

The background is a blue gradient with faint concentric circles. White circuit-like lines with circular nodes are positioned in the corners: top-left, top-right, bottom-left, and bottom-right.

BLACKSTONE VALLEY AMATEUR RADIO CLUB

WELCOME TO THE CONSORTIUM

FEATURED IN THE
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W1YRC Bob Beaudet

K1GND Jim Johnson

The background is a blue gradient with decorative white circuit-like lines in the corners. The text is centered and reads:

VISIT OUR WEB SITE AT
WWW.W1DDD.ORG
FOR DETAILS OF
UP COMING EVENTS
AND CLUB ACTIVITIES



SMALL HF ANTENNAS

THE SMALL SPACE AND BIG ANTENNA DILEMMA

CONSTRAINTS

COVENANTS

RESTRICTED LOT SIZE

CITY BYLAWS

BOARDS OF VARIANCE

STRATA RULES

NEIGHBOR COMPLAINTS OF UNSIGHTLY STRUCTURES

WHAT ELSE AS IF THAT'S NOT ENOUGH ?

THE CHALLENGE

- How to make HF antennas perform in small spaces
- Small antennas

Small means shorter antennas that fit available space

- How to make a **STEALTH** antenna

Antennas that are visible but don't look like antennas

- How to Hide antennas

Out of sight but somewhere in/on the housing structure

OPERATING ISSUES

- Performance issues using short antennas

Lower gain – less “wire in the sky”

Narrower bandwidths – tuning required

- Interference more likely

Proximity to audio, video, AM, FM, PC, Tel, etc. equipment

QRP to 100 watts probably max

- Safety issue

You and the antenna may share the same space

RF biological exposure limits to be checked

Structural integrity of mounted antennas – make secure

BUILDING RF TRANSPARENCY

- Wooden frame structures

RF transparency – good

Internal conductors – “antennas”

Power, telephone, cable, alarm, etc. wiring

Copper plumbing

- Concrete structures

RF shielded at HF

Rebar and metal framed windows – small aperture

Metal 2 X 4 framing inside building

Internal conductors

WHICH FLOOR? APT. / CONDO

- Top floor
 - access to roof top antennas
 - short feeder runs
 - best separation from tenants, none above
- Bottom
 - access to ground mounted antennas
 - grounding systems possible
 - feeder runs OK
 - tenant spacing, top & 2 sides
- Mid floors
 - interior or balcony mounted antennas
 - tenants all around



SOME ANTENNA THEORY

- BASIC ANTENNA FORMS – ONLY 2
 - DIPOLE FORM
 - VERTICAL FORM
- UNDERSTANDING SHORT ANTENNAS
 - PROPERTIES
 - BEHAVIOR
 - PERFORMANCE
- WHAT TYPE MIGHT BE BEST DEPENDS ON CIRCUMSTANCES

ANTENNA CIRCUIT

- Generator – the transmitter
- Feedline – two conductors
- Antenna – two wires
- Antenna as $R = \text{radiation resistance at resonance}$
- Complete the circuit – current must flow entirely around the loop

