spiderbeam
high performance lightweight antennas

SIMPLE ANTENNAS THAT WORK GOOD

USING TELESCOPING FIBERGLASS POLES

IOTA EXPEDITION
TO VINEY ISLAND
OC-266

IT DOESN'T HAVE TO BE PERFECT TO WORK GOOD.

Photo: "Crocodile Andy", VK5MAV/6

Rick Westerman, DJ0IP (NJ0IP)
Customer Support Manager
Spiderbeam GmbH, GERMANY

IOTA EXPEDITION TO VINEY ISLAND OC-266

Photo: VK5MAV

Through the window I saw a Crocodile in front of my tent.

I pulled out my survival knife and cut a large hole in the back of the tent.

Somehow I ran and crawled about 100m over the rocks and through thorns, cutting and scratching my leg. My shoes were torn to shreds.

I hid in the high rocks without water, with a t-shirt wrapped around my head.

After several hours, I wrapped my feet with the remains of my shorts and hobbled back to my tent. The Crocodile was gone.

After an emergency call with the Satellite phone, and several hours wait, the rescuers finally arrive… First Aid !

2 DAYS LATER: Andy was *On The Air* Agn!

FULL STORY: http://www.gdxf.de/reports/files/VK5MAV-OC-266-2016.pdf

spiderbeam
high performance lightweight antennas

TOPICS FOR TODAY:

- Brief Introduction to Spiderbeam
- Overview of Possible Antennas Types
- Basics of Wire Antenna Performance
- Close look at Vertical Antennas
  - CHOICE: CONVENIENCE OR PERFORMANCE?
- Quick look at Loop Antennas
- Construction Tips (WIRES & FIBERGLASS POLES)
- Where to find more Information

Spiderbeam (the company)

- **"Spiderbeam" was the idea of 'Con' – DF4SA**
  - In 1999, after 10+ years of Contest Expeditions, "Con" asked himself the simple question:
    - ***Why do our radios keep getting smaller but our antennas remain big, bulky aluminum monsters?***
  - Using Antenna Modeling Software, he solved that problem:
    - **3-band portable Spiderbeam Yagi** (20/15/10m)
- **In 2002 he founded the Spiderbeam company to sell Yagi Kits**
  - It was followed by 5-Band Spiderbeam, WARC-Band and other versions / kits . . . and eventually pre-assembled antennas.
- **He soon focused on the low band antennas,** bringing out the 12m telescoping fiberglass pole, followed by 18m/26m/22m.
    - **Tall, Lightweight, Efficient Low Band Verticals**

Spiderbeam (the company)

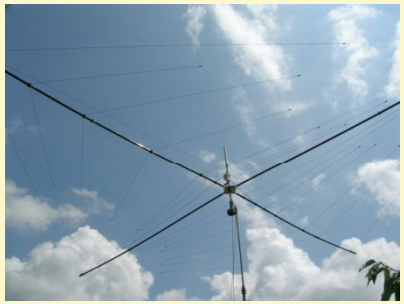
Montechiari

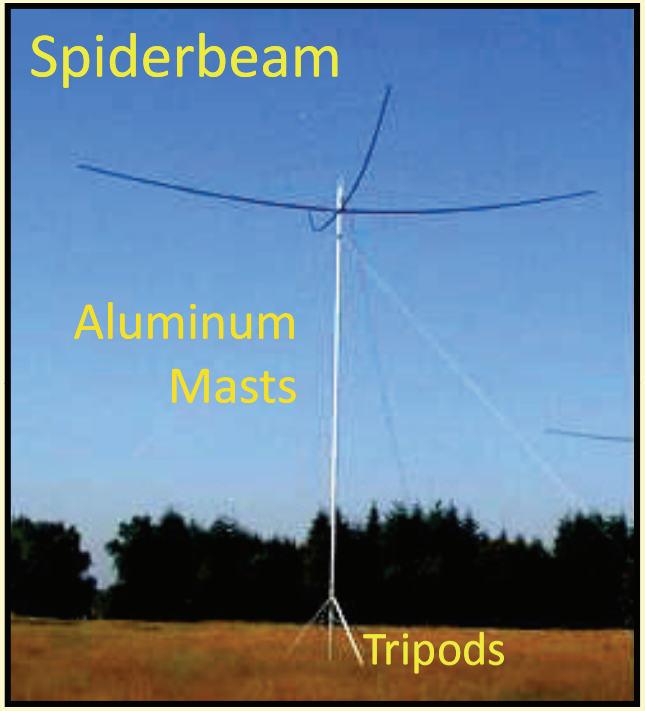
FOCUS TODAY

OUR PRODUCTS:

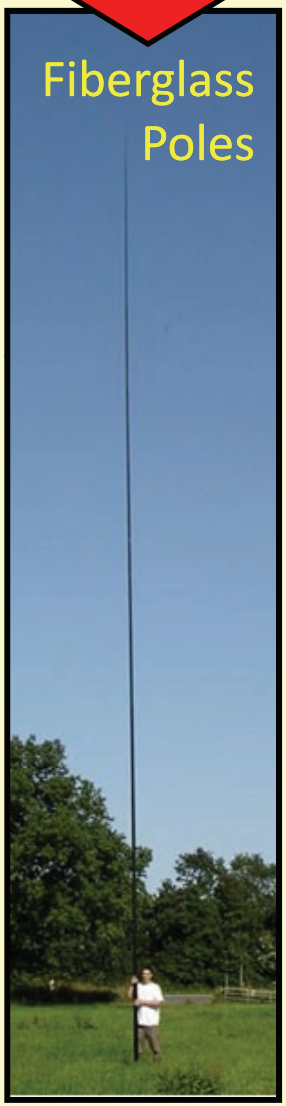
- Spiderbeam Yagi Antennas
- Wire Antennas
- Fiberglass Poles
- Aluminum Masts and Accessories
- Guying Material
- Ant. Hardware
- Spare Parts

SUN SPOTS





Fiberglass Poles



Spiderbeam Yagi Antennas & Kits

GoPak (Go Portable Antenna Kit)

