	9+	9	9+	9+	9+	9+	9+	9+	8	4*	2*	-	-	-	-	-	
VU = 22	-	-	-	-	-	2	9	9	9	9	9	9	9+	8	5	-	-	-	-	-	-	-	-	-	
JT = 23	-	-	-	-	-	5	9	9	9	9	9	7	-	-	-	-	-	-	-	-	-	-	-	-	
VS6 = 24	-	-	-	-	-	9	9	9	9	9	9	9	9	4	-	-	-	-	-	-	-	-	-	1*	
JA1 = 25	4*	2*	1*	-	-	-	1	9	8*	4*	3*	1*	1*	-	-	-	-	-	-	-	-	-	2*	2*	
HS = 26	-	-	-	-	-	2	9	9	9	9	9	9	9+	9	9+	9+	9+	9+	6	2	-	-	-	-	
DU = 27	-	-	-	-	-	9	9	9	9	9	9	9	9	9	9	8	2	-	-	-	-	-	-	1*	
YB = 28	-	-	-	-	-	2	8	9	9	9	9	9	9	9+	9+	9+	9+	9+	9	7	1	6	4	-	
VK6 = 29	6	7	-	-	-	6	7	8	8	7	7	6	1	-	3	4	3	1	-	-	-	-	-	1	
VK3 = 30	5	4	-	-	-	3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	
KH6 = 31	2*	2*	-	-	-	-	5*	2*	1*	1*	-	-	-	-	-	-	7	9	3*	3*	3*	1*	1*	-	
KH8 = 32	4*	3*	-	-	-	-	1*	-	7	8	6	7	5	1	-	-	7	9	4	1*	2*	4*	4*	-	
CN = 33	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
SU = 34	2	1	-	-	-	7	-	9+	9+	9+	4	3	6	9	9+	4	5*	9	9+	9	9	9	7	4	
6W = 35	9	8	6	2	-	-	-	9+	1*	2	-	-	-	-	-	-	-	5	4	9	9	9	9	9	
D2 = 36	6	7	8	-	-	-	7	5	2	2	1	2	2	2	1	2*	1*	7	6	-	-	1	5	-	
5Z = 37	9	8	2	-	-	5	9+	9+	9+	9+	6	6	9+	9+	6	1	6*	1	1	4	8	9	9	9	
ZS6 = 38	9	8	5	-	-	1	9	9	9	8	9	9	9	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	9	
FR = 39	8	4	1	-	-	5	9	9	8	9	9	9	9	9+	9+	9+	9+	9+	9+	9+	9+	9+	9+	8	
FJL = 40	-	-	-	-	-	-	-	-	2	8	9	9	9	9	5	-	-	-	-	-	-	-	-	-	
Zone	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	

Expected signal levels using 1500 W and 4-element Yagis at 60 feet at each station.

# ANTENNA BOOK



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