STEALTH ANTENNAS

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

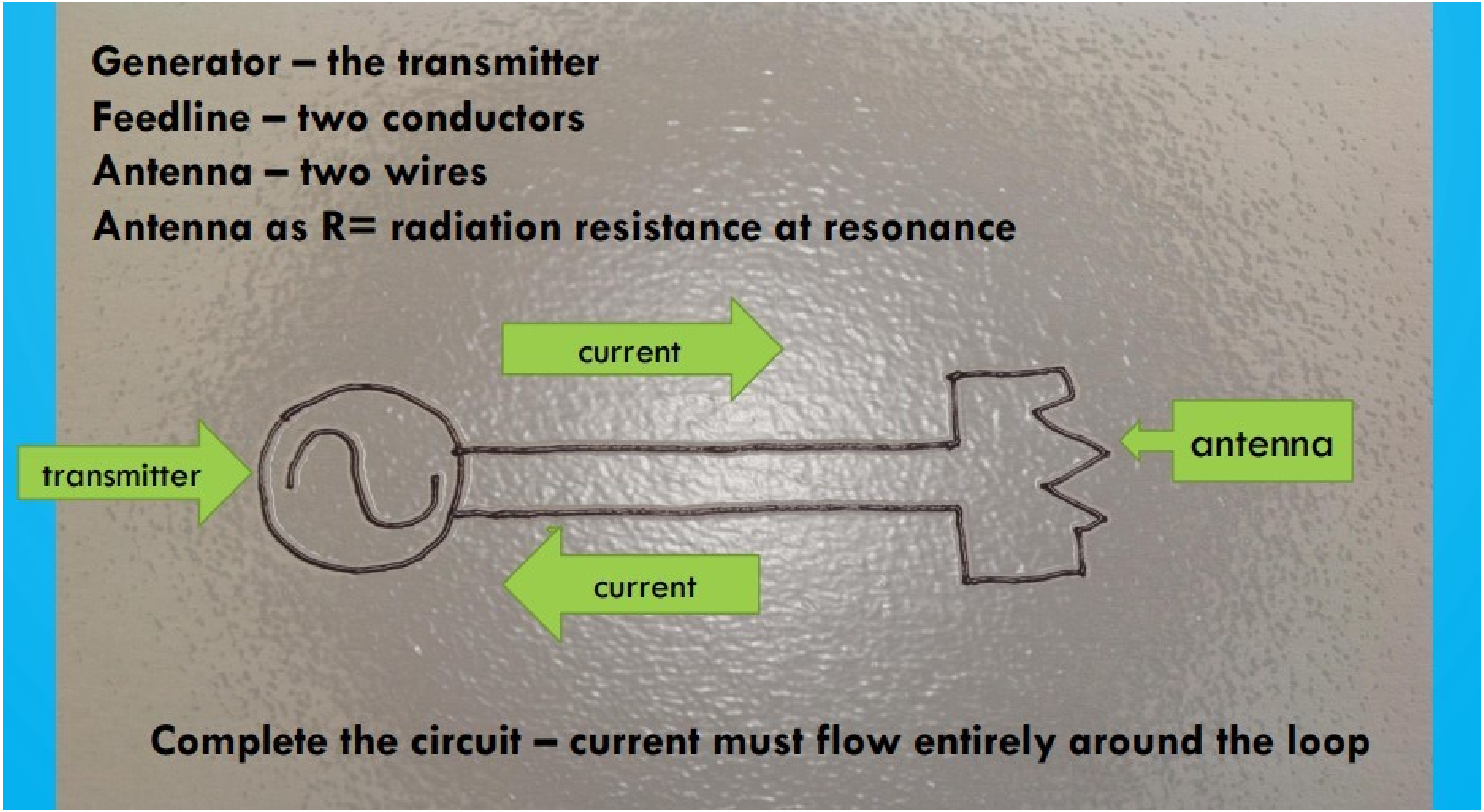
SOME ANTENNA THEORY

- 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 = radiation resistance at resonance
- Complete the circuit – current must flow entirely around the loop

Antenna Circuit



STANDARD ANTENNA

to which most other antennas are compared

- Resonant Half Wave dipole
- ½ Wave length elevation above ground
- 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
- Antenna no longer resonant at desired frequency
  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