Alu-Masts

Tripods

spiderbeam
high performance lightweight antennas

ABOUT: This Presentation

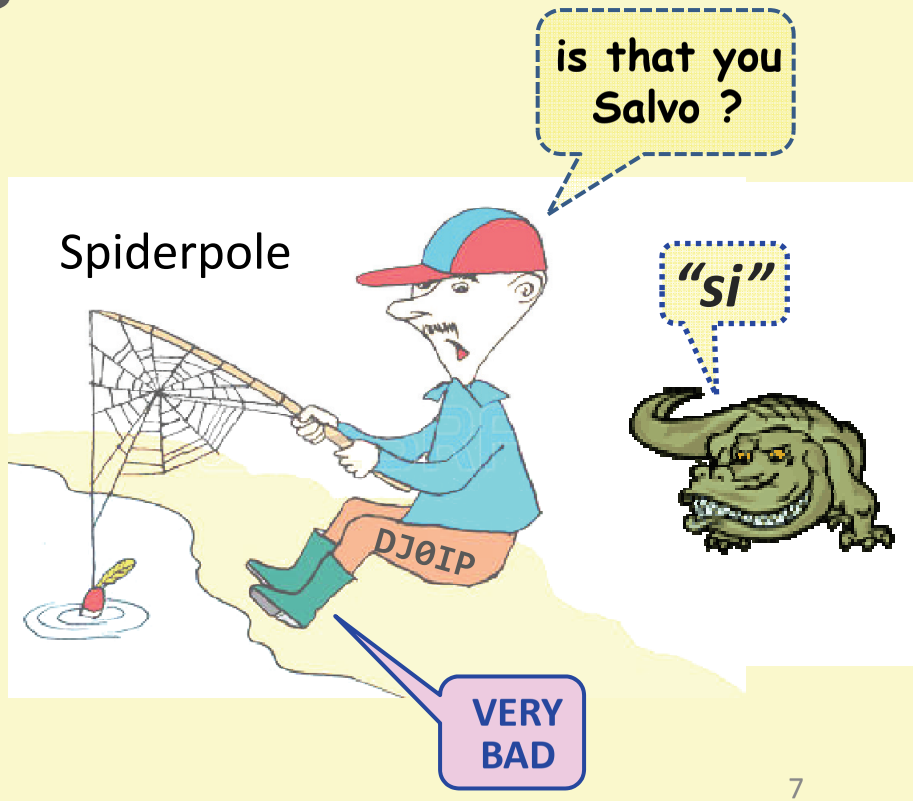
- **ABOUT: BUILDING SIMPLE & PRACTICAL ANTENNAS**
  - Antennas that work very good.
  - Antennas that EVERYONE can build themselves.
- **NOT ABOUT:** the ultimate optimization of each antenna.
  - Not about using complex math or computer modeling or building complex matching networks.
  - Not a high-tech presentation; it's a practical presentation.
- **ALSO ABOUT:** ***Practical Tips*** for successful deployment of lightweight telescoping fiberglass poles.
- **ALSO ABOUT:** Where to find more detailed information.

spiderbeam
high performance lightweight antennas

WHAT CAN WE DO WITH THESE POLES?

- HORIZONTAL DIPOLE ANTENNAS
- INVERTED-V ANTENNAS
- LONGWIRE ANTENNAS
- VERTICAL ANTENNAS
- INVERTED-L ANT.
- LOOP ANTENNAS

. . . Or Just Go Fishing . .



spiderbeam
high performance lightweight antennas

FUNDAMENTALS

WIRE ANTENNA PERFORMANCE

- **VERTICALS ANTENNAS:**
  - **a. HEIGHT IS MIGHT!** It determines the 'Radiation Resistance' of the antenna.
  - **b. MINIMIZE GROUND LOSSES** by using a good radial network.
  - **c. MINIMIZE MATCH LOSSES** by choosing the best matching method.
- **HORIZONTAL ANTENNAS:**
  - **HEIGHT IS MIGHT!** It reduces ground losses and lowers the **T**ake-**O**ff **A**ngle.
  - **TOA: λ/4=63º - λ/2=28º - λ=14º**
- **MOUNT FREE AND IN THE CLEAR**

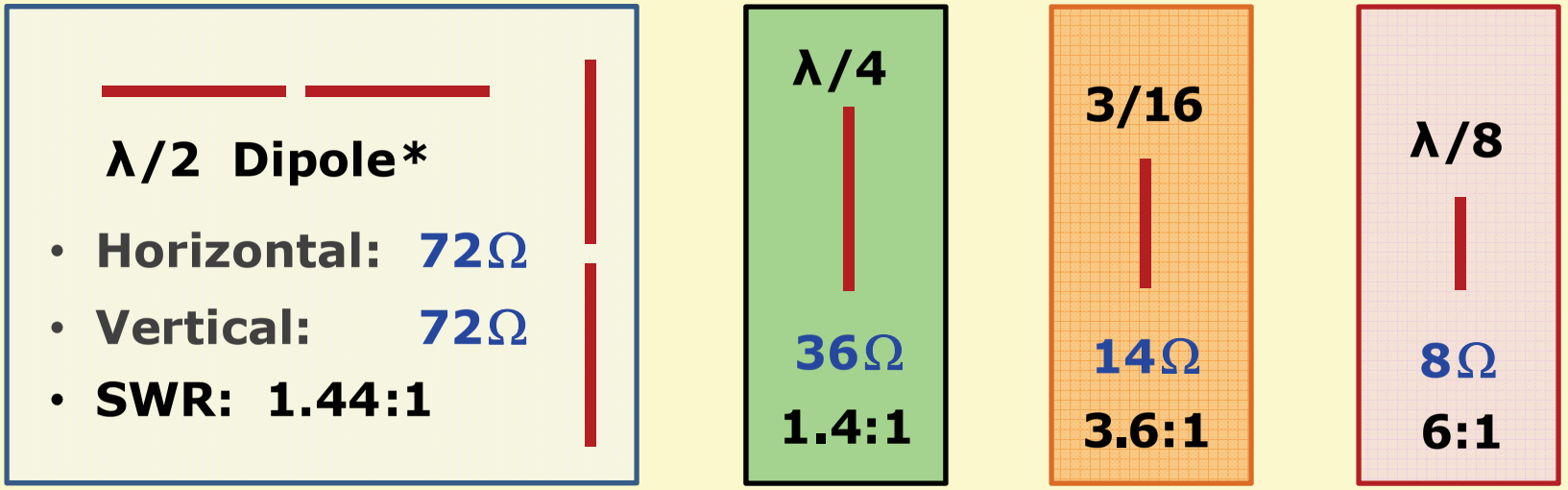
S W R ?

spiderbeam
high performance lightweight antennas

VERTICAL PERFORMANCE A: Radiator

1. **'Radiation Resistance' is complex, and is primarily determined by the 'physical length' of the radiator.**
   - **This is a physical property that cannot be tricked.**
   - **No loading or gimmick or trick can improve this.**

RADIATION RESISTANCE:



* ½ w.l. high

Source: W2FMI / QST March, 1973 – p. 15

spiderbeam
high performance lightweight antennas

VERTICAL PERFORMANCE A: Radiator

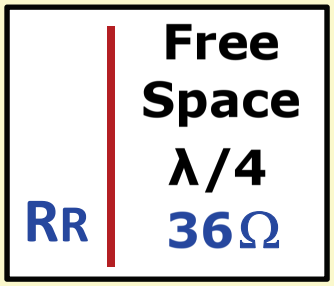
- **In FREE SPACE**, 100w fed to the antenna radiates 100w even though the SWR is about 1.4:1. **Efficiency = 100%**
- **On Earth,** we introduce "**G**round **R**esistance" (**GR**). The Impedance* of the antenna is RR + GR, or in this example, 36 + 12 = 48 Ohms. {*simplified: no reactance}
- **EFFICIENCY = RR divided by (RR+GR) times 100.** In this example, Eff. = (36/48) x 100 . . . or **75%.**

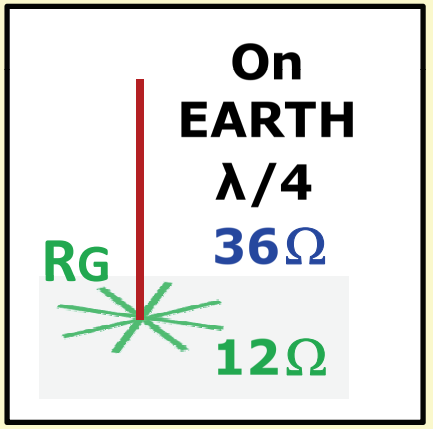
In the case of the λ/8 vertical, we introduce yet another term: "**Match Loss**." A typical value for matchboxes is 5% to 10% . Let's use 10% to keep the math simple.

