George
KJ6VU
Goal...

Effective, Portable HF Antenna System for...

- Field Day
- Backpacking
- Car Camping
- SOTA
- Park Ops
- Day Hikes
- Air Travel

Size & Weight Are Important
PackTenna
Topics

- “Dummy’s Guide to portable HF antennas”
- PackTenna design
- Materials and construction
- Field results
Effective Portable HF Antenna System

- **Effective**
  - Good performance (equal to a full size dipole)
  - Minimal or no tuning

- **Portable**
  - Light weight & compact
  - Easy to set up

- **System**
  - Deploy in various configurations
  - Modular - components added over time
  - Optimize the configuration for each event
Rule #1 - Size Matters

A full size ½ wave dipole is better than a shortened antenna

Loading reduces efficiency & narrows bandwidth
Rule #2 - Elevation Matters For Horizontal Antennas

DX

NVIS

Close proximity to ground will detune the antenna
Rule #3 - Vertical Antennas Are More Noisy

- Low angle of radiation
- Good for DX
- Bad for NVIS

Noisier than horizontal antennas
Rule #4 -
Resonant is Better Than a Non-Resonant

- Non-resonant antennas are less efficient
- Significant losses in matching circuits
- Non-Resonant antennas require more gear

½ Wave Vs.
Rule #5 - Make It Easy

- Compact
- Light weight
- Easy and quick to set up
- Easy and quick to take down
Goal

• Full Size
• Resonant
• Horizontally polarized
• As high as possible
• Small & light weight
• Easy and quick to deploy
Popular Portable Antennas...
Topics

• “Dummy’s Guide to portable HF antennas”

• PackTenna design

• Materials and construction

• Field results
Thought #1
My Favorite Field Day Antenna...

• 28’ wire taped to a fiberglass mast
• SGC tuner in an ammo can
• 8-16 radials on the ground
• Works all bands
• 10 minutes to set up
• 10 minutes to pack it up
Thought #2 - “Think Like a Backpacker”

1. Weigh your stuff - Ounces add up to pounds.
2. Trim the fat: leave the kitchen sink at home.
3. Plan your trip: limit your contingencies.
4. Take the lightest possible item to do the job.
5. Simplify: take items that serve multiple functions.
6. Don’t just take a bunch of stuff: build a system.
7. Get back to the basics - don't over complicate things.

Backpacking Light 101” By Ryan Jordan
"Seven Steps to Enlightenment"
www.backpackingleight.com
PackTenna - Key Decisions

Full size wire elements
- Good performance
- Very compact

Fiberglass support pole
- 30’ + tall can handle any band down to 40m
- Collapse down to about 2’ for packing
PackTenna Part Details

- Supports
- Wire
- Feed points
- Chokes
- Hardware
- Coax
You Can Make Almost Anything...

- Ground Plane
- Dipole
- Off-Center Fed Dipole
- Inverted Vee
- Delta Loops
- End-Fed Sloper
- End-Fed Vertical or Ground Mounted Vertical
- End-Fed Long Wire
20m Inverted Vee
40m Inverted Vee

Antenna Wire

Antenna Wire

Fiberglass Mast

Guy

Guy

Guy

Guy
Ground Plane

Antenna Wire

Antenna Wire

Guy

Guy
Dipole
Phased Verticals
Topics

- “Dummy’s Guide to portable HF antennas”
- PackTenna design
- **Materials and construction**
- Field results
**Mast**

- 32.8’ Tall
- 17 Sections
- 26” Collapsed
Support

Guyed

33'

Tripod
20/40 Wire Elements

~16' 10"

~33' = 20m \( \frac{1}{2} \) wave

~66' = 40m \( \frac{1}{2} \) wave
“S-Clips”

Universal Antenna-Clips for
- Dipole links
- Guy links
- Just about anything

Dipole Link
Multiband Linked Inverted Vee
Dipole Link Options

- Mini Banana Plugs In Use

Link Switch

Heat Shrink
S-Clip is a great universal mechanical connector

End of the antenna wire has a mini banana plug to easily add a tuning whisker
1:1 Feed Point Balun

- Vertical wire element jack
- Mounting holes for mini-bungee cords
- Zip-tie holes to mount toroids
- Horizontal or Vee wire element jacks
- Coax connector
- Holes for S-Clips
  - Antenna wire strain relief
  - Mounting
Use
Feed Points and Chokes

1:1 Balun Feedpoint

9:1 UNUN Feedpoint

In-LineCurrent Choke
9:1 UNUN Feed Point

- Helps match Hi-Z antenna to the tuner
- Antenna tuner required
In-Line Choke

- Suppresses common mode current on the coax shield
- Helpful with end-fed antennas when running high (>25 watts) of power
Picking Toroid Materials Ain’t Easy

• Many variables
  – Frequency, wire vs coax, turns, mix, etc...
• Bum advice on the web
  – These are simple mechanical devices so *everyone* thinks they can build one
• Find a reliable source of information...
  – Palomar Engineers
  – G3TXQ  http://www.karinya.net
• Conclusions
  – Type 2:  Good for 9:1 transformer balun (not a choke)
  – Type 43: Best overall for common mode choke
  – Type 43: Best for 1:1 balun
Wisdom from E-Ham.com