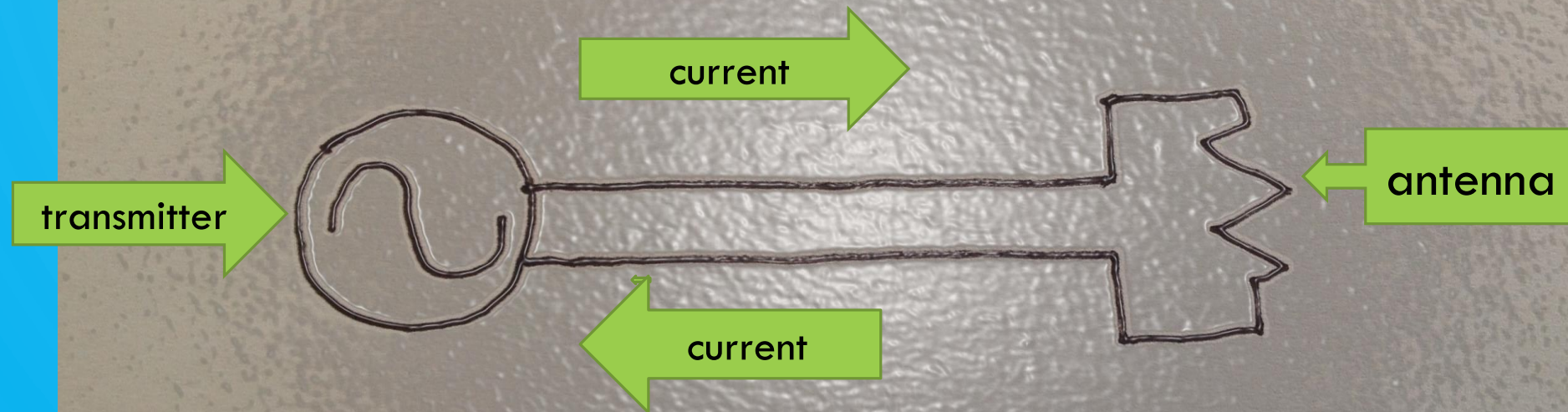
Antenna Circuit

Generator – the transmitter

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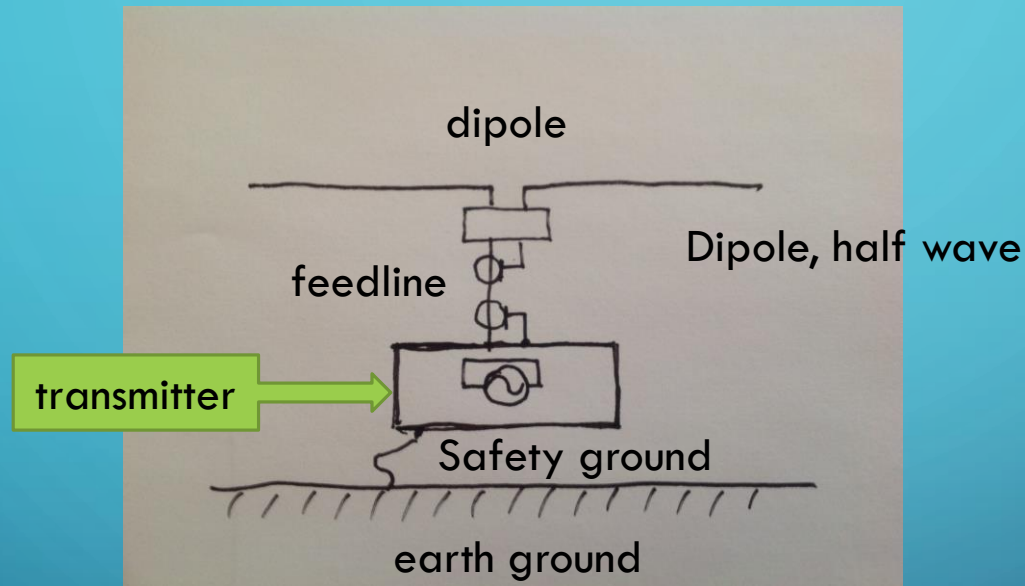


DIPOLE ANTENNA

NO EARTH CONNECTION REQUIRED FOR ANTENNA – GOOD
ANTENNA RADIATES INDEPENDENT OF GROUND
RIG GROUNDED BY GREEN WIRE IN POWER CORD – SAFETY
THIS GROUND IS NOT PART OF THE ANTENNA SYSTEM.

Dipole Antenna

- No earth connection required for antenna – good!
- Antenna radiates independent of ground
-



- Rig grounded by green wire in power cord – SAFETY
- This ground is not part of the antenna system

DIPOLE ANTENNA



VERTICAL ANTENNA

- Antenna operates “against” ground
- Ground circuit is required – real earth or artificial
- Ground is the other half of the antenna circuit
- Ground consists of a conductive surface to mirror the top half of a vertical quarter wave antenna
- Rig grounded by green wire in power cord – SAFETY
- Safety ground could become part of antenna system
- Not desirable