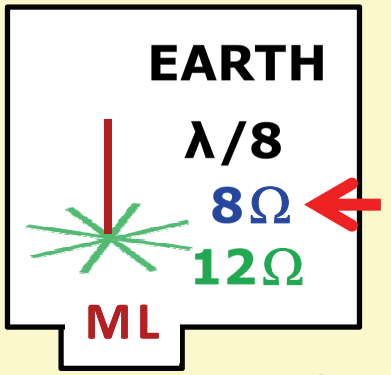
The efficiency before considering match loss is just **40%**. (8/20 x 100 = 40%). *(Neglecting transmission line loss.)*

Since we are losing 10w in the matchbox, we are actually radiating 40% of 90w, or just 36 watts.

The efficiency, all things considered, is now just 36%.







spiderbeam
high performance lightweight antennas

VERTICAL PERFORMANCE B: Radials

ALL Quarter-Wavelength (or Short-Q-WL) verticals REQUIRE a good Radial Network.

- **In theory**, the more radials we use, the more efficient the antenna will work.
  - There is no *technical* reason not to continue adding more radials…. **FOREVER**
- **In practice**, we quickly reach the point of diminishing Return On Investment (ROI).
  - There is ***no practical reason*** to continue adding radials once we have reached this point.

BUT WHERE IS THAT POINT ?

HOW MANY RADIALS DO WE NEED ?

This is what we call a "Rubber Question".

spiderbeam
high performance lightweight antennas

VERT. PERF. B: Radials *(continued)*

For a 40m full size quarter wavelength vertical:

FOCUS: "NUMBER OF RADIALS"

Source: Rudi Severns, N6LF – QST March, 2010, pages 30 - 33

Table 1

Relative Signal Strengths for 4, 8, 16 and 32 Radials

Number of Radials		***Normalized to 4 Radials*** *33' Radials*	
4		0	
8	*Con / DF4SA	2.26	> 2.26dB from 4 to 8 radials.
16	*Rick / DJ0IP	3.76	> 1.50dB from 8 to 16 radials.
32		4.16	> 0.40dB from 16 to 32 radials.

*** For TEMPORARY Field Installations**

Going from 32 to 64 Radials only improves the signal by 0.2 dB

6dB = 1 S-Unit - - - so 0.2 dB is simply non-discernible!

Note: all numbers are slightly higher for shorter radiators.

spiderbeam
high performance lightweight antennas

VERT. PERF. B: Radials *(continued)*

For a 40m full size quarter wavelength vertical:

FOCUS: "LENGTH OF RADIALS"

Source: Rudi Severns, N6LF – QST March, 2010, pages 30 - 33

Table 1

Relative Signal Strengths for 4, 8, 16 and 32 Radials, Comparing Lengths of 33' and 21'

Number of Radials	*Normalized to Four 33' Radials (dB) 33' Radials*	*Normalized To Four 33' Radials (dB) 21' Radials*	*Gain Change (dB)*
4	0	3.08	+3.08
8	2.26	3.68	+1.42
16	3.76	3.95	+0.19
32	4.16	4.04	–0.12

IMO: 8 to 12 Radials, 21' long is the best solution for portable / temporary operations… **(DJ0IP)**

The radials here are 0.16 (1/6) wavelength long.

spiderbeam
high performance lightweight antennas

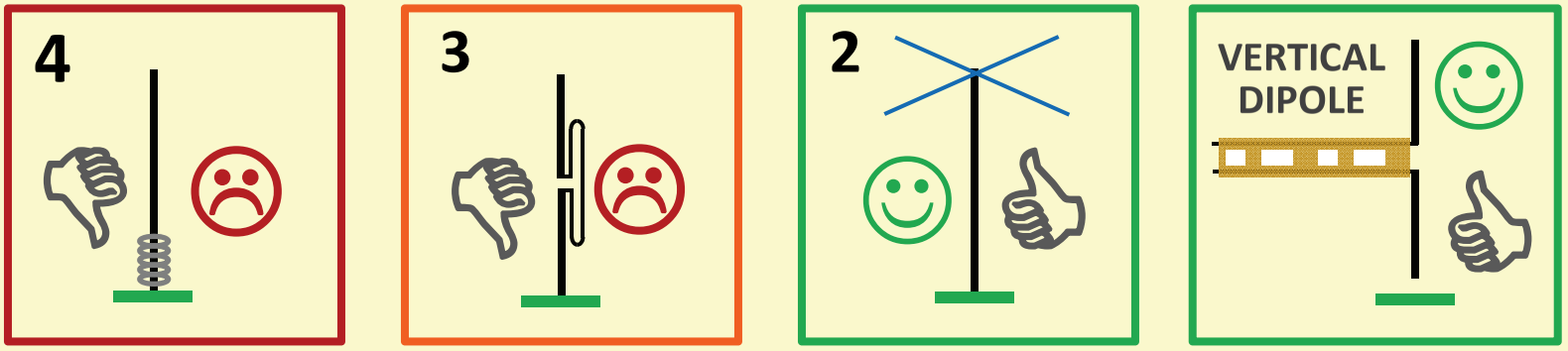
VERTICAL PERFORMANCE C: Matching

TOO SHORT: WE MUST FIND A GOOD WAY TO LENGTHEN IT:

- 1st BEST: Just make it longer (If Possible) R.R. ⬆
- 2nd BEST: Use Top-Hat Wires (Simple)
- 3rd Better: Use Linear Loading (Not Simple in the Field)
- 4th Worst: Use a Loading Coil (Simple, but not efficient)

Loading Coil = higher losses and smaller bandwidth.

ALL SPIDERBEAM SHORT VERTICALS USE TOP-HAT WIRES, (EXCEPT FOR ONE).



Electrical ⬇ Mechanical ⬇ Favorite ⬆ *(Special Case ⬆)*

spiderbeam
high performance lightweight antennas

VERTICAL PERFORMANCE C: Matching

SHORT DIPOLE RADIATION RESISTANCE

Capacitive Loading
Vs.
Inductive Loading

Inductive = Coil or Stub

For short vertical, use ½ the value.

Source: *hf antennas for all locations,* p.28, by L. Moxon, G6XN

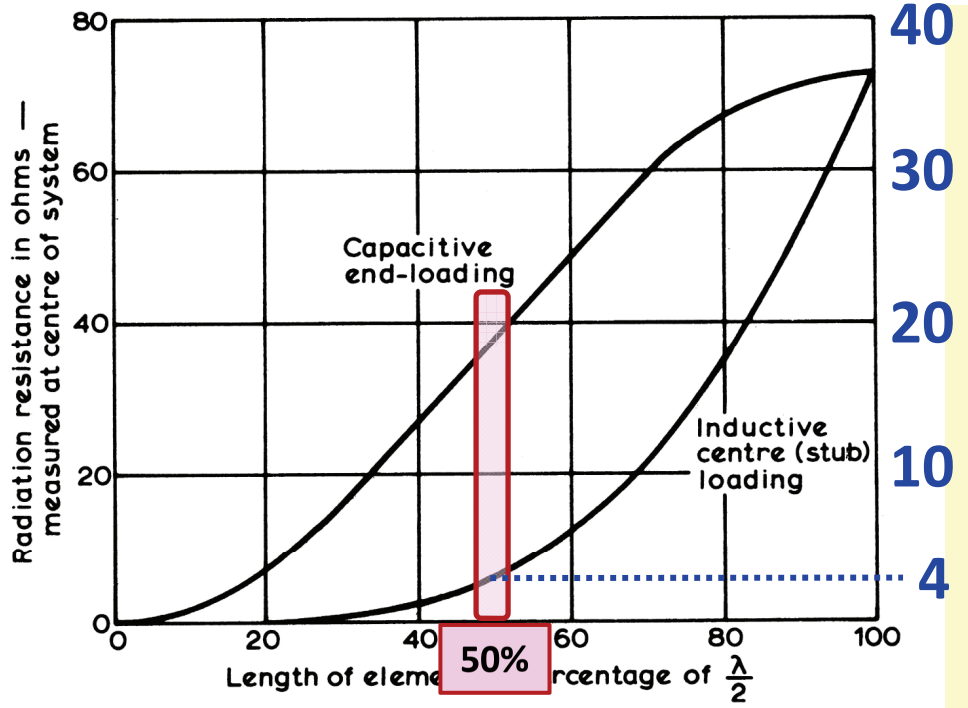


Fig 3.12. Radiation resistance of short dipoles with alternative methods of loading.