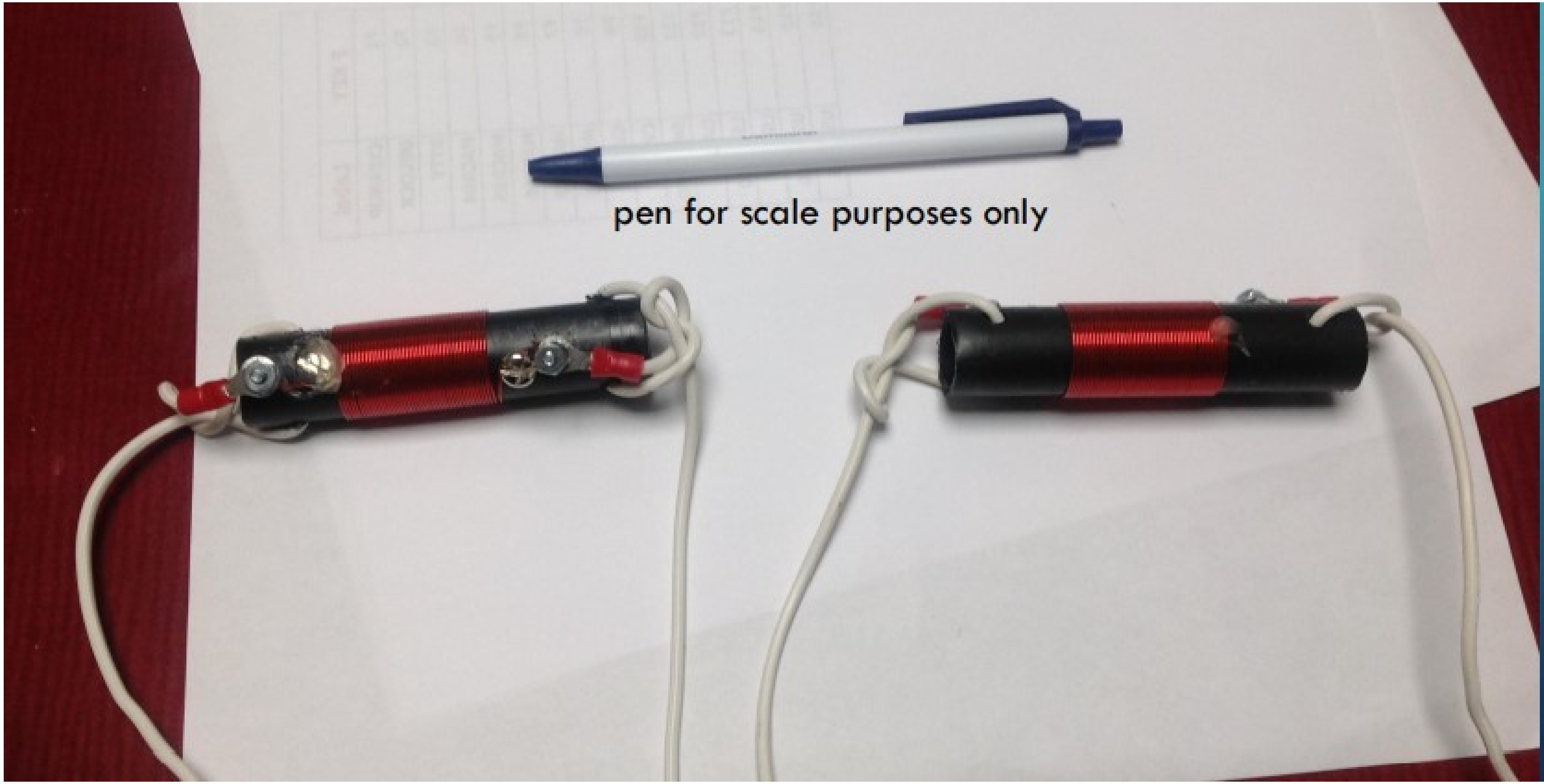
LOADING COILS

- 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

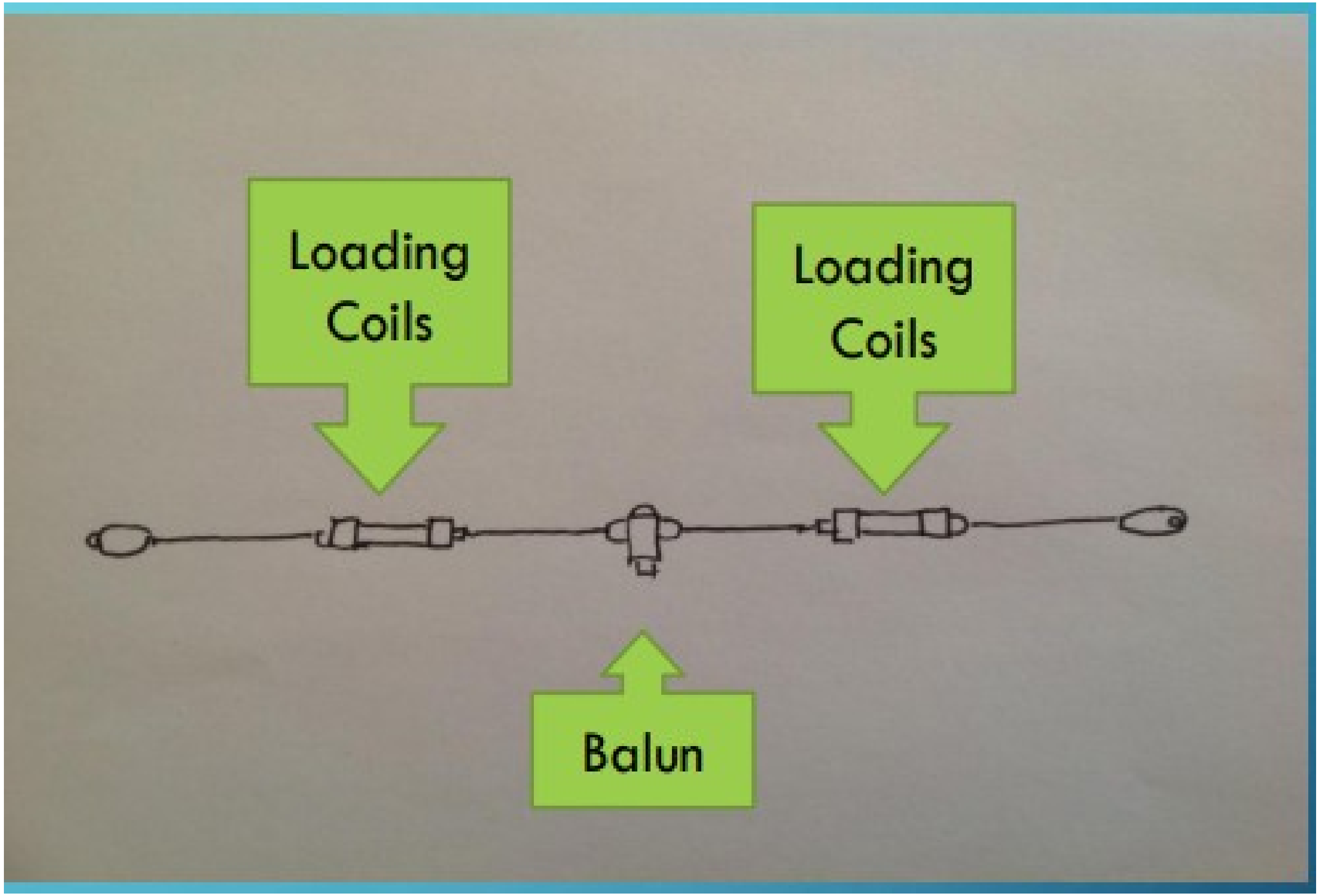
COIL LOADED DIPOLE

- 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



Coil Loaded Dipole

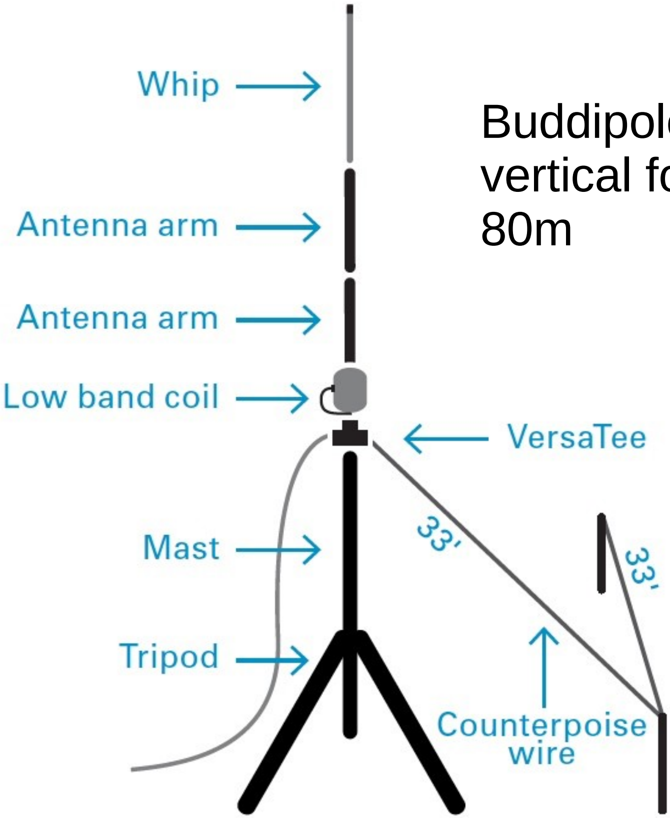


STEALTH

- 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)