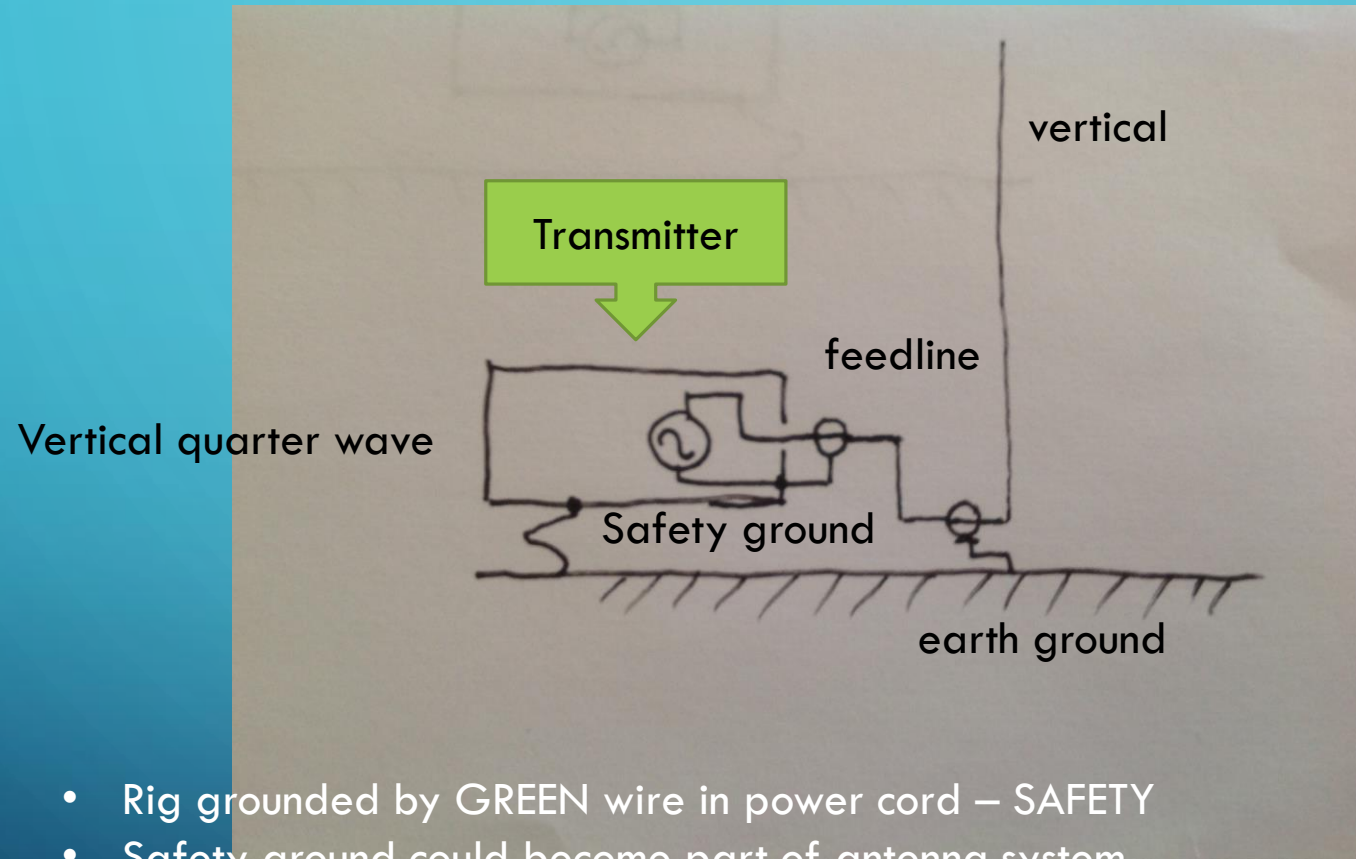


radials

VERTICAL ANTENNA

Vertical Antenna

- Antenna operates “against” ground
- Ground circuit is required – real earth or artificial
- Ground is the other half of the antenna circuit
- Ground consists of a conductive surface to mirror the top half of the antenna



- Rig grounded by GREEN wire in power cord – SAFETY
- Safety ground could become part of antenna system
- Not desirable

STANDARD ANTENNA

to which most other antennas are compared

- Resonant Half Wave dipole
- At resonance, feed point ~ 50 ohms (radiation resistance)

Good match to 50 ohm coax

Low VSWR

Maximum power transfer from rig to antenna

- Short antenna performance measured against this

Gain, impedance, bandwidth

SHORT ANTENNA PROPERTIES

- Antenna gain is reduced due to shortness
- Feed point impedance changes
 - radiation resistance drops significantly
 - capacitive reactance appears at the feed point
 - feedline matching becomes poor and high VSWR results
- Efficiency drops
 - ohmic losses become a significant part of the feed point Z

SOLUTIONS

- Dipoles
- Loops
- Verticals
- Long (actually short) wires
- Other?