For a half size vertical, the radiation resistance is:

λ/8

- **18 Ohms** with Capacitive End-Loading
- **4 Ohms** with Inductive Center (or Base) Loading

Performance or Convenience ?

spiderbeam
high performance lightweight antennas

VERTICAL PERFORMANCE / SWR

RELATIONSHIP BETWEEN SWR and ANT. PERFORMANCE:

nessuna

I am not aware of any other relationship.

~~SWR?~~

FAKE NEWS

SWR describes: ***the ability to deliver power to the antenna.***
It says <u>NOTHING</u> about what the antenna can do with the power.

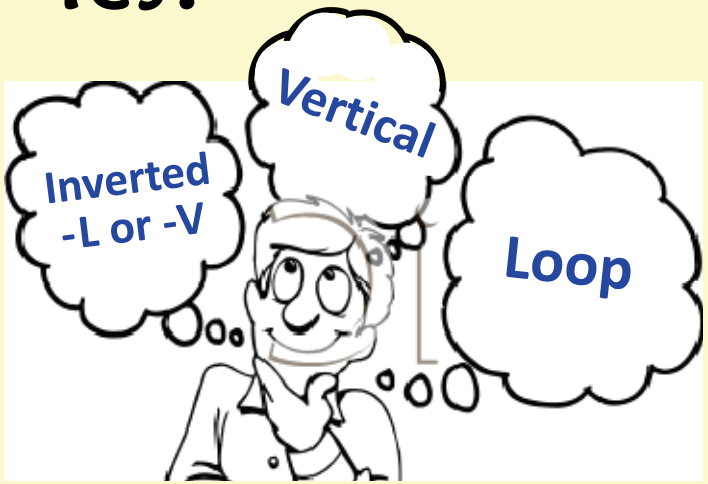
spiderbeam
high performance lightweight antennas

That's Enough Theory . . .

Let's Build Some Antennas!

BIG GUN

Yes!

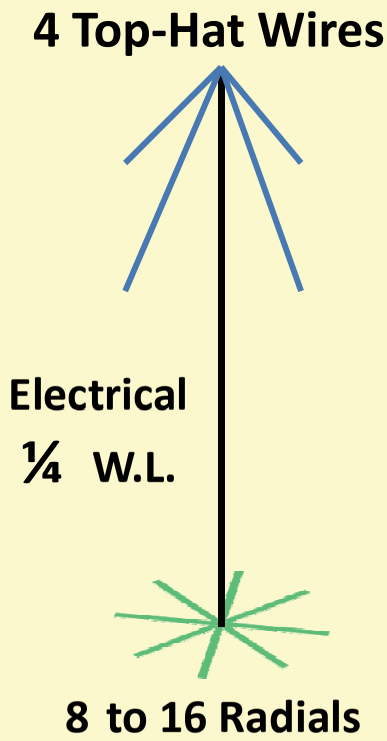


Little
Pistole

¼ Wavelength VERTICAL ANTENNAS

With Spiderbeam's Fiberglass Pole Portfolio, we can build 20~22 different ¼ W.L. (electrical) Vertical Antennas. We have detailed instructions for 12 antennas.

ELECTRICAL 1/4 WAVE DIPOLE	SPIDERPOLE			
ANTENNA TYPE	12m	18m	22m	26m
160m Vertical	O	✓	•	✓
160m Inverted-L	✓	✓	•	•
160/80m Vertical (Dual Band)	O	✓	•	•
80m Vertical	✓	✓	•	•
80m Inverted-L	✓	eFP		
80/40m Vertical (Dual Band)	O	✓		
40m Vertical	✓	eFP		
40m Vertical / el. Radials	✓			
40m Minimum-Space Vertical	✓			



• The pole is good for this purpose.

✓ The pole is good / **we have detailed instructions.**

O The pole is NOT good for this purpose.

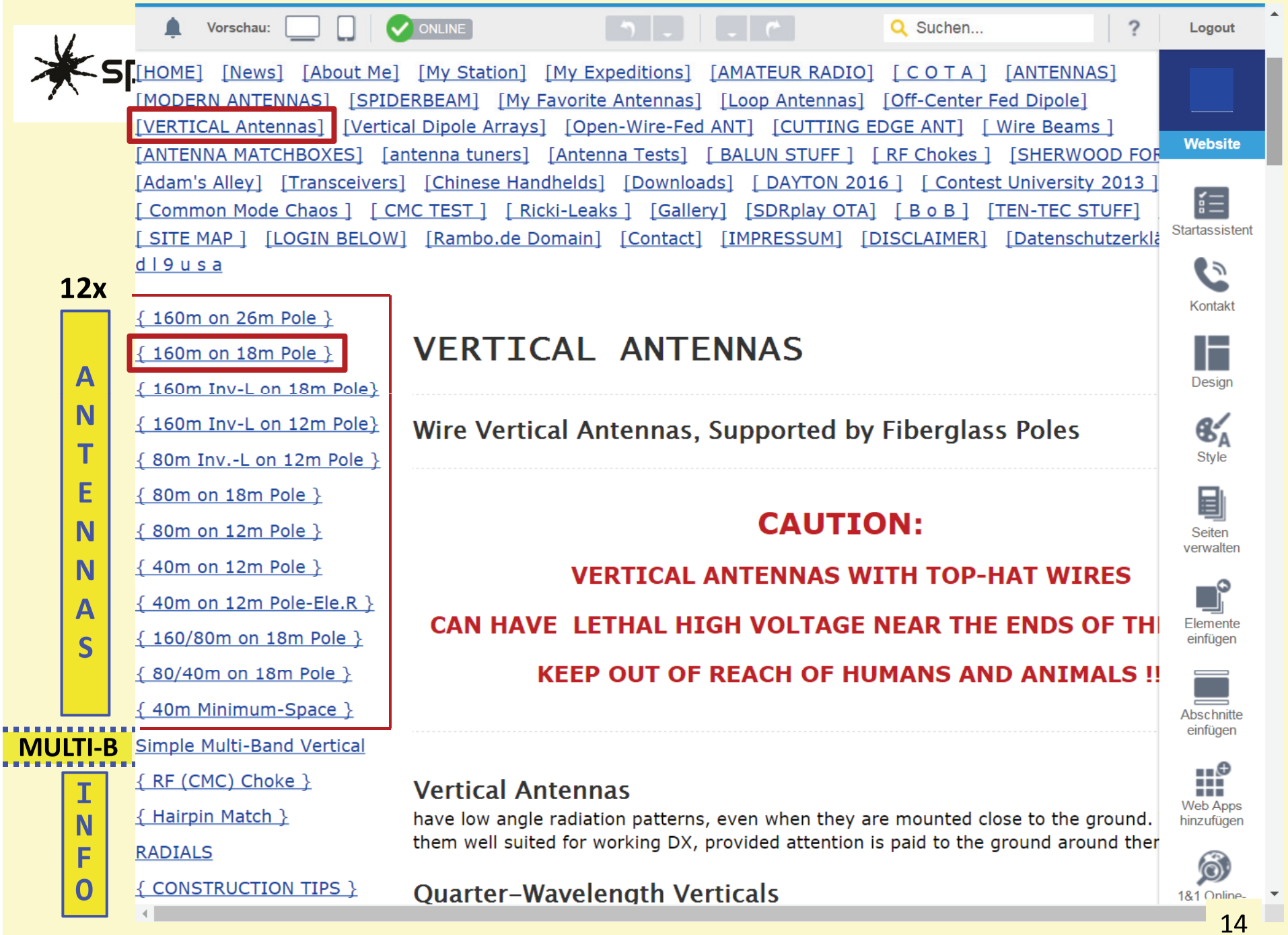
eFP With Elevated Feed Point

Pole is too long.