STEALTH & SHORT VERTICAL

OCF Flagpole Vertical HF Antenna

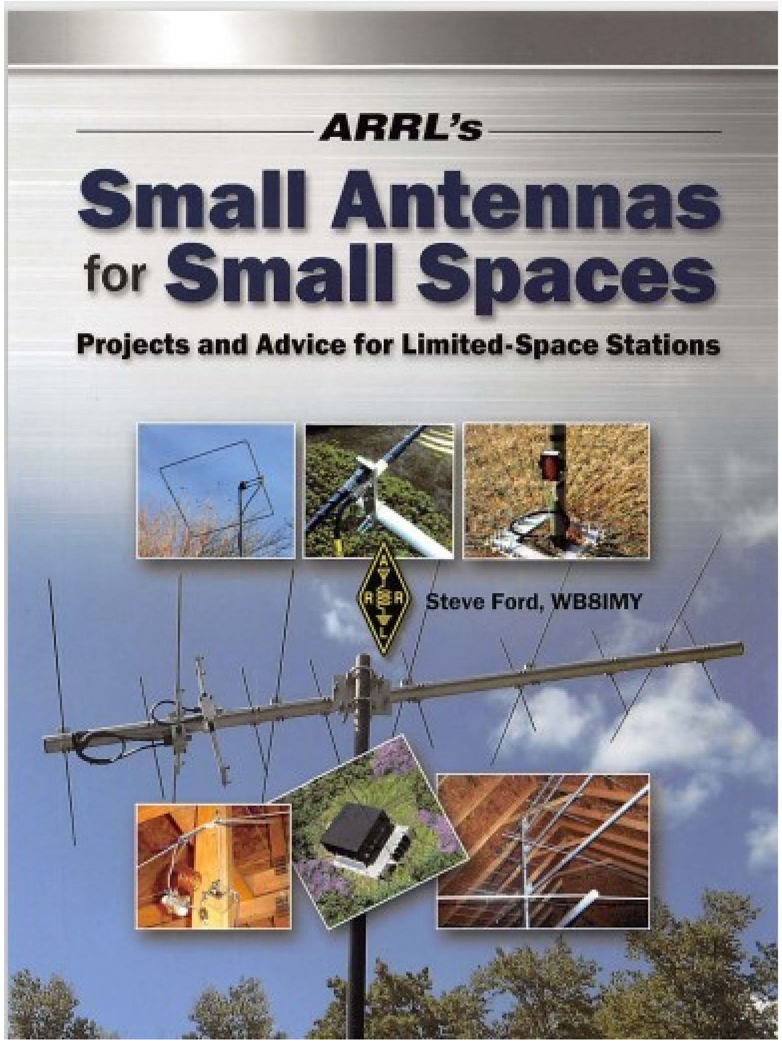


Buddipole vertical for 80m

ARRL publication available online as a free pdf file.

It is an excelent resource for all versions of compact antennas.

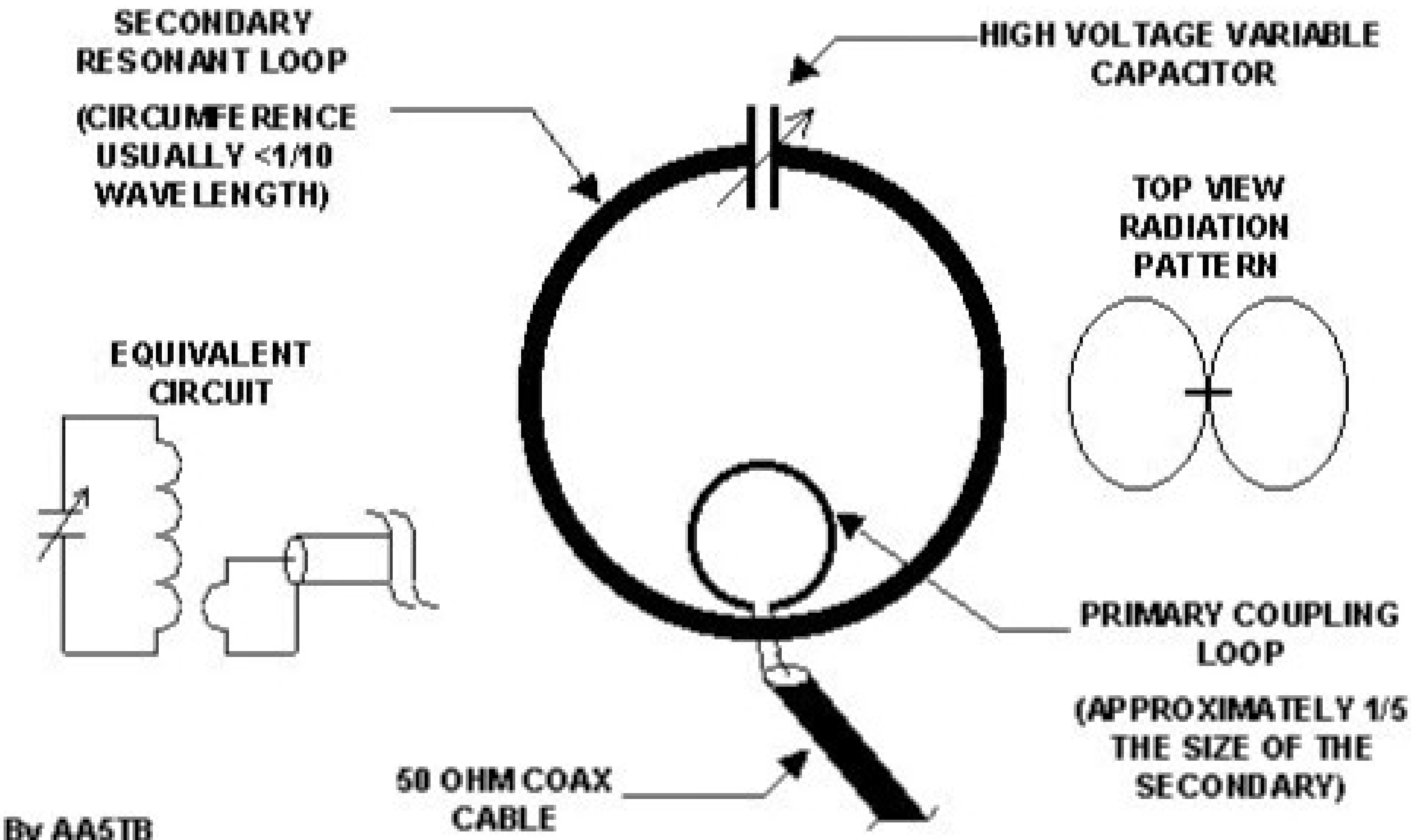
Search on the title and several sites will be listed for downloading