RESTORE RESONANCE

- Short antenna “looks” capacitive
- Restore feed point impedance to look resistive
- Add an inductor somewhere “in” the antenna
 - nulls out the capacitance – creates resonant circuit
 - used with both dipoles & verticals
- Add a capacitor to the end of the antenna
 - make antenna look longer (electrically) than it is
 - used most often with verticals

USE AN EXTERNAL TUNER

- Antenna is not brought back to resonance
no inductive or capacitive loading added
- Tuner matches complex antenna feed point impedance to 50 ohm output of transmitter
- Useful for multi-band operation
- Tuning limitations may be evident if tuner cannot match the antenna / feed line impedance
- Antenna is not brought back to resonance
- Rig tuners not well suited to off-resonant antennas



**EXTERNAL ANTENNA
TUNER**

LOADING COILS

- Loading Coils are inserted in series with antenna
“makes up for shortness”
- Cancels the Capacitive component
- Resonates the antenna
- Coil placement

Dipoles – one in each leg

Verticals – one towards or at the bottom

COIL LOADED DIPOLE

- Balanced system
- Single band
- No ground issues
- Reduce lengths

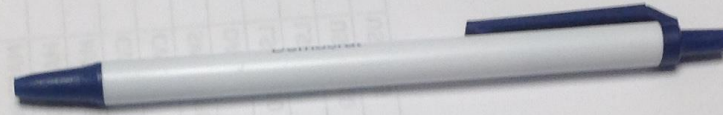
80m dipole from 132 ft to 69 ft

40m dipole from 66 ft to 38 ft

most likely an outdoor application

- Radio tuner ought to be OK

LOADING COILS



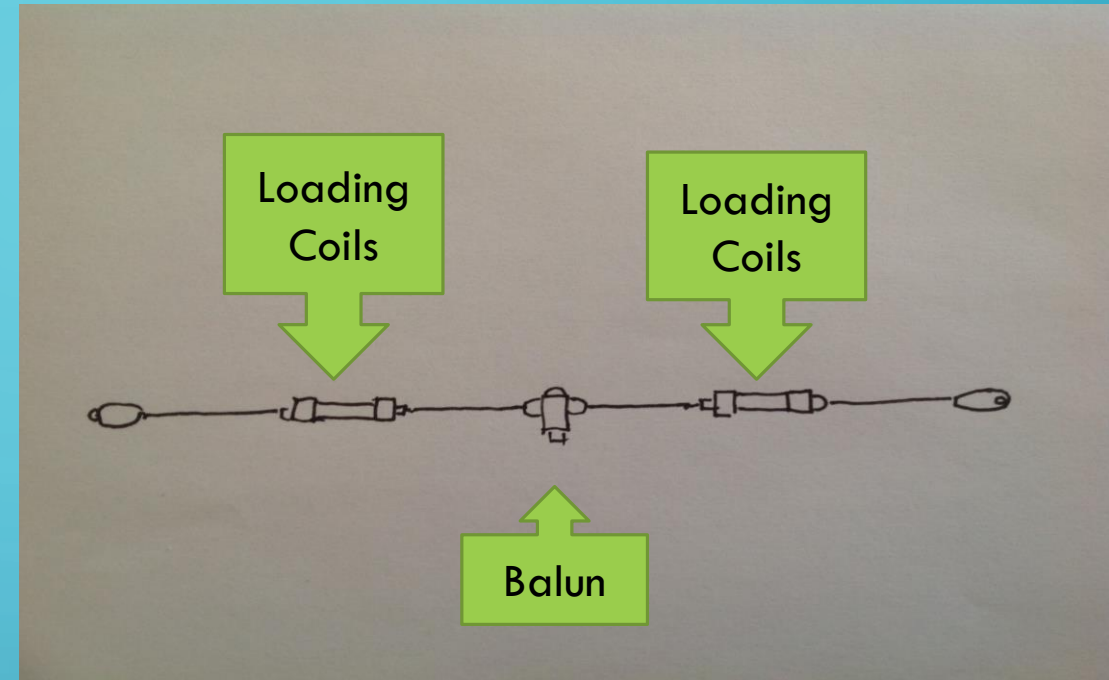
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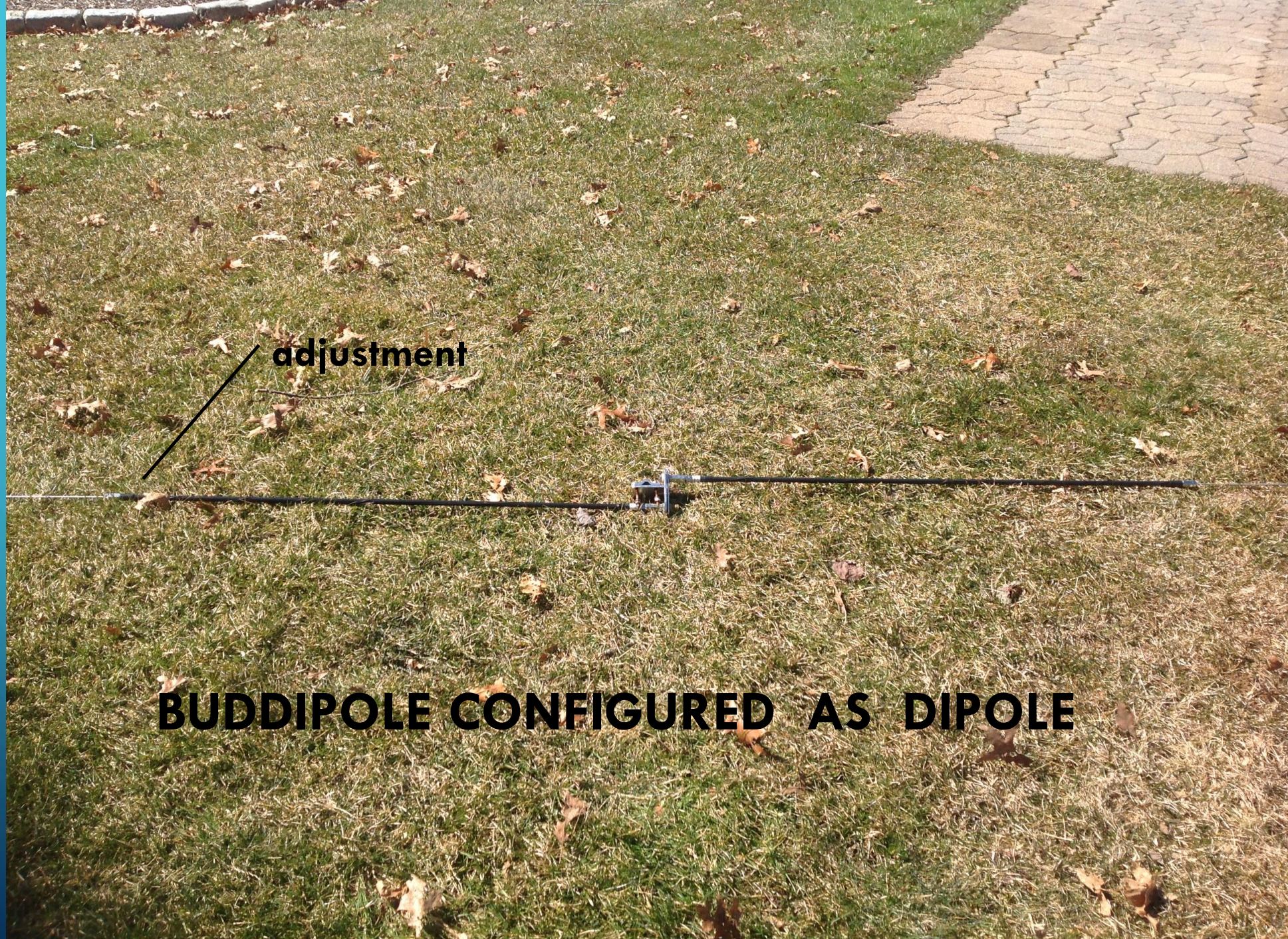


Coil Loaded Dipole

Loading Coils (2) – “Shortner”
Balun

- Balanced system
- Single band
- No ground issues
- Reduce lengths
 - 80m dipole from 132ft to 69 ft
 - 40 dipole from 66 ft to 38 ft
 - most likely an outdoor application
- Radio tuner ought to be OK





adjustment

BUDDIPOLE CONFIGURED AS DIPOLE

WIRE ANTENNAS

- Shortened, loaded balanced multi-band dipoles
 - no ground issues
 - multi band
 - outdoor
- Alpha Delta
 - DX-EE 40 ft / 40 thru 10
 - Radio tuner probably OK
- B & W
 - BWD series 20 ft / 20 thru 10m
 - Radio tuner OK
- Radio Works
 - G5RV all band
 - External tuner needed

COMPACT DIPOLES

- Ventenna (antenna that looks like a roof vent stack)
 - 20 to 10m
 - 80 & 40m options
 - length unknown
- Buddipole
 - 40 to 2m
 - coil loaded
 - collapsible
 - 16 feet extended