¼ Wavelength VERTICAL ANTENNAS

Where to find this information:

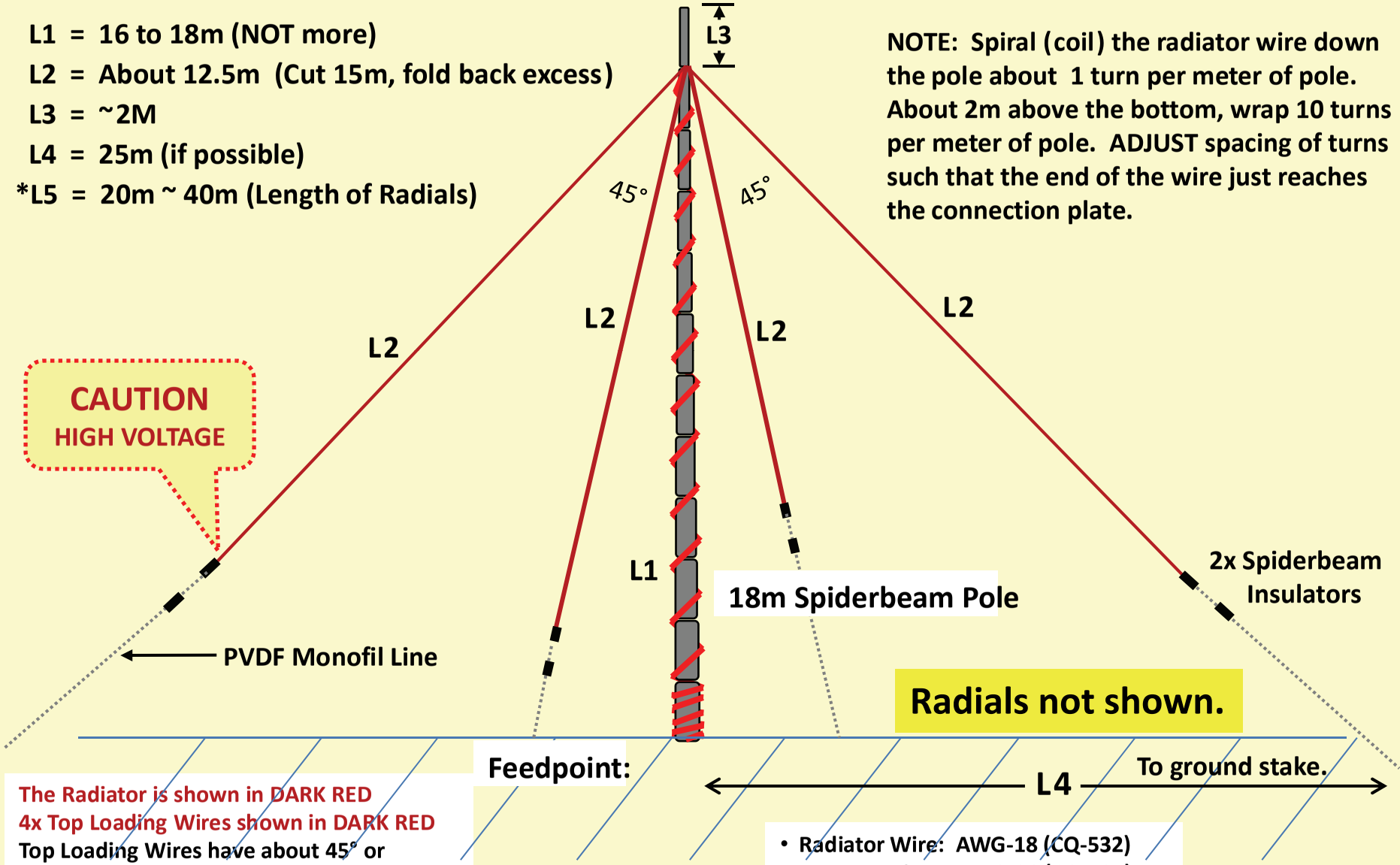
CLICK


Vorschau:
ONLINE
Suchen...
Logout
[HOME] [News] [About Me] [My Station] [My Expeditions] [AMATEUR RADIO] [C O T A] [ANTENNAS]
[MODERN ANTENNAS] [SPIDERBEAM] [My Favorite Antennas] [Loop Antennas] [Off-Center Fed Dipole]
[VERTICAL Antennas] [Vertical Dipole Arrays] [Open-Wire-Fed ANT] [CUTTING EDGE ANT] [Wire Beams]
[ANTENNA MATCHBOXES] [antenna tuners] [Antenna Tests] [BALUN STUFF] [RF Chokes] [SHERWOOD FOR
[Adam's Alley] [Transceivers] [Chinese Handhelds] [Downloads] [DAYTON 2016] [Contest University 2013]
[Common Mode Chaos] [CMC TEST] [Ricki-Leaks] [Gallery] [SDRplay OTA] [B o B] [TEN-TEC STUFF]
[SITE MAP] [LOGIN BELOW] [Rambo.de Domain] [Contact] [IMPRESSUM] [DISCLAIMER] [Datenschutzerkl
d l 9 u s a
12x
ANTENNAS
{ 160m on 26m Pole }
{ 160m on 18m Pole }
{ 160m Inv-L on 18m Pole}
{ 160m Inv-L on 12m Pole}
{ 80m Inv.-L on 12m Pole }
{ 80m on 18m Pole }
{ 80m on 12m Pole }
{ 40m on 12m Pole }
{ 40m on 12m Pole-Ele.R }
{ 160/80m on 18m Pole }
{ 80/40m on 18m Pole }
{ 40m Minimum-Space }
MULTI-B
Simple Multi-Band Vertical
INFO
{ RF (CMC) Choke }
{ Hairpin Match }
RADIALS
{ CONSTRUCTION TIPS }
VERTICAL ANTENNAS
Wire Vertical Antennas, Supported by Fiberglass Poles
CAUTION:
VERTICAL ANTENNAS WITH TOP-HAT WIRES
CAN HAVE LETHAL HIGH VOLTAGE NEAR THE ENDS OF TH
KEEP OUT OF REACH OF HUMANS AND ANIMALS !!
Vertical Antennas
have low angle radiation patterns, even when they are mounted close to the ground.
them well suited for working DX, provided attention is paid to the ground around ther
Quarter–Wavelength Verticals
Website
Startassistent
Kontakt
Design
Style
Seiten verwalten
Elemente einfügen
Abschnitte einfügen
Web Apps hinzufügen
1&1 Online-

160 M Top-Loaded Spiderbeam Vertical on 18m Spiderbeam Pole

L1 = 16 to 18m (NOT more)
L2 = About 12.5m (Cut 15m, fold back excess)
L3 = ~2M
L4 = 25m (if possible)
*L5 = 20m ~ 40m (Length of Radials)

NOTE: Spiral (coil) the radiator wire down the pole about 1 turn per meter of pole. About 2m above the bottom, wrap 10 turns per meter of pole. ADJUST spacing of turns such that the end of the wire just reaches the connection plate.



The Radiator is shown in DARK RED
4x Top Loading Wires shown in DARK RED
Top Loading Wires have about 45° or greater angle to the pole.
Feedpoint about 10cm off the ground.
*L5 = Length of Radials (not shown)

- Radiator Wire: AWG-18 (CQ-532)
- Top Hat Wires: AWG-26 (CQ-534)

Start with L1 = 18m and trim to adjust frequency.

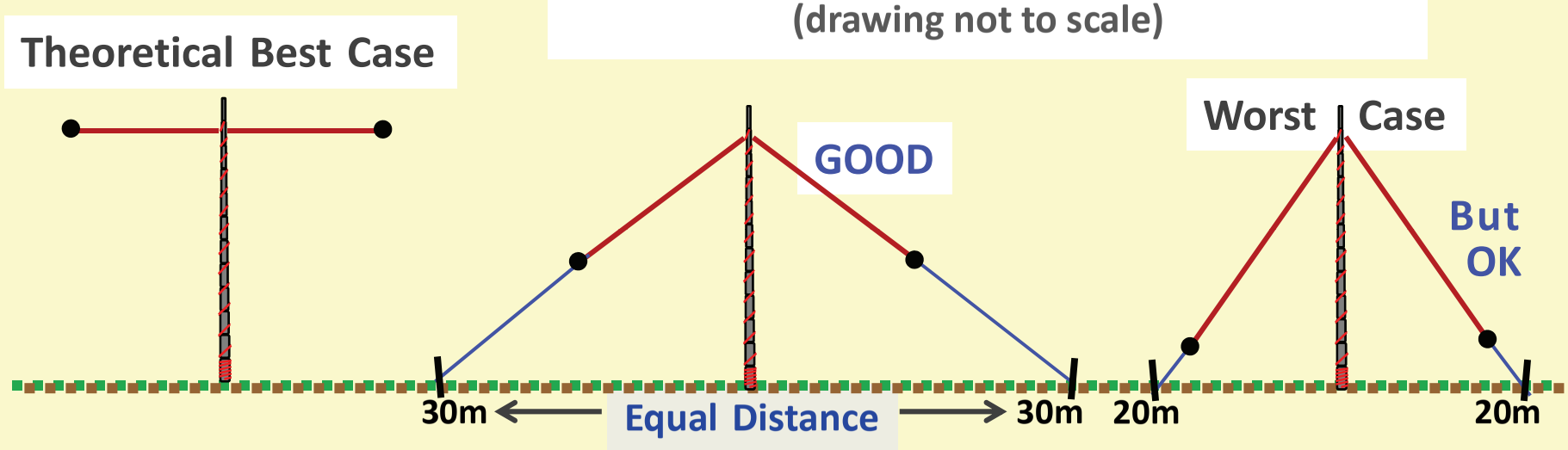
spiderbeam
high performance lightweight antennas

VERTICAL CONSTRUCTION TIPS

ANGLE OF THE 4 TOP HAT WIRES

For simplicity, only 2 wires shown here.

(drawing not to scale)

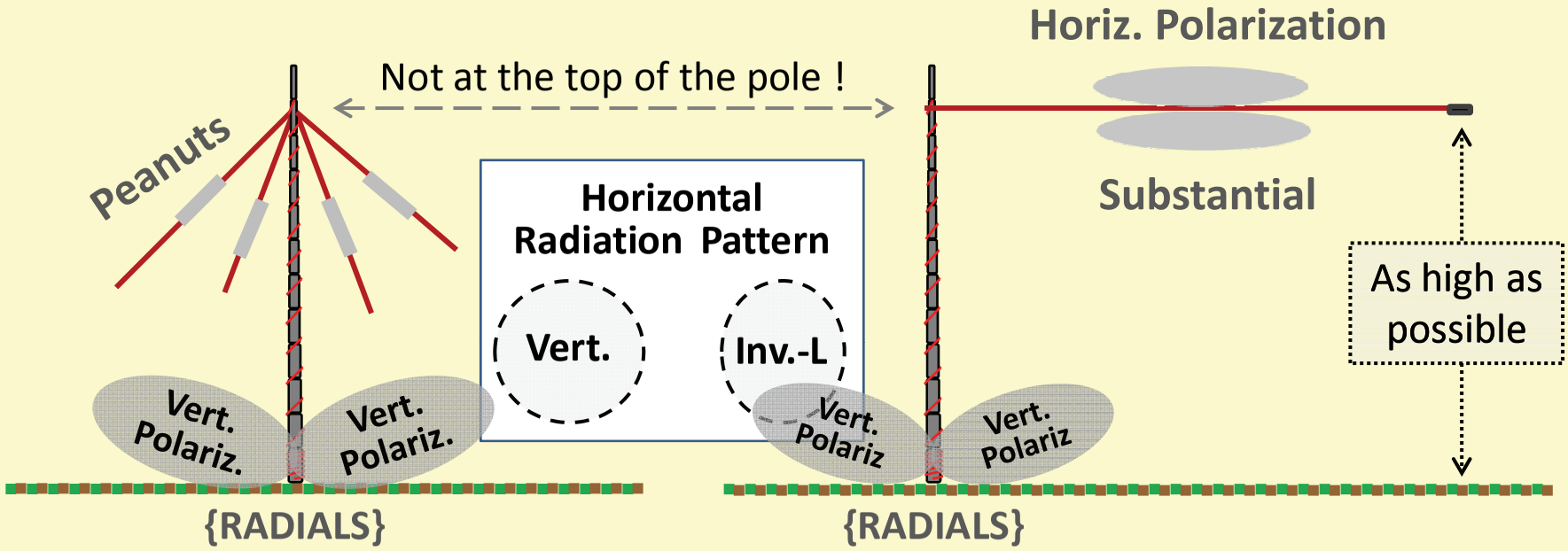


Assuming the Vertical Radiator is the Same:

- **The closer the Top-Hat is to the pole (smaller the angle), the longer the wire must be.**
- **The wider the angle (higher Top-Hat), the higher the efficiency.**
- **Best Practice: 'Horizontal' Top-Hat Wires (usually impossible to implement)**

spiderbeam
high performance lightweight antennas

VERTICAL Vs. INVERTED-L



FEATURES: (RR=??Ω)

- Hat does not Radiate much
- LONG-DX: VERY GOOD
- EU-DX (NVIS): Not so Good
- Build: Slightly Complex

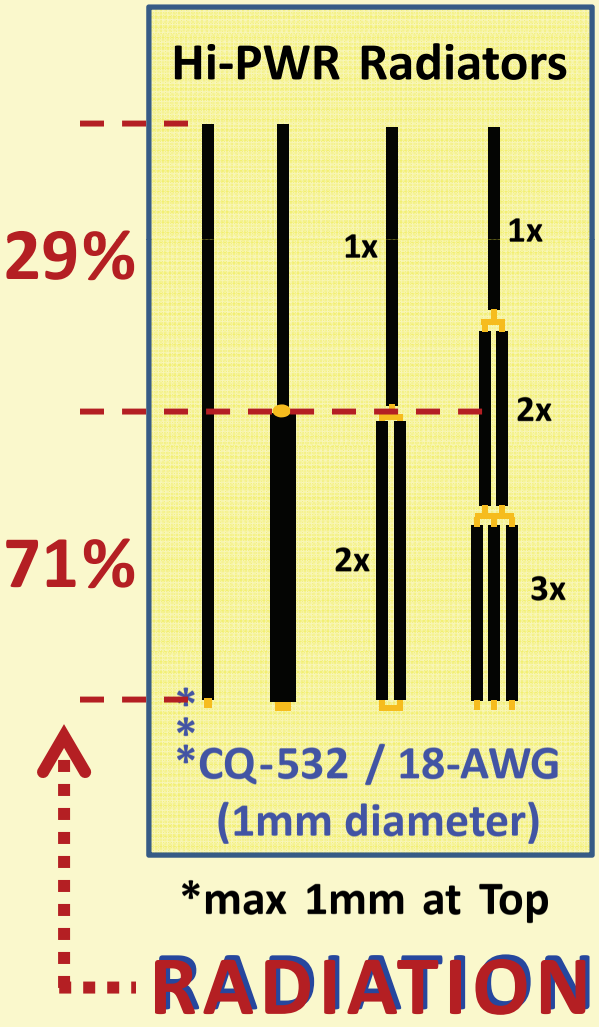
FEATURES: (RR=36Ω)

- Horiz. Wire does Radiate
- LONG-DX: GOOD
- EU-DX (NVIS): GOOD
- Build: Very Simple

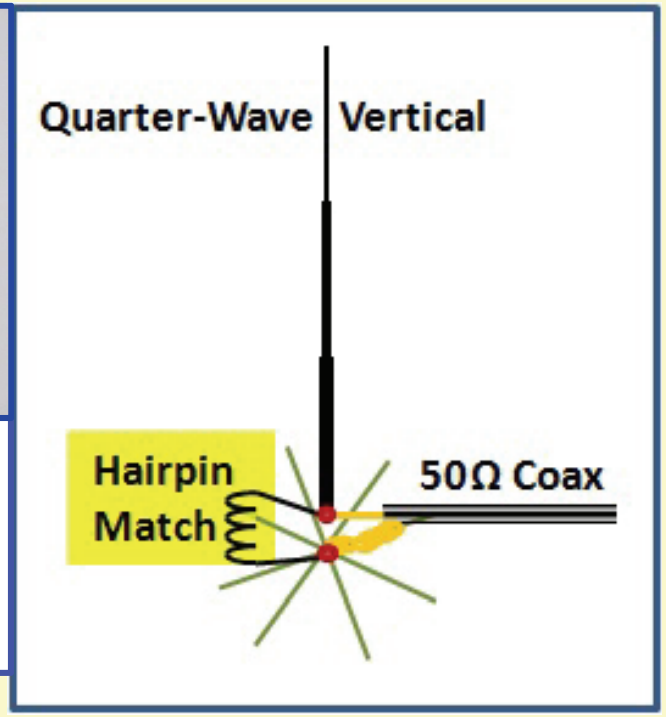
spiderbeam
high performance lightweight antennas

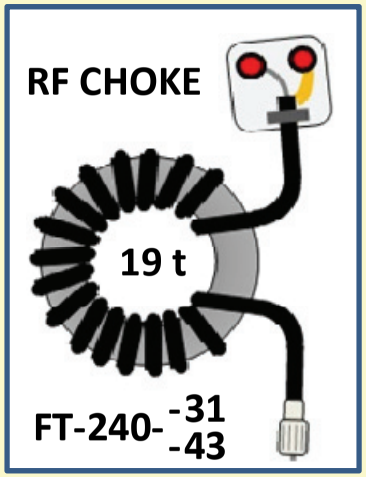
VERTICAL CONSTRUCTION TIPS

160m Vertical



Typical SWR = 2.8:1
Reduce to ~1.5:1
with Hairpin Match





Feed Point Tips

Use 1 core per 500w
(3 cores for 1500w)
Secure with Cable Ties

(for Hi-Pwr: Use RG-142)

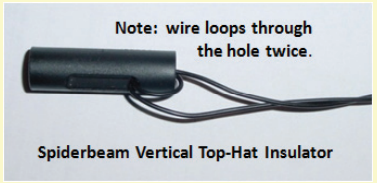
spiderbeam
high performance lightweight antennas

160m Vertical on 18m Pole

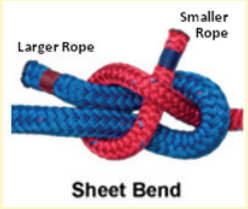
INSTRUCTION MANUAL*
Step-by-Step Instructions

Radial Connection Box

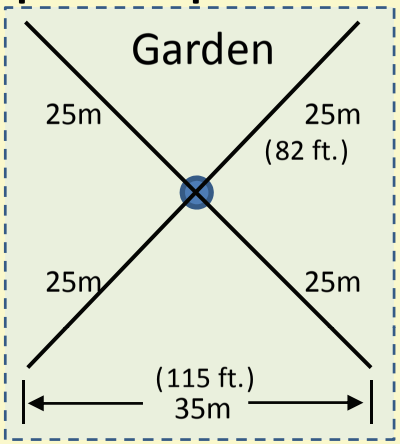
End-Insulator



How to tie knots

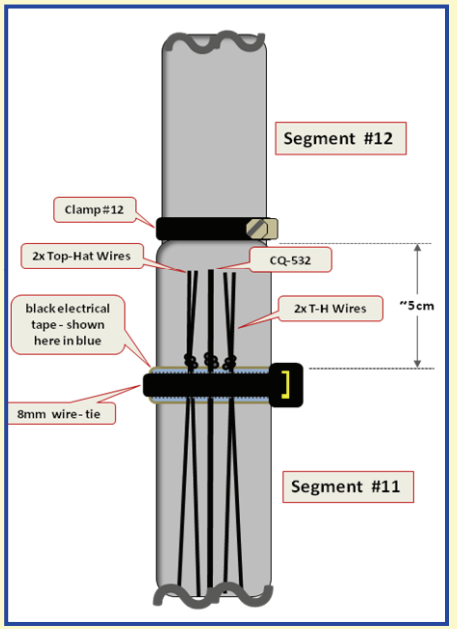


Space Requirements

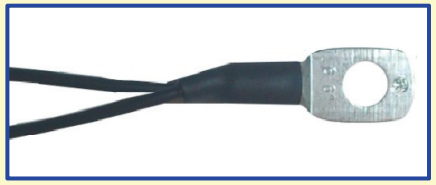


Kevlar Preparation

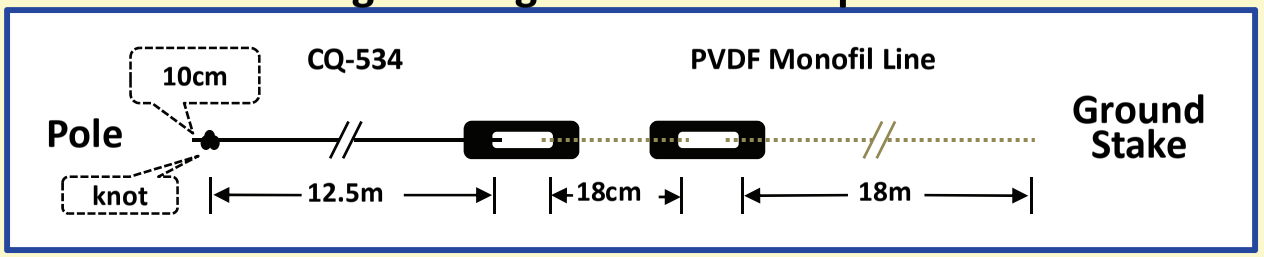
Radiator/Top-Hat Connection



Radial Attachment



High Voltage Insulator Preparation

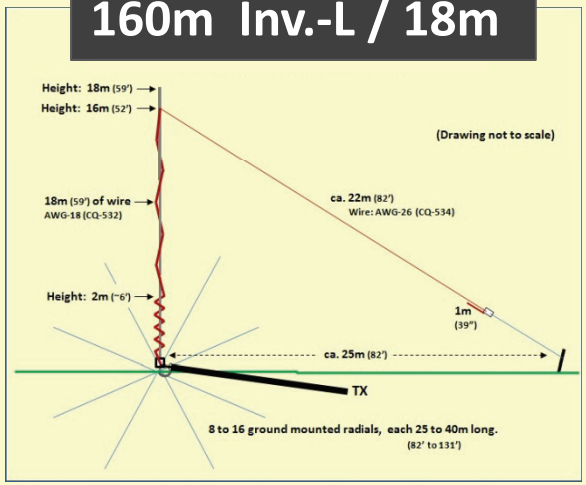


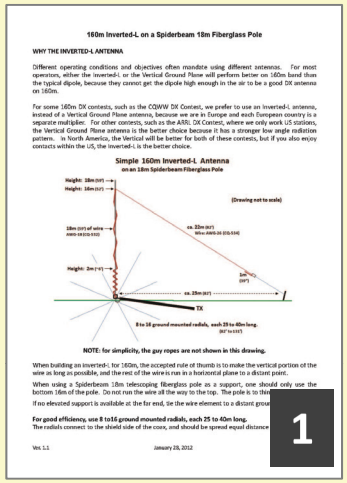
* www.spiderbeam.com/pdf_files/160-18-4WTH.pdf

spiderbeam
high performance lightweight antennas

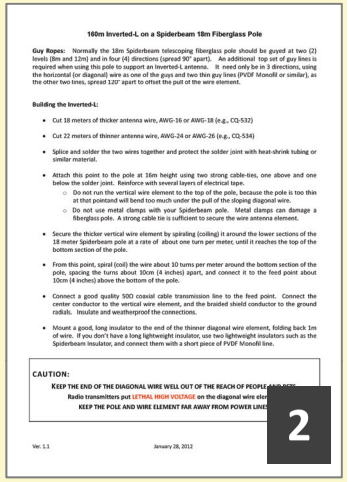
Otr. Examples: www.DJ0IP.de

160m Inv.-L / 18m

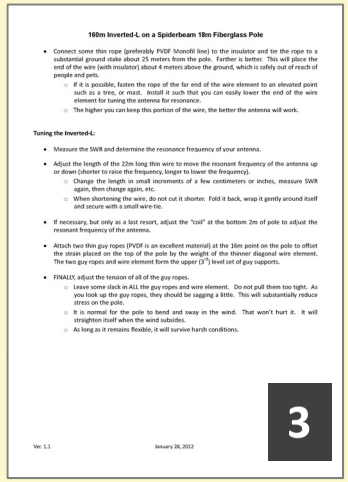




1

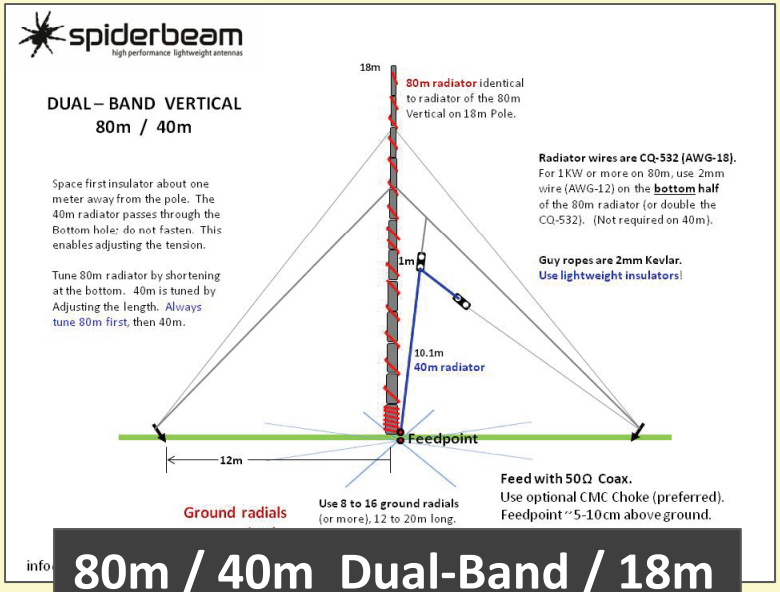


2

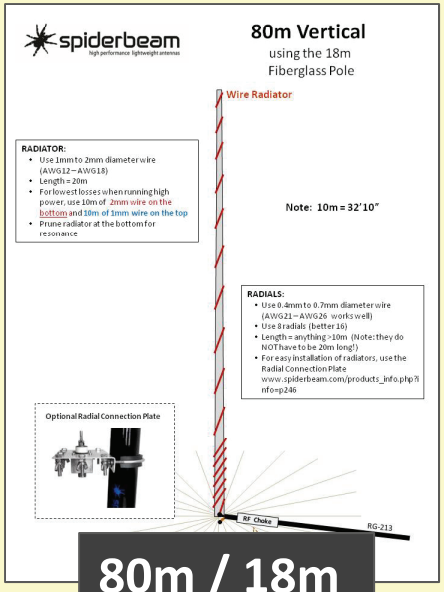


3

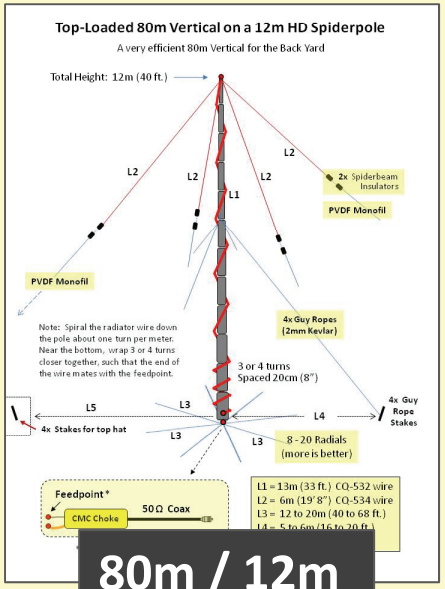
80m / 40m Dual-Band / 18m



80m / 18m



80m / 12m



spiderbeam
high performance lightweight antennas

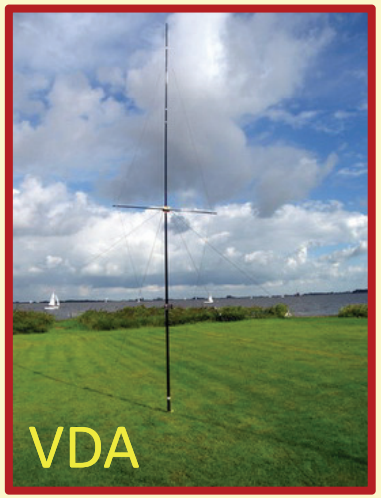
Building Blocks

ALL ANTENNAS Built On Spiderbeam Poles

80M 4-SQUARE: VP6DX, DUCIE ISL

Band: Antenna(s)

- 160m: 26m tall vertical
- 80m: Two 4-Squares
- 40m: Two 4-Squares
- 30m: 4-Square
- 20m: Vertical Dipol Array
- 17m: Vertical Dipol Array
- 15m: Vertical Dipol Array
- 12m: Vertical Dipol Array
- 10m: Vertical Dipol Array



SINCE 2008, SEVERAL MAJOR DX-PEDITIONS HAVE SWITCHED FROM ALUMINUM TO ALL-FIBERGLASS.