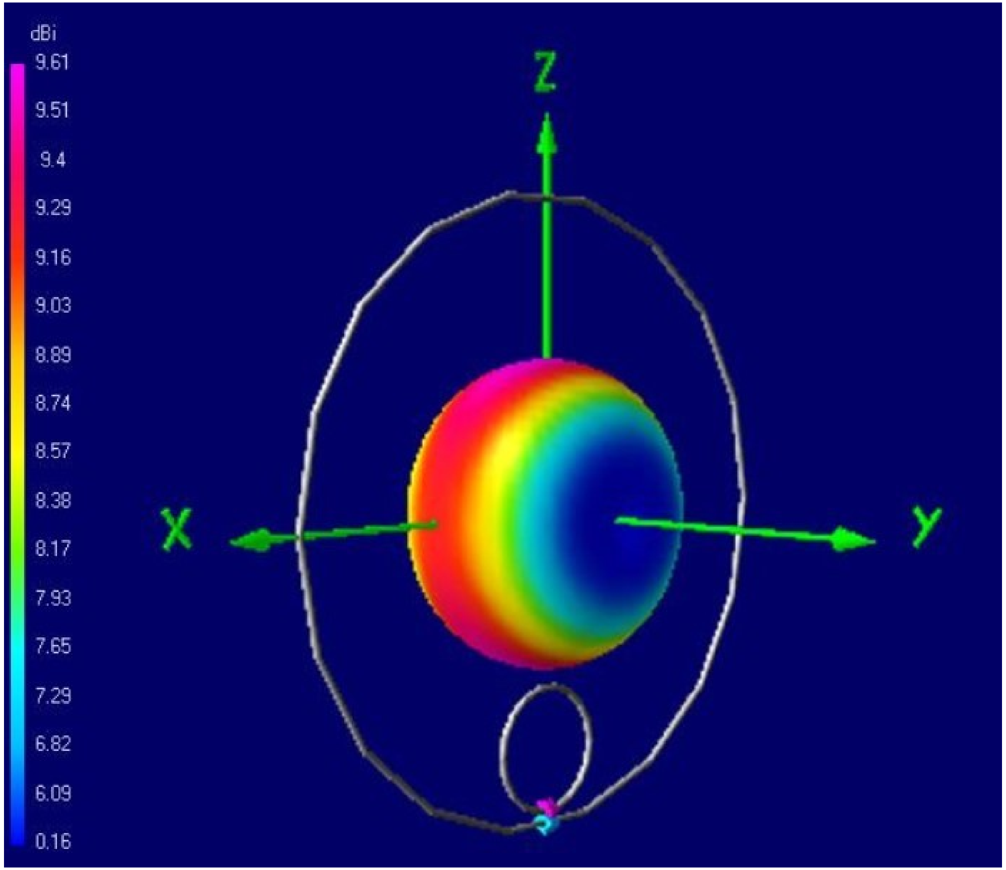
HF Magnetic Loop Antenna

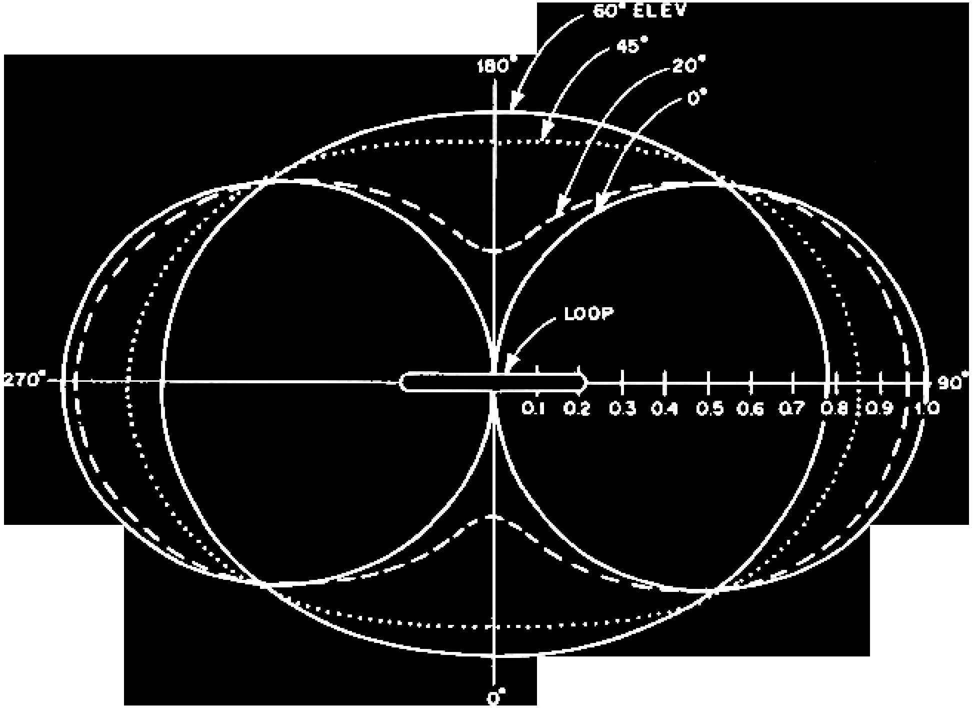
Magnetic Loop Antenna

1. What exactly is an MLA or STL?
2. Differences between dipole and loop antennas
3. Why is an MLA a good stealth antenna?
4. How to construct a high performance MLA.


SECONDARY RESONANT LOOP
(CIRCUMFERENCE USUALLY <1/10 WAVELENGTH)
HIGH VOLTAGE VARIABLE CAPACITOR
TOP VIEW RADIATION PATTERN
EQUIVALENT CIRCUIT
PRIMARY COUPLING LOOP
(APPROXIMATELY 1/5 THE SIZE OF THE SECONDARY)
50 OHM COAX CABLE
By AA5TB

