“A Beginners Guide to Making Antennas”
What criteria am I looking for in an antenna?

- It is like looking for a car.
  - How many people will it hold?
  - What is the gas mileage?
  - 2 wheel drive, 4 wheel drive, all wheel drive?
  - Does it have enough power to tow my boat?
What criteria am I looking for in an antenna?

- Polarity
- Gain
- Size
- Directionality
- Portability
- Multi band
Gain

- What gain is
- How it is expressed
- How it is connected to an antenna
Gain (Horse Power + Drivetrain)

- An antenna's **power gain** or simply **gain** is a key performance figure which combines the antenna's directivity and electrical efficiency. As a transmitting antenna, the gain describes how well the antenna converts input power into radio waves headed in a specified direction. As a receiving antenna, the gain describes how well the antenna converts radio waves arriving from a specified direction into electrical power. Due to reciprocity, the specified gain for any antenna applies identically whether it is used for transmitting or receiving.
Gain

- Antenna gain can be specified in a few different ways, sometimes invoking confusion. Most often gain is expressed in decibels with the units denoted as $dBi$. However sometimes the gain is compared to the maximum gain of a lossless half-wave dipole antenna (1.64-2.2) in which case the units are written as $dBd$.

- Gain is always a comparison to something else
Gain

- For a given frequency the antenna's effective area is proportional to the power gain. An antenna's effective length is proportional to the square root of the antenna's gain for a particular frequency and radiation resistance.

- In other words, as the length increases the gain increases exponentially.

- It is like a fishing net, the bigger it is the better chance you have to catch something.
Why do I care?

- Gain is a major factor as to how well an antenna functions both in transmit and receive.

- **Power Gains**
  - 3 db = X2 power
  - 6 db = X4 power
  - 10 db = X10 power
  - 20 db = X100 power

- **Power Loss**
  - -3 db = ½ power
  - -6 db = ¼ power
  - -10 db = 1/10 power
  - -20 db = 1/100 power
Reading Materials

- ARRL Antenna Source Book
- QST Magazine
- Internet
  - Most of the designs in this presentation were found online.
Basic antenna types

- Dipole antenna, consists of 2 radiating elements apposed from each other, feed point is at the center of the 2 elements
- Ground plane antenna, consists of one radiating element and a ground plane, feed point is at the connection of the ground plane and the radiating element
- Yagi antenna, directional dipole, dB, how long do you want to make it?

  - 1/4 Wave length radiators 2.2 dBi, 0 dBd
  - 1/2 Wave length radiators 3.8 dBi, 1.6 dBd
  - 5/8 Wave length radiators 5.2 dBi, 3.0 dBd

This reference material uses 2.2 dB as dipole gain
Collinear Antennas

- A collinear antenna is 2 or 3 radiating elements stacked on top of each other separated by a phasing coil to increase gain
- 5/8 Wave over 1/4 wave 5.4dBi, 3.2dBd
- 5/8 Wave over 1/2 wave 5.6dBi, 3.4dBd
- 5/8 Wave over 5/8 Wave over 1/4 wave 7.2dBi, 5.0dBd
- 5/8 Wave over 5/8 Wave over 1/2 wave 7.6dBi, 5.4dBd
J Pole

1/2" Rigid Copper Plat
Cap ends with 1/2" caps
and solder.

705/f(MHz) = Feet
"A"

22/f(MHz) = feet
"D"

Multiply feet by 12 to get total inches.

234/f(MHz) = feet
"B"

23/f(MHz) = feet
"C"

Connect Coax Shield Here

Connect Coax Center Here

2' Stainless Steel Hose Clamps
Arrow J pole

Simply the Best
Does NOT require a ground plane.
Mount on a metal mast.

Ideal for mounting in an attic,
On a roof vent pipe, (up to 1 1/2")
On a wooden or Fiberglass pole,
On Fiberglass or Plastic Vehicles,
(Motorhomes, Trucks, Boats)
Mount it just about anywhere.

Low SWR - Wide Bandwidth

Has Gain over a 1/4 wave.

Omnidirectional.

This is a very Heavy Duty Antenna.
The Elements are made from 3/8"
Solid Round Aluminum with a Heavy
Duty Angle Mounting Bracket.

Mounting Hardware for
mast up to 1 1/2" included.