COMPACT VERTICAL

- Venna

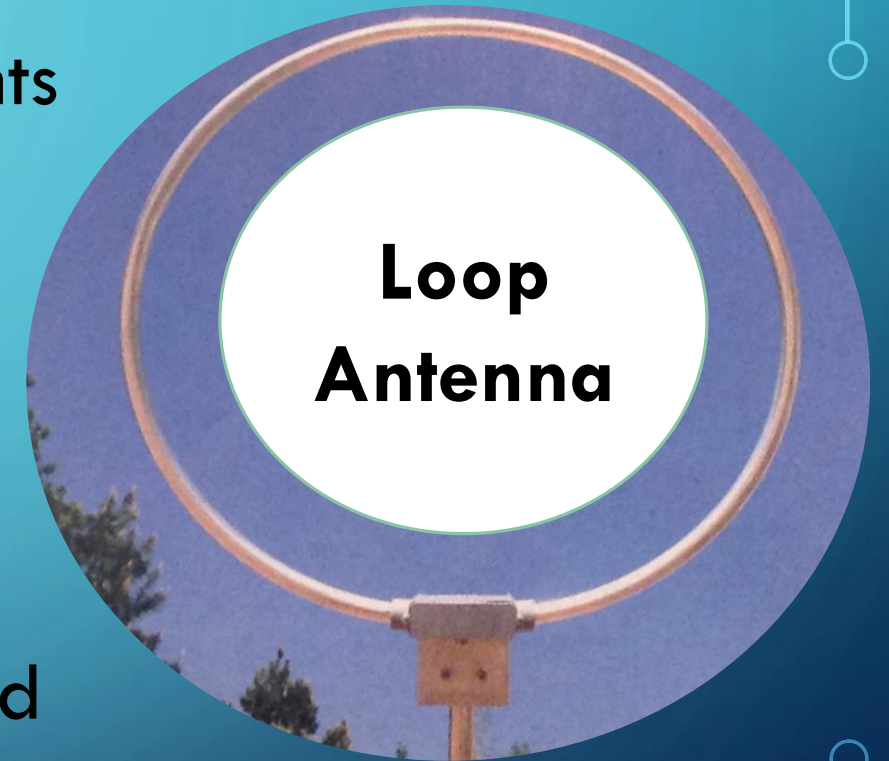
40 to 10m

80m option

length 10'6"

LOOP ANTENNA

- Small and very suitable for apartments
- 36 inch diameter
- No ground system required
- 20 thru 10m or 40 thru 15m
- Good performance reviews on eHam
- Low noise advantage
- Self tuning – no external tuner needed
- Inside or outside dwelling



WIRE LOOP ANTENNA

- Home made – construct wire loop
- Could reside inside dwelling
- Hang horizontal or vertical
- Requires external tuner & balun

LDG Z-100 tuner + balun

- No ground required
- Random length loop – big as possible

COMPACT YAGI'S

- Hybrid Quad

20 thru 6m

11 ft elements / <5 ft boom

- Mini Beam

10 thru 40m

Gain rated at ~ 6.0 dbi

Boom length (m) ~ 3.82

Radius (m) ~ 5.0

VERTICAL ANTENNAS

- Verticals are unbalanced antennas
- Require a ground plane or counterpoise
- Copper plumbing and Safety ground wiring NOT a good choice for RF ground / counterpoise
- Mounting possible off balconies, rooftops or at ground level
- Inside a dwelling, maybe not so practical

RADIAL SYSTEM

MULTI-WIRE

- A system of wires at base of vertical
 - minimum 2 per band if using multi band vertical
 - single band, try for 8 as long as possible, up to $\frac{1}{4}$ wave
- Lay radials out symmetrically as possible
- Bend ends to fit, no bends at base
- Lay radials on surfaces
 - roof, hold in place with bricks
 - lawns – trench and bury (staples available)



radials

VERTICAL ANTENNA

COUNTERPOISE

SINGLE WIRE

- A conductor(s) used as a substitute for earth or ground in an antenna system
- Usually just one or two wires
- Counterpoise will have RF on it and will radiate
- Undefined operation if using building copper pipe or safety ground wiring as counterpoise
- Artificial Ground – loads a short counterpoise

COIL LOADED VERTICAL

- Coil at base = feed point
- Intended for mobile applications
- Uses car body as counterpoise
- Use as base with a radial or counterpoise system