MLA Radiation Pattern





Differences between dipole and loop antennas

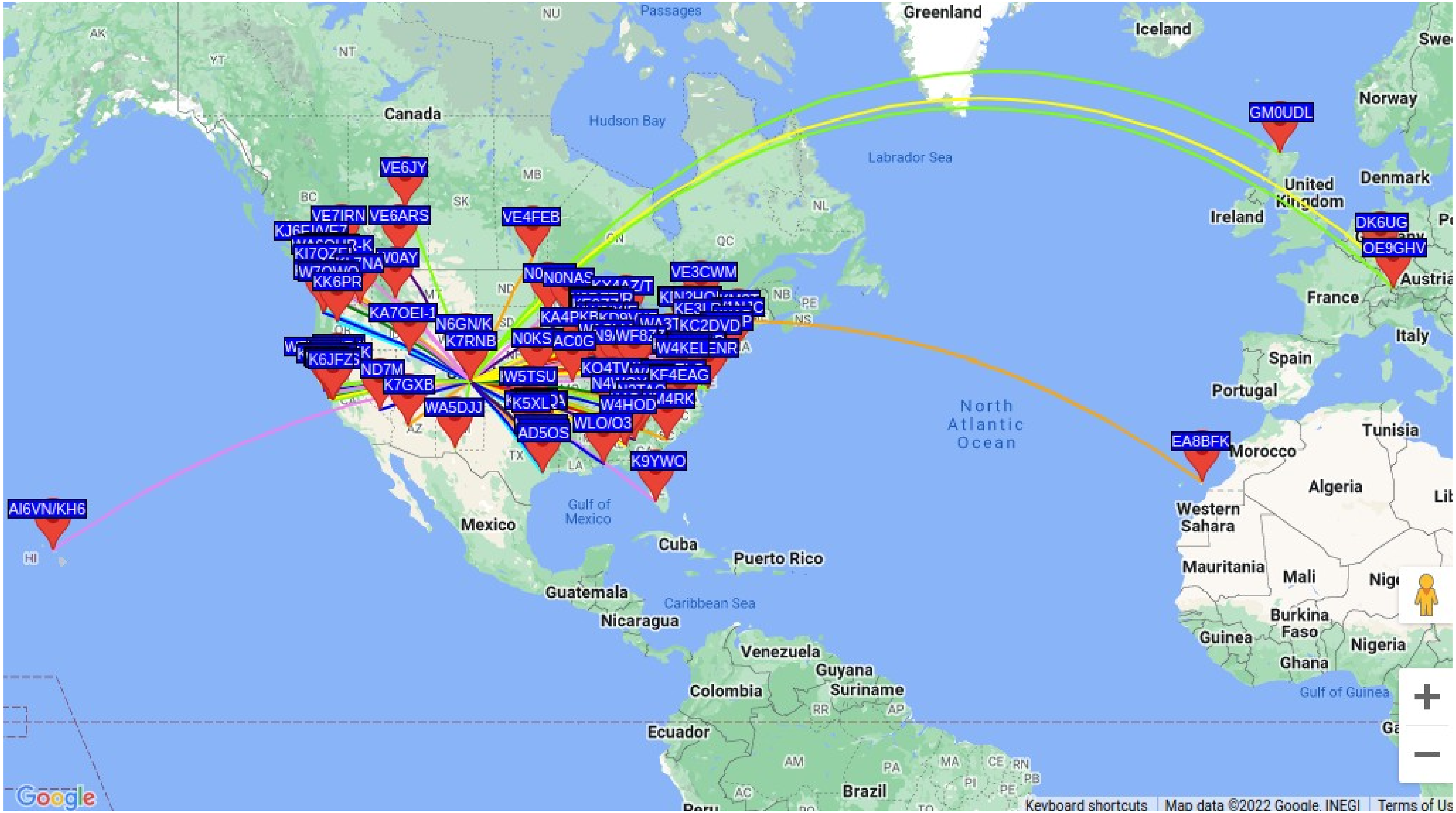
1. ½ λ long wire vs 3 foot diameter loop
2. Height ½ wave length vs 1 Loop diameter
3. ¼ λ vertical gnd dependence vs no loop ground
4. Elevated, low V & I vs Close by, very high V & I
5. Broadband, efficient vs Narrow band, < efficient
6. Set & forget vs Remote capacitor tuning (hi Q)
7. Cheap to buy/build vs Expensive unless DIY

Why is an MLA (STL) a good stealth antenna?

1. Work efficiently in the 40M thru 10M bands
2. No ground plane required
3. Can be mounted close to physical ground
4. HOA friendly due to small size, easily disguised
5. Attic mount, covert outdoor, portable indoor
6. Reduce QRM and QRN

20M STL (3FT Diameter- Stand Mounted)