• “Mix 43 is best at HF. 61 is best at VHF”

• “Contrary to what was said before, mix 31 is the material of choice”

• “The 43 material is better suited for this application”

• “Mix 43 is not a good choice for frequencies below 10 MHz”

• “61 or 65 materials would be very good if you have enough turns, I'd stay away from 43 material”
Ferrite Mix According to G3TXQ

Common-mode Choke Impedances - G3TXQ

Ferrite-cored
- 17T RG58 on FT240-43
- 12T RG58 on FT240-43
- 8T RG58 on FT240-43
- 17T RG58 on FT240-31
- 12T RG58 on FT240-31
- 8T RG58 on FT240-31
- 9T bifilar on 2 x FT240-31
- 10 x FB-31-1020 beads on RG213
- 6 x FB-31-1020 beads on RG213
- 4T RG174 on binocular 2xFB-31-1020
- 11T RG58 on 2 x FT240-52
- 16T RG174 on FT140-61
- 17T RG58 on FT240-61
- 12T RG58 on FT240-61
- 8T RG58 on FT240-61
- 14T bifilar on 4 x FT240-61

Frequency (MHz)

>500  >1k  >2k  >4k  >8k

Rs > Xs
Coax

- 2x 25’ RG58 BNC/BNC
- Alternate: RG316
- Good for ultra lite apps
Philosophical Point #1: Go Lite
Count the ounces and ...
...the pounds take care of themselves

- Take advantage of light weight gear for backpacking
- Aluminum tent stakes
- Reduce bulk where possible
- Use 3mm paracord, not 550
Philosophical Point #2: Universal Hardware
Minimize the Number of Unitaskers

S-Clips “’Tenna Clips”
• Antenna strain relief
• Guy line clip
• Guy line tensioner

Mini-Bungee Cords
• Feed point mount
• Pole / tripod fastener
• Long wire strain relief
Philosophical Point #3: It Will Break
Make it Robust - Plan For Equipment Failure

• Use more robust gear
  – Use RG58 coax, not RG174
  – Backpacking? Use RG316
  – Medium duty antenna wire
  – Triangular tent stakes, not rods

• Something will break or get lost
  – One is none, two is one.
  – Plan for no single point of failure
Philosophical Point #4: Make it Easy Quick and Easy to Set Up and Pull Down

• Single support mast makes it simple
• Antenna wire is pre-cut
• Everything plugs together
• No tools required
Topics

- “Dummy’s Guide to portable HF antennas”
- PackTenna design
- Materials and construction
- Field results
Beric K6BEZ Running Antenna Shootout Software
Computer controlled RF coax switch
Reference antenna
20m Buddipole

18’ elevation

2 long extension arms

Full size whips
PackTenna

30' fiberglass telescoping mast

Tripod base & one ground stake

Mast bungee corded to the tripod
Tripod base

Light weight mast needs one ground stake

Mast bungee corded to the tripod
Simple feed point for inverted VEE configuration

Coax ends in banana jacks.

Connection point bungee corded to the mast

To be replaced by 1:1 choke balun
Antenna Shootout Comparison

20m Full size Buddipole dipole vs PackTenna Inverted Vee

Result: Similar. PackTenna is slightly better

40m Loaded Buddipole vs Packtenna Inverted Vee

Results: PackTenna worked better

40m 5 BTV roof mount vs PackTenna Inverted Vee

Results: Similar but PackTenna was 3 S-units quieter
The PackTenna System

Standard System
• 10 meter mast
• 4x 20m quarter waves
• Wire winder
• 1:1 Feed point choke
• Mini bungee cords
• 3 guy rings
• 8 guy lines
• S-clips
• 6 ground stakes
• 25’ RG58 Coax
• Carry bag

Options
☑ 9:1 feed point UNUN
☑ in-line RF choke
Now What ???

PackTenna + HamLog
Let’s Build an Antenna Analyzer
Beric, K6BEZ’s Prototype
$25 in Parts ~ $40,000 VNA

![Graph showing VSWR vs MHz for Anritsu VNA Master and K6BEZ](chart.png)

- **VSWR** (VSWR vs MHz)
- **MHz** (6.7 to 7.6 MHz)
- **Chart** showing comparison between Anritsu VNA Master and K6BEZ.
Beric, K6BEZ’s Kit

40m F 7190k SWR1.451
K6BEZ PC Software

3.802MHz
1.60:1
Direct Digital Synthesis Module

- AD9850 DDS chip
- Frequency range: 0-40MHz
RFDuino

More power then the Arduino UNO
Runs the same Arduino code as the UNO

Radio
• Bluetooth LE RF Module
• Built-In Chip Antenna
• Transmit Power 4dbm

Microcontroller
• CPU 16MHz ARM Cortex-M0
• Flash 128kb
• Ram 8kb
• Typical Supply Voltage 3V
Case

- Plastic case
- External grip
- Built in battery
- BNC connector
- Power switch
PackTennAlyzer
PackTennAlyzer App

3.802 MHz
1.60:1