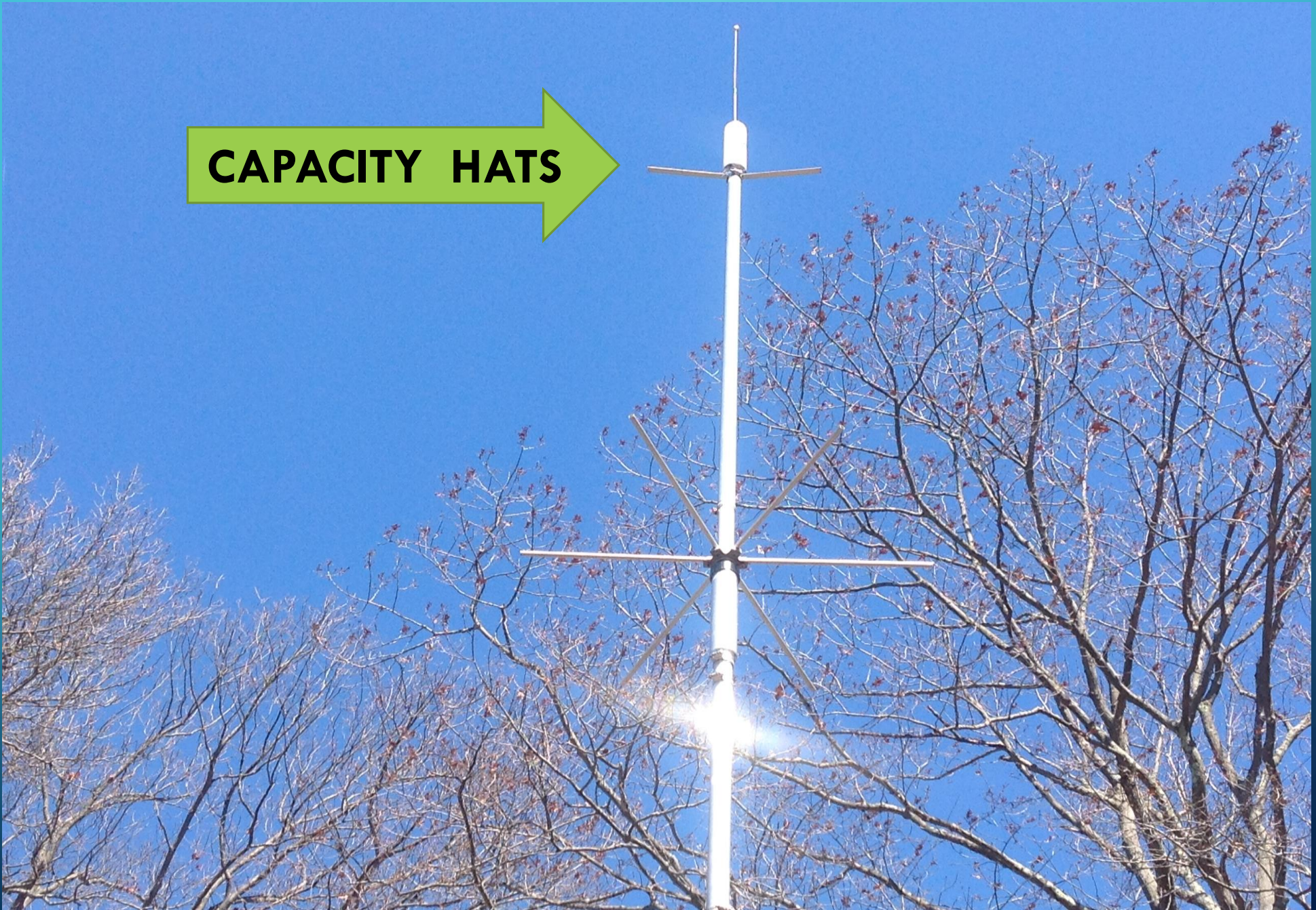


LOADED VERTICAL

CAPACITY “HATS”

- Capacity “Hat” placed at end (top) of antenna
- Resonates the antenna
- Removes the Capacitive component
- Placement most effective at end of antenna

CAPACITY HATS



CURRENT BALUNS

- Coax feedline to vertical – use a current choke / balun
- Keep RF from flowing on coax & entering shack
- Isolates rig / antenna from safety ground
- Coax coil choke

home made coil of coax

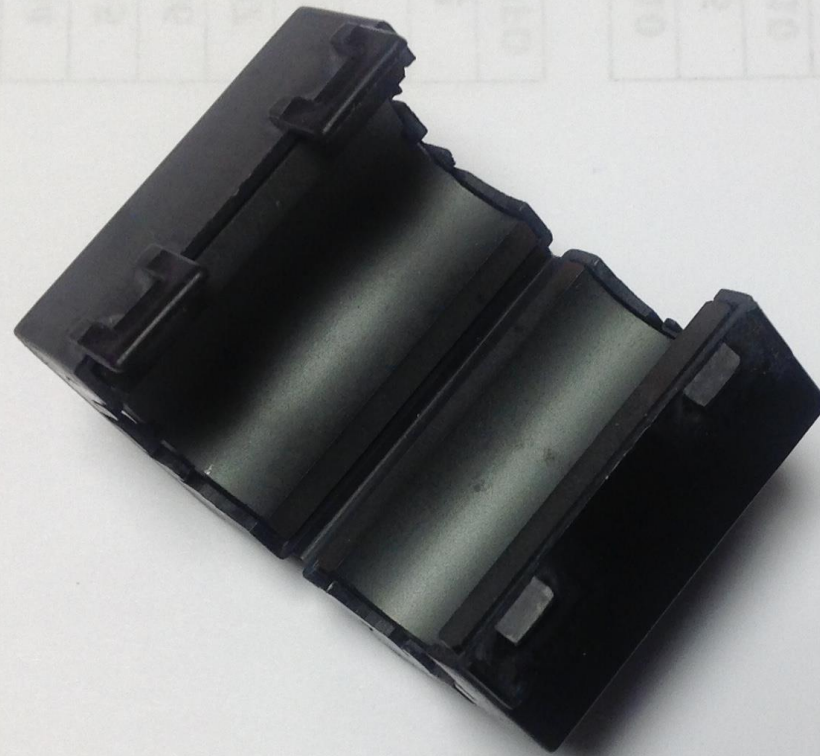
- Snap On Chokes (available commercially)
- Ferrite Beads (available commercially)

UGLY BALUN





**BALUN AND
LINE CHOKES**



FERRITES

SOME VERTICAL ANTENNAS

- Trap

Good for ground mount or flat roof to 30 ft high

Requires ground system

Multi-band 80 thru 10m

MFJ

Hygain

- Screwdriver

Motorized, tuneable

Multiband, fully resonant 80 – 10m

Extends to ~ 9 ft, some shorter

Requires ground system

High Sierra

Tarheel

TARHEEL





**BUDDIPOLE COULD BE
CONFIGURED AS A VERTICAL**

BALCONY MOUNTED

- Short verticals mounted on railings

Metal railings as counterpoise

Wooden railings, run counterpoise wires on wood or on floor;
cover with mat

- Longer verticals

Painter pole, retractable, telescoping “mast”

Mobile Whips

PAINTERS POLE



LONG WIRE ANTENNAS

- Random lengths of wire – long as possible
 - easy to build – string outdoors, #22 insulated black
 - need to support two ends
- Typically non resonant
- Usually end fed – high Z point
- Must have a tuner (other than rig)
- Tuner must have a “ground” or counterpoise connection

STEALTH

- ARRL Book
- Flagpole Verticals – ground mounted
- Wires lying on roof tops

Black insulation, small diameter, #22

- Wires on Gable ends

No good under AL eaves with AL gutters

- Wires on Fences – Loops
- Attics for yagi's
- VHF/UHF on short mast looks like TV antennas
- Vent pipe VHF/UHF verticals, roof mounted (Ventenna)

SUBSURFACE DIPOLE

- If on ground floor and able to trench the yard

Buried ~ 8 inches

Reported less gain

~ 3 S units less than a comparable, low dipole

Totally “experimental”

SAFETY

- Exposure to RF fields

Biological heating

Safety Code – American Standard

Exposure Factor – closeness to antenna

Exposure Factor – transmitter power levels

- Antenna Voltages

RF burns from ends of antennas

“Hot” grounds at unknown locations if safety ground or plumbing
used as counterpoise

SUMMARY

- Consider balanced antenna systems first
- Verticals will work but require radials or counterpoise
- Long wires will work but require counterpoise
- Try and get the antenna outside somewhere
- Do not create a “special” station RF ground – the radial or counterpoise is your RF ground
- Keep antenna away from metallic objects

Aluminum window frames

Service entrance

- If moving, choose antenna friendly site