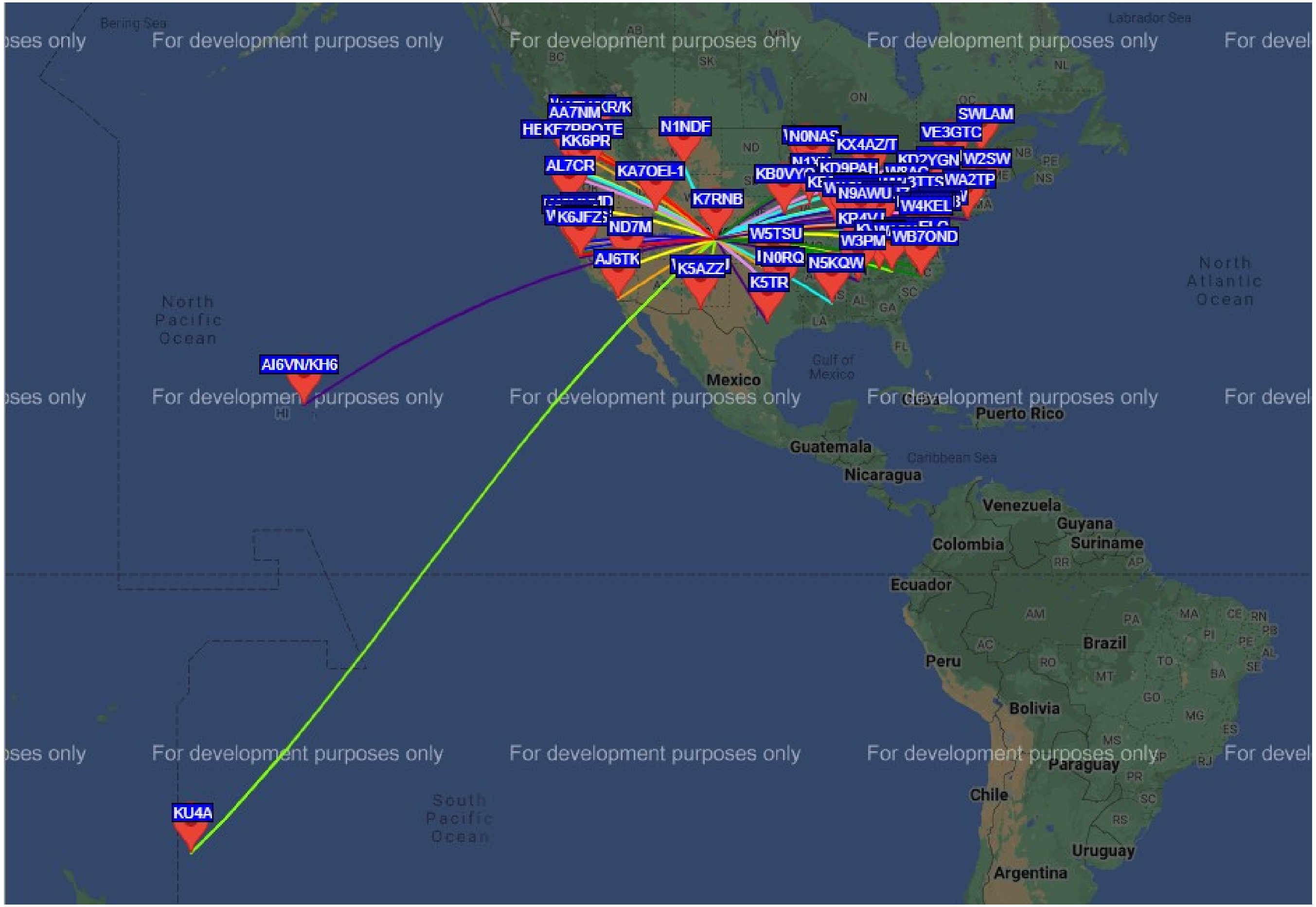
5 WATTS WSPR



40M thru 30M 6 Foot Diameter STL

40M STL (6FT Diameter- Attic Mounted)

5 WATTS WSPR



Recommended for the MFJ-1788X, SUPER HI-Q LOOP, 36~ DIA, 15-40 METER, 220VAC

MFJ-1788, SUPER HI Q LOOP, 36~DIA, 15-40 METER

$719.95

MFJ

MFJ-1786X, SUPER HI-Q LOOP, 36~ DIA, 10-30 MHz, 220VAC

$649.95

MFJ

MFJ-1786, SUPER HI-Q LOOP, 36~ DIA, 10-30 MHz

$649.95

MFJ

MFJ-1782, SUPER HI-Q LOOP ANTENNA, STANDARD REMOTE CONTROL

$609.95

MFJ

CHA F-LOOP 3.0

$500.00

FREE SHIPPING

★★★★★ 7 Reviews

OPTIONS

CHA F-LOOP 3.0 BASIC KIT

SUPPORT (optional)

-- Select --

Quantity

1

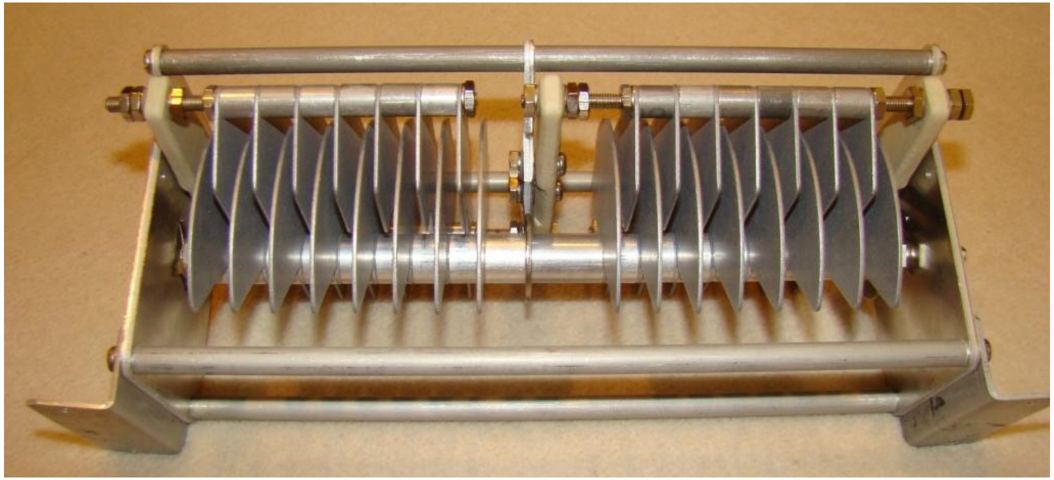
Add to Cart

The **CHA F-LOOP 3.0** was designed with portability, ease of use simplicity,

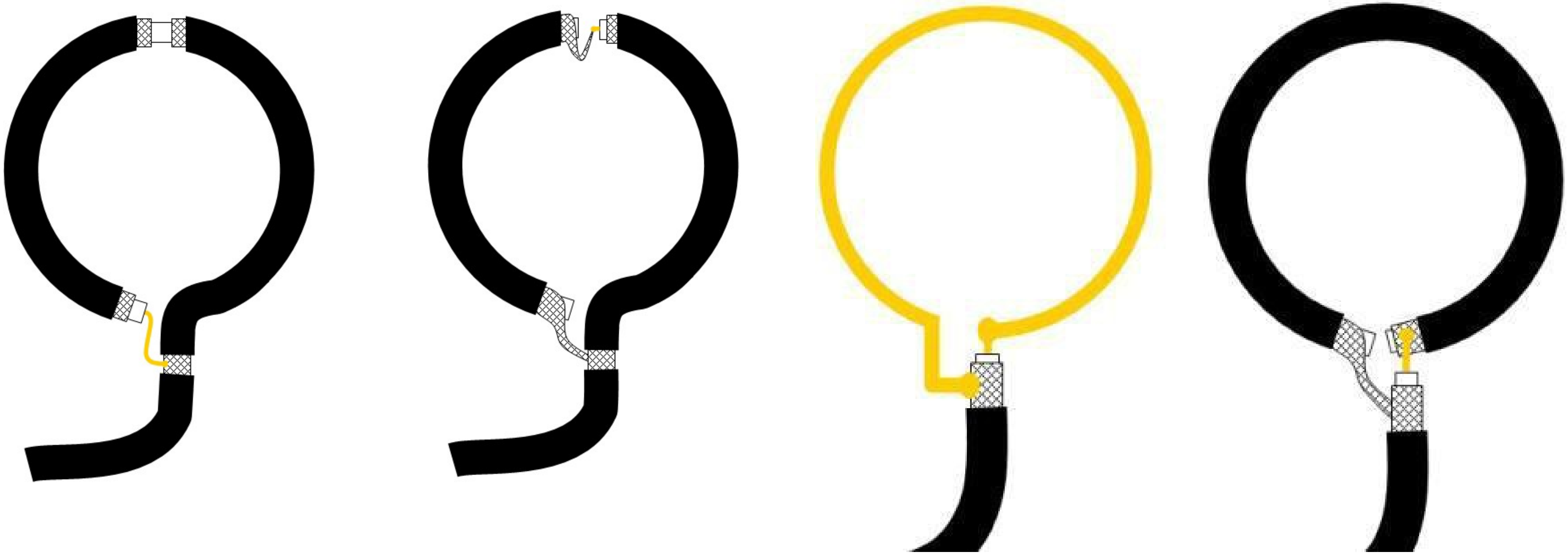
How to construct a high performance STL

1. High quality (low ESR) capacitor required
2. Cap must have KV and high amp capabilities
3. Large diam. round or wide flat conductor loop
4. Minimum solder joints, use silver solder
5. Can be circular, octagon, square shape
6. Maximize enclosed area of the loop
7. Minimize every milliohm of resistance (loss)

