High performance RX antenna for a small lot

Jose Carlos        N4IS
Receiver antennas for small lot

Basic concepts to receive weak signals

- Directivity & gain
- RDF
- Interaction and degradation
- Urban noise
- Receiver antenna definition

New olds receiver antennas

- Historic evolution
- Single direction EWE FLAG DHDL
- Rotatable antennas HWF VWF
- High performance RX systems Dual DHDL; QDFA

RX antennas not sensible for man-made noise

- TX antenna interaction
- Common mode noise
- TX/RX leaking
- Polarization filter HWF
- Twisted pair lines
- HWF single loaded loop construction
- HWF dual loaded loop construction
- Multiples loaded loops RX arrays
Basic concepts

Jose Carlos       N4IS
RX antennas directivity & gain

- It all about signal noise ratio
- Minimum Detected signal “MDS”

The ability to copy a weak signal depends mainly on the difference between the signal and receiver output noise.

Signal 30db above noise
Noise floor
Bandwidth
Signal at noise level
• The gain is the difference between an amplifier input and output intensity.
  
  – Adding a 18 db gain amplifier, the signal and the noise will increase 18db and the signal noise still will be the same.
RX antennas directivity & gain

1840 KHz carrier received with vertical TX antenna

Same signal received with a Big Waller Flag
When the signal is above noise there is little difference on the audio. The receiver AGC will make the strong signal just more comfortable to copy but it should not be used for evaluation of the receiver antenna.

A good receiver antenna will provide copy of weak signals not present or buried in the noise on the transmit antenna.
Directivity & RDF
RDF

- RDF = Gain – Average Gain

RDF = -18.0 - (-28.47) = 10.47 dB
RDF for known antennas

- VERTICAL 1/4
- Inverted V 160m 40m de altura
- Dipole 160m 20 m high
- Vertical
- HWF Beverage 1 wave
- Waller Flag: 40, 25, 10
- Beverage 1 wave DHDL
- DHDL X
- Beverage 2 waves long
RDF for known antennas

- **2 Element vertical**: 8 dB
- **4 square**: 9 dB
- **Yagi - 2 elements**: 10 dB
- **Quad - 2 elements**: 11 dB
- **Yagi - 3 elements**: 12 dB
- **Yagi - 5 elements**: 13 dB

Horizontal HF
- (PY2XB PY1RO)
- WF N4IS 160 80 40 m
- HWF 3.5 MHz
- 3 x WF
- 4 x WF or EWE
- 4 x DHDL
Power line noise at home

<table>
<thead>
<tr>
<th>Standard S meter</th>
<th>S 1</th>
<th>S 2</th>
<th>S 3</th>
<th>S 4</th>
<th>S 5</th>
<th>S 6</th>
<th>S 7</th>
<th>S 8</th>
<th>S 9</th>
</tr>
</thead>
</table>
What we can really hear?

SSB 3 db 2,5KHz        CW 0 db 100Hz

160 m  47 dBm  42 dBm  30 dBm
80 m  35 dBm  30 dBm  22 dBm
40 m  20 dBm  15 dBm  10 dBm

Man-Made Noise in a 500Hz Bandwidth
from Rec. ITU-R P.372.7 Radio Noise

residential         blue  rural        green  quiet rural      black  typical receiver MDS

RECEIVER NOISE FLOOR
New RX antennas

Jose Carlos        N4IS
History of Flag RX antenna


1995 JF1DMQ wrote an earlier article about the Flag antenna in November 1995 in a Japanese magazine. His was only 3.3 feet by 16.4 feet long (1 by 5 m). K6SE's 160m optimized versions are 14 by 29 feet (4.3 by 8.8m).

1995 "Is This EWE for You?" (QST February, 1995, p.31) and "More EWES for You", QST January, 1996, p. 32) both by WA2WVL.

1996 The Pennant was originated by EA3VY and optimized for 160 meters by K6SE, who first wrote about them on the Top Band Reflector in 1998

1997 The K9AY Terminated Loop—A Compact, Directional Receiving Antenna By Gary Breed, K9AY

1998 W7IUUV rotatable Flag and preamplifier >> http://w7iuuv.com/

2000 QST Magazine, July 2000, page 34 for K6SE's classic article: "Flags, Pennants, and Other Ground-Independent Low-Band Receiving Antennas" ...

2003 NX4D developed the first dual flag vertical array

2006 N4IS developed the BIG flag vertical array >> www.n4is.com

2008 N4IS developed the Horizontal flag array

2009 Dr Dallas Lankford, wrote the Flag Theory and design the Quad Flag Array >> http://www.kongsfjord.no/dl/dl.htm

2009 AA7JV George Wallner developed the DHDL (TX3A) >> http://tx3a.com/docs/TX3A_DOUBLE_HALF_DELTA_LOOP.ZIP

To a large and enthusiastic audience composed of radio engineers and scientists of prominence, at a joint meeting of the Institute of Radio Engineers and the New York Electrical Society, held March 5, 1919, Roy A. Weagant, Chief Engineer of the Marconi Wireless Telegraph Co. of America, delivered a paper describing in detail his apparatus for the elimination of the great bug-bear of transoceanic wireless communication -- static interference.

