Vari-Vert 40-6 Meters

A Flagpole ‘ish Antenna

Excerpt from the TVARC presentation of February 2017
by
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An “Electrically” Variable Vertical

The design, construction and performance of an inexpensive “Low Observable” antenna that provides 40-6 Meter capability.

- The antenna ‘looks like’ and performs like a Flagpole.
- 20’ Flagpoles are allowed in Florida by State Statute 720.304 (2b).
- Commercial antennas with controllable length elements are expensive and generally require maintenance or repair by the manufacturer.
- The following slides deal with an electrically similar homebrew antenna that is simple to build and easy to maintain.
Flagpole Type Verticals

20’ Flagpole, Non-Resonant (in ham bands)
  – Requires a Remote Tuner at the antenna, OK
  – Tuner In Operator Location, Not so good….

¼ λ Resonant Vertical, so…. No Tuner
  (aka; Marconi antenna)

Thinking…. SteppIR Vertical? You are close!
Trade-Off’s

Flagpole Radiator

• Remote Tuner **Required**
  – 100 watt class or big $$$
  – Tuner is somewhat delicate
  – Tuner loss, moderate
  – Cost ~$350
  • Aluminum Flagpole
  • Tuner
  • Bias T

¼ λ Resonant Radiator

• No Tuner
  – Legal Limit, **No Tuner Loss**
  – Simple Mechanics
  – No critical dimensions
  – Cost ~$350

• Carbon Fiber Pole
  • Homebrew Mechanics
  • Enclosures, Micro Processor/Display,
  • Bias T

Not a clear winner….. BUT

*If any repair is needed you can do it yourself* after all you built it.
A sense of accomplishment is worth something! Great talking point
The Vari-Vert

Parameters:

- True \( \frac{1}{4} \lambda \) Antenna
- Low Angle for DX op’s
- 20 - 6 Meters - - No Tuner needed
- 40-30 Meters uses 2 relays and a tapped L, fixed C
- Digital Control / Readout Unit
- Build it all for ~$350

Uses inexpensive, readily available component parts
Tools; a Dremel Rotary, a Soldering Iron and household tools
Vari-Vert Layout
Prototype Configuration

Fiberglass

Monofilament

Fishing Sinkers
5 x 1.5 oz

Wire; 21Awg 7 Strand Copper

Gear Motor

Readout Pot
“Fiberglass” Flagpole Material Properties

Carbon Fiber, non-conductive, ideal antenna support
Carbon Fiber and Aluminum … similar strength

<table>
<thead>
<tr>
<th>Deflection calculator for round tube beams</th>
<th>Output</th>
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</thead>
<tbody>
<tr>
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<td><strong>Output</strong></td>
</tr>
<tr>
<td>Length (inches)</td>
<td>240</td>
</tr>
<tr>
<td>Diameter (inches)</td>
<td>2</td>
</tr>
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<td>Wall thickness (inches)</td>
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<td>Force (pounds)</td>
<td>1</td>
</tr>
<tr>
<td>Material</td>
<td>Aluminum</td>
</tr>
</tbody>
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**Aluminum 1.42”**
- Deflection (inches): 1.417793021798
- Bending Stress (psi): 738.4338665200
- Energy (joules): 0.080693711729

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<td>Std. Carbon Fiber</td>
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**Carbon Fiber 1.4”**
- Deflection (inches): 1.396840415564
- Bending Stress (psi): 738.4338665200
- Energy (joules): 0.078910606816
Mast Components

- Fiberglass Pipe 8’ by 1.5”, 1.75”, 2”dia.
- Homebrew Low Friction Pulley
- Hose Clamps between pipe sections
Vari-Vert “All-Up”

- Radiating wire length is set for $\frac{1}{4} \lambda$
Vari-Vert Component Trade-Off’s

Motor Options
- Brush Type DC,
- Brushless DC,
- Stepper,
- AC

Sensor Options
- Multi-Turn Potentiometer
- Incremental Encoder
- Absolute Encoder $$$
- Mechanical Counter

I just used things on hand.
- Brush Type DC Motor
- Multi-Turn Potentiometer
Antenna wire “pays” off the spool and makes additional RF contact with the brass pulley and copper guide.
Model Layout

Height is Variable
Radials 8-10’ & 8-20’ @ 1” above Ground for Model *
Average Soil C=5ms, Er=13

Nec2 Modeling Engine

* The NEC-2 Modeling Engine does not permit wires below ground, but comparisons by L.B. Cebik W4RNL (SK) indicate above ground provides good correspondence
NEC2 Modeling Predictions

- 21’ Flagpole with Tuner to Match at the FP Base
- Vari-Vert Radiator Length set to $\frac{1}{4}\lambda$ by remote
- **Note:** Vari-Vert acts as $\frac{3}{2}\lambda$ at 50.5 MHz
7.2, 14.2, and 18.1MHz Elevation Plots Shapes

Freq = 7.2MHz

Freq = 14.2MHz

Freq = 18.1MHz

21’ Flagpole

Freq = 7.2 MHz

Freq = 14.2 MHz

Freq = 18.1 MHz

Vari-Length Vertical ¼ λ
21.2, 24.9, and 28.5Mhz Elevation Plots Shapes

21’ Flagpole

Vari-Length Vertical
21' Flagpole

14.7' Vari-L  $\frac{3}{4} \lambda$

6 Meters the Vari-Vert works as a $\frac{3}{4} \lambda$ vertical

Provides $\sim 1.6$ db Gain overall advantage
Desktop Controller

Requirements:

– Digital display of Frequency and Length
– Smooth motor speed ramping
– Expandable functions and inexpensive
– Future features…. 
  • Pushbutton command to calibrate the radiator length *
  • Stall sensor motor shutdown *
Controller Components

- Arduino Mega 2560: $12
- Breakout Board: $15
- 2x16 Backlit LCD: $13
- Dual H Bridge Motor Driver: $5

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Controller Breadboard

Arduino Development Program (Free)

Connectivity by USB to the 3 board stack
14.10mhz 20.000ft
198

Display Readout

RAW POT 1023 MAX

Dial readout controls 2-arrays
Freq and Length
“The Programmer IDE… PC or MAC”

IDE means.. Integrated Development Environment

– Features

  • “Sketch” entry for typing in your program code
  • Details any errors it uncovers in the code
  • Compiles and loads the code to the target computer board
  • Calculates memory usage
  • Provides Serial Monitor for debugging
  • Powers up the hardware through the USB

– Arduino IDE is a FREE download

  • Lots of shared software “sketches” on the web
  • Good ‘forum’ support for beginners
  • Lots of easy projects to get your feet wet
Field Experience

- Operated at a local hams QTH during Nov – Dec 2016
- Good contacts and on-the-air reports operating CW at 3-5 watts
- Experienced mechanical hang-ups due to the jerky start / stop motion

As Demo’ed at the TVARC Meeting

- Microprocessor Smart Controller was designed during the field evaluation period.
- Microprocessor code was written debugged and readied for testing
- The micro processor provided smooth start/run/stop and resolved the hang-ups
Interested in more info about this antenna?

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