Variable Capacitor



Feeder Loop



Faraday Shielded Loop

Un-shielded Loop

MLA Build Materials

0.016X4X10”
Aluminum sheets
Ace or Hob Lob

3/4”X ¾” Aluminum
Extrusion - HD

Paint stir stick - HD

Not pictured:
Center Hub and
Silver Solder

6-32 Screws &
Nuts - HD

Snow markers
HD

6-32 Threaded
Shaft - Grainger

Cu sheet - web

3/4”Cu Pipe - HD

66pacific.com
Small Transmitting Loop Antenna Calculator

Length of Conductor (antenna "circumference")

10.8 feet

Diameter of Conductor

(For efficiency, should be > 3/8" or 1 cm)

1.0 inches

Frequency

14.0 megahertz

Transmitter Power (optional)

100 Watts

Units of Measurement

◉ English (feet and inches)

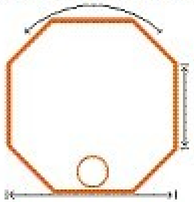
○ Metric (meters and centimeters)

CALCULATE

Antenna efficiency: 71% (-1.5 dB below 100%)
Antenna bandwidth: 18.0 kHz
Tuning Capacitance: 52 pF

Capacitor voltage: 4,127 volts RMS
Resonant circulating current: 18.8 A
Radiation resistance: 0.101 ohms
Loss Resistance: 0.040 ohms
Inductance: 2.49 microhenrys
Inductive Reactance: 219 ohms
Quality Factor (Q): 778
Distributed capacity: 9 pF

Antenna "circumference": 10.8 feet



Antenna diameter: 3.3 feet

Comments:

The specified conductor length of 10.8 feet is OK.

66pacific.com

Capacitance Calculator

Area of one plate

11 square inches

Separation distance

0.045 inches

Number of plates (2 or more)

3

Dielectric constant

Air: 1.001

Units of Measurement

- (●) **English (feet and inches)**
- ( ) **Metric (meters and centimeters)**

Calculate

RESULTS:

Capacitance: 110 picofarads

Input Values:

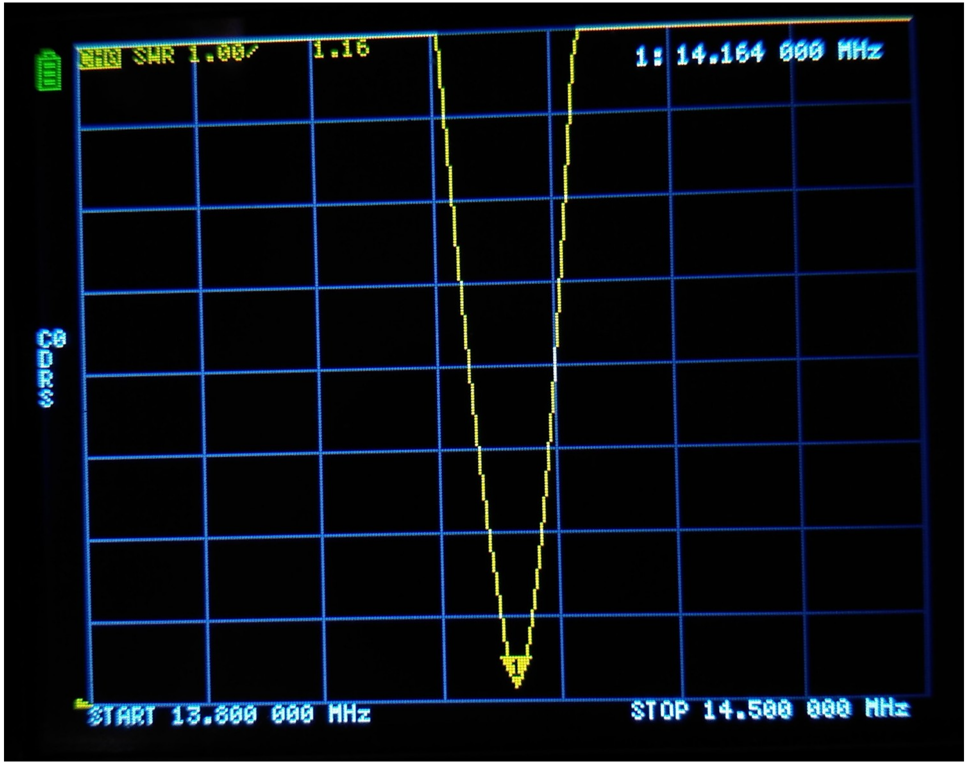
Area: 11 square inches

Separation distance: 0.045 inches

Number: 3

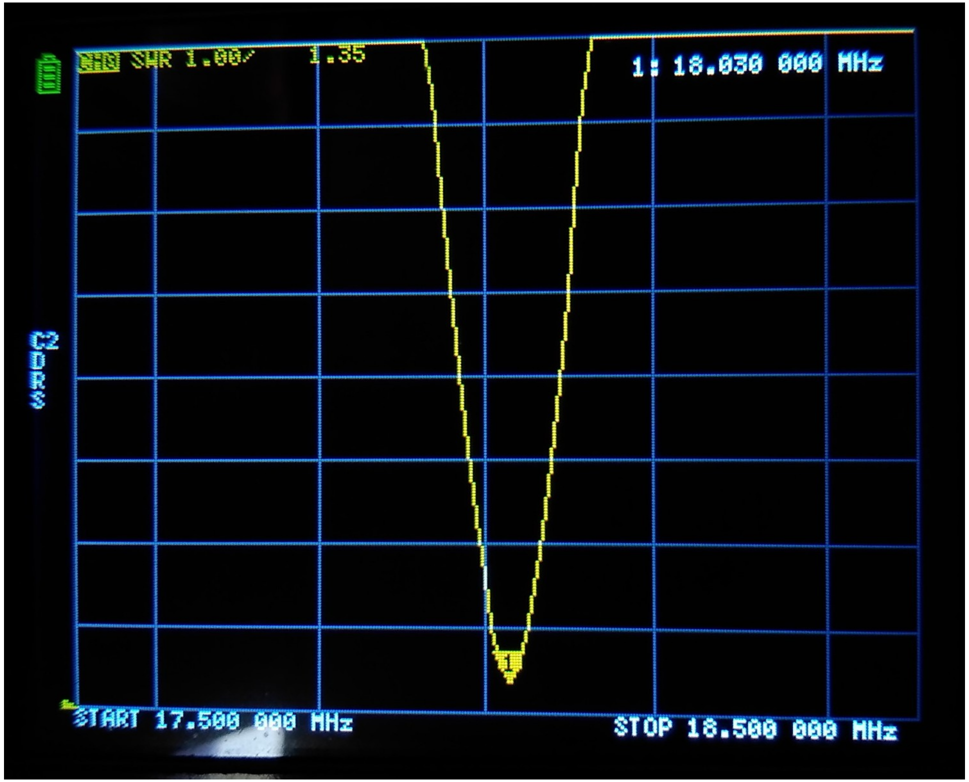
Dielectric constant: Air: 1.001

20M – 10M STL: Nano VNA SWR Sweeps



STL Tuned to 20M

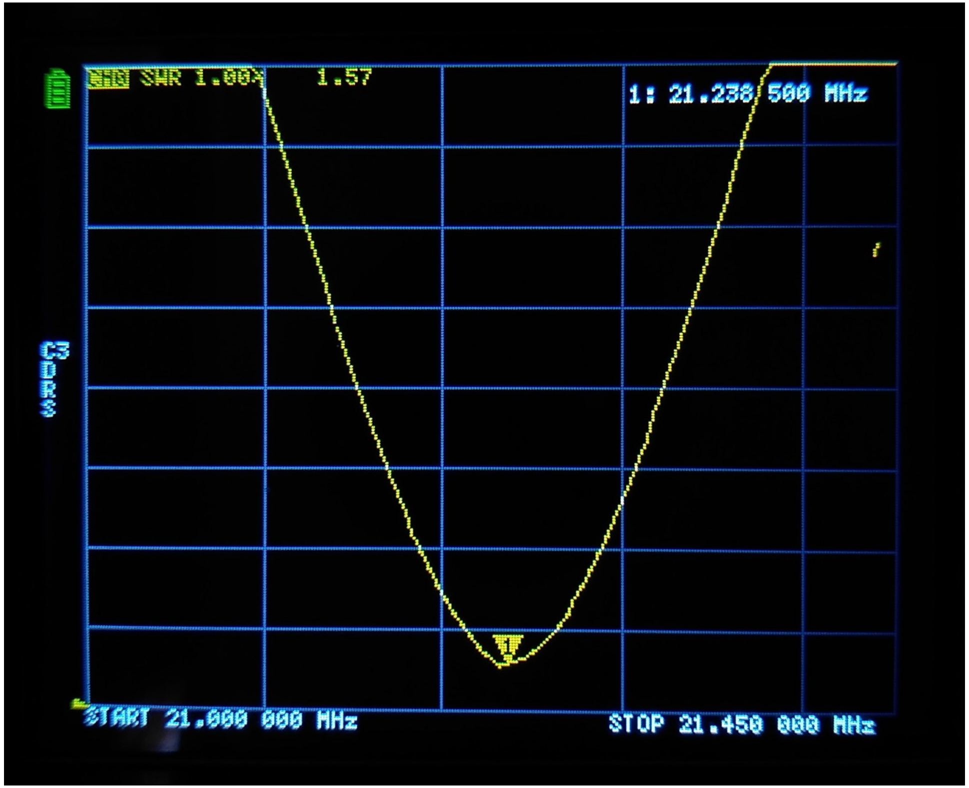
Antenna efficiency: 72% (-1.4 dB below 100%)



STL Tuned to 17M

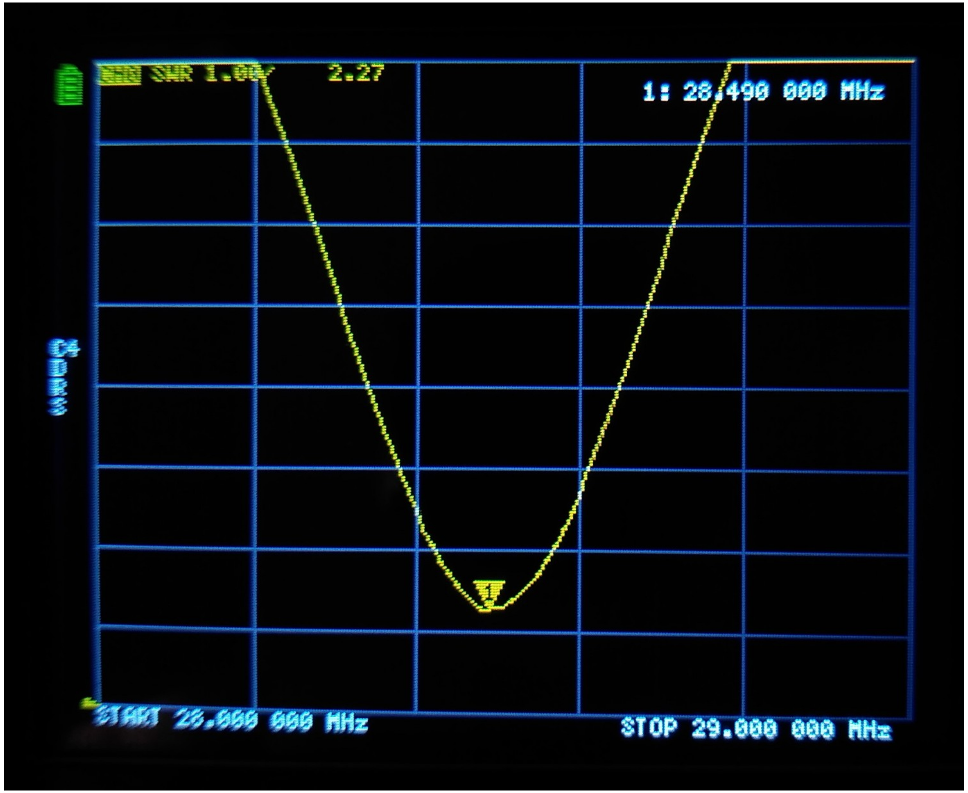
Antenna efficiency: 86% (-0.7 dB below 100%)

20M – 10M STL: Nano VNA SWR Sweeps



STL Tuned to 15M

Antenna efficiency: 91% (-0.4 dB below 100%)



STL Tuned to 10M

Antenna efficiency: 97% (-0.1 dB below 100%)

IC 7300 40M SWR Sweeps

20M Dipole Plus Automatic Tuning Unit

40M 6 Ft Diameter STL

References

BLACKSTONE VALLEY AMATEUR RADIO CLUB

W1YRC Bob Beaudet   K1GND Jim Johnson

https://www.nonstopsystems.com/radio/pdf-ant/article-antenna-mag-loop-2.pdf

“An Overview of the Underestimated Magnetic Loop HF Antenna”

By Leigh Turner VK5KLT (updated Oct, 2015)