Figure 17—Reception curve of the Weagant system showing the unidirectional characteristic which may be obtained by proper adjustment of the phases of the currents in one loop. Maximum reception is obtained in directions extending through part of the first and second quadrants and minimum reception in the third and fourth quadrants. The line of zero reception may be swung through the third and fourth quadrants as will, by proper phase shifting.
Flag EWE Delta Pennant etc.

+ Resistor and Transformer
Two vertical in phase RDF = 8.25 dB
EWE RDF = 7.02 dB
Dual Half Dual Loop AA7JV
Dual DHDL Quad WF

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azimuth Plot</td>
<td></td>
</tr>
<tr>
<td>Elevation Angle</td>
<td>18.0 deg.</td>
</tr>
<tr>
<td>Outer Ring</td>
<td>-37.51 dBi</td>
</tr>
<tr>
<td>Cursor Az</td>
<td>180.0 deg.</td>
</tr>
<tr>
<td>Gain</td>
<td>-37.51 dBi</td>
</tr>
<tr>
<td>3D Max Gain</td>
<td>-37.51 dBi</td>
</tr>
<tr>
<td>Slice Max Gain</td>
<td>-37.51 dBi @ Az Angle = 180.0 deg.</td>
</tr>
<tr>
<td>Front/Back</td>
<td>41.1 dB</td>
</tr>
<tr>
<td>0.0 dBmax</td>
<td>0.0 dBmax</td>
</tr>
<tr>
<td>0.0 dBmax3D</td>
<td>0.0 dBmax3D</td>
</tr>
<tr>
<td>Beamwidth</td>
<td>70.5 deg.; -3dB @ 144.8, 215.3 deg.</td>
</tr>
<tr>
<td>Sidelobe Gain</td>
<td>-61.46 dBi</td>
</tr>
<tr>
<td>Front/Sidelobe</td>
<td>23.95 dB</td>
</tr>
</tbody>
</table>
QUAD DHDL and Quad WF
Twisted pair

Big Waller Flag

RL1 = 820 Ohms
RL2 = 836 Ohms
TR1 = TR2
9:1 BALUN

PL2

TR3 1:1 BALUN
PL1 = PL2 100 ohms Balanced Line

CHOKE 50 ohms line

CHOKE
Waller Flag feed system

**INVERT WIRES TO GET 180 DEGREE PHASE**

**9:1 BALUN**

**TAPE TWO FT50B-77**
1 turn = 1 pass  2 turns = 2 passes

**1:1 BALUN**

**50 ohms**

**PG 58**

**PHASE LINE OPTIONS**

1. TAPE 2 RG58 TOGETHER SOLDER SHIELDS EACH END
2. 100 ohms Balanced Coax
3. ZIP cord inside the boom

**Belden 2907 Twinax**

**ZIP CORD or SPEAKER WIRE**
Transformer 9:1
NX4D BIG Vertical Waller Flag

15 m

8 m

15 m
N4IS Vertical Waller Flag VWF

15 m
N4IS Horizontal Waller Flag HWF
PY1RO single HWF
PY2XB Single HWF

50 MHz yagi

HWF

50 MHz yagi
N8PR WF with polarization rotation.
N2NL  WF  all PVC
TX3A ( AA7JV ) DHDL
N4IS all metal WF 2009
New solution to fight power line noise

Jose Carlos        N4IS
Polarization filter HWF

* Total Field
  Horizontal Pol
  Vertical Pol

- 30 db

1.83 MHz
Polarization filter HWF

### Total Field

- **Horizontal Pol**
- **Vertical Pol**

#### Parameters:
- **Azimuth Plot**: 38.0 deg.
- **Elevation Angle**: 0 deg.
- **Outer Ring**: -50.47 dBi
- **3D Max Gain**: -50.47 dBi
- **Slice Max Gain**: -50.47 dBi @ Az Angle = 180.0 deg.
- **Front/Back**: 25.31 dB
- **Beamwidth**: 84.1 deg; -3dB @ 138.0, 222.1 deg.
- **Sidelobe Gain**: -70.61 dBi @ Az Angle = 44.0 deg.
- **Front/Sidelobe**: 20.14 dB

**Gain**: -50.47 dBi
**Cursor Az**: 180.0 deg.
**Cursor Gain**: -50.47 dBi
**0.0 dBmax**: 0.0 dB
**0.0 dBmax3D**: 0.0 dB
N4IS Horizontal Waller Flag 2012
N4IS preamps
RF CHOKE

http://www.yccc.org/Articles/W1HIS/CommonModeChokesW1HIS2006Apr06.pdf

http://audiosystemsgroup.com/publish.htm

Coaxial Transmitting Chokes
Jim Brown K9YC

http://audiosystemsgroup.com/RFIHamNCCC.pdf
AC filter at N4IS
AC filter at N4IS
Don’t need to move out in the woods, just improve your receiving system and enjoy the good stuff.