Covers 150-162 MHz.
With an VSWR of less than 1.5 - 1

Covers 143-148 MHz. VHF
Covers 437-450 MHz. UHF
With an VSWR of less than 1.5 - 1
Horizontal Dipole
Vertical Dipole

1/4 Wavelength

20 inches

Balun 5 to 6 turns

Hose clamps

Zip Tie as needed

Not Drawn to Scale

N4UJW
Vertical with Ground Plane

http://ham-antennas.blogspot.com/
Stacked J Pole

YOU CAN BUILD A 5/8th WAVE STACKED J-POLE FOR ABOUT $20.00!

PVC 3/4” 10' WHITE

#14 SOLID COPPER ABOUT 12”

WOOD DOWL

A PACKAGE OF WIRE TIES TO BE USED TO ATTACH AND HOLD WIRE TO PVC

COPPER WIRE #6 SOLID 161 1/2” TOTAL

GROUNDING WIRE

MEASURE AND MARK REFERENCE POINTS ON WIRE

PLACE WOOD DOWL INSIDE PVC AND DRILL HOLES

MAKE FIRST BEND IN WIRE AT “BEND-4” AND FEED WIRE THROUGH

AFTER MAKING THE REST OF THE BENDS AND FITTING THE WIRE TO THE PVC PLACE WIRE TIES ABOUT EVERY 12” TO KEEP WIRE STATIONARY

DRILL

ABOUT 5” OF WOOD DOWL TO ATTACH TO A GROUNDED MAST SECTION

TIP: BUT BLUE THE WIRE TIES TO THE PVC...

47 1/2”

76”

48 1/2”

115”

142”

143”

161 1/2”

Steve W. Merrill KB1DIG Email: buck0@mediamere.net

SHOULD LOOK SOMETHING LIKE THIS WHEN YOUR DONE

OVER 6th GAIN!

3.8 waves

3.8 waves filled

5.6 waves

1.2 wave folded matching section

GROUND SIDE OF FEED 30’ 70 1/8 WAVE MATCHING SECTION

2 TURNS IN COAX

SOLDER ATTACH TO MAST #14 WIRE

DRILL

47 1/2”
Stacked Vertical

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<th>MODEL</th>
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<tr>
<td>FB3800WA</td>
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**SPECIFICATIONS**

- **GAIN**: 7.2 dBi
- **TYPE**: 5/8 over 5/8 over 1/4 wave
- **VSWR**: 2:1
- **COLOR**: Black
- **WHIP**: .100, twin open coil
- **POWER RATING**: 150 Watts
- **MAX HEIGHT**: 32”
- **FEED CONNECTION**: N Female
- **WIND LOAD**: 100 mph
Yagi
Construction tips

- Soldering
  - Solder iron
  - Solder gun
  - Propane torch

- Heat shrink
  - Encapsulating
  - Non encapsulating

- PVC tubing

- Loading effect
- Ferrite chokes
- Waterproofing
SWR

- VSWR Voltage standing wave ratio, commonly referred to as SWR.

- The SWR of the antenna is the ratio of the maximum to minimum values of voltage in the standing wave pattern appearing along a transmission line with an antenna as a load.

- Basically it is an indication of how much energy is being radiated and how much is being reflected back, typically < 2:1 SWR is ok.
SWR

- Now, just because the SWR of an antenna is less than 2:1 does not mean it is radiating energy
- A 50Ω load or 1000 ft of coax will result in a very low SWR
- Low SWR is an indicator that it will not harm the transmitter, using tried and tested designs ` having a low SWR will usually result in a good performing antenna
Test Equipment

- SWR Meter
- SWR Tester
- Antenna Analyzer
- Field Strength Meter
SWR Meter

- SWR meter is the minimum test equipment needed to tune an antenna. (frequency specific)
- An SWR meter measures how much power is reflected back toward the radio from the antenna
- When using this method you will need to announce your call sign when testing, and stay 5 KHz inside the ham bands
SWR Tester

- This is similar to an SWR meter but the SWR tester has its own transmitter that has a dial to sweep a frequency range very quickly and display SWR as it sweeps across the band.
Antenna Analyzer

- An SWR analyzer does more than just tell you SWR ratio, depending on the make and model it will display information like:
  - Impedance
  - Inductance
  - Phase shift
  - Frequency
- If you are serious about designing antennas you will need an antenna analyzer
Field Strength Meter

- A field strength meter measures the strength of the Rf field generated by a transmitting antenna.
- Basically this is a comparative device to determine RF energy at a given distance, it will give you an indication of improvements you’ve made to an antenna or compare different antenna performances.
- Poor mans “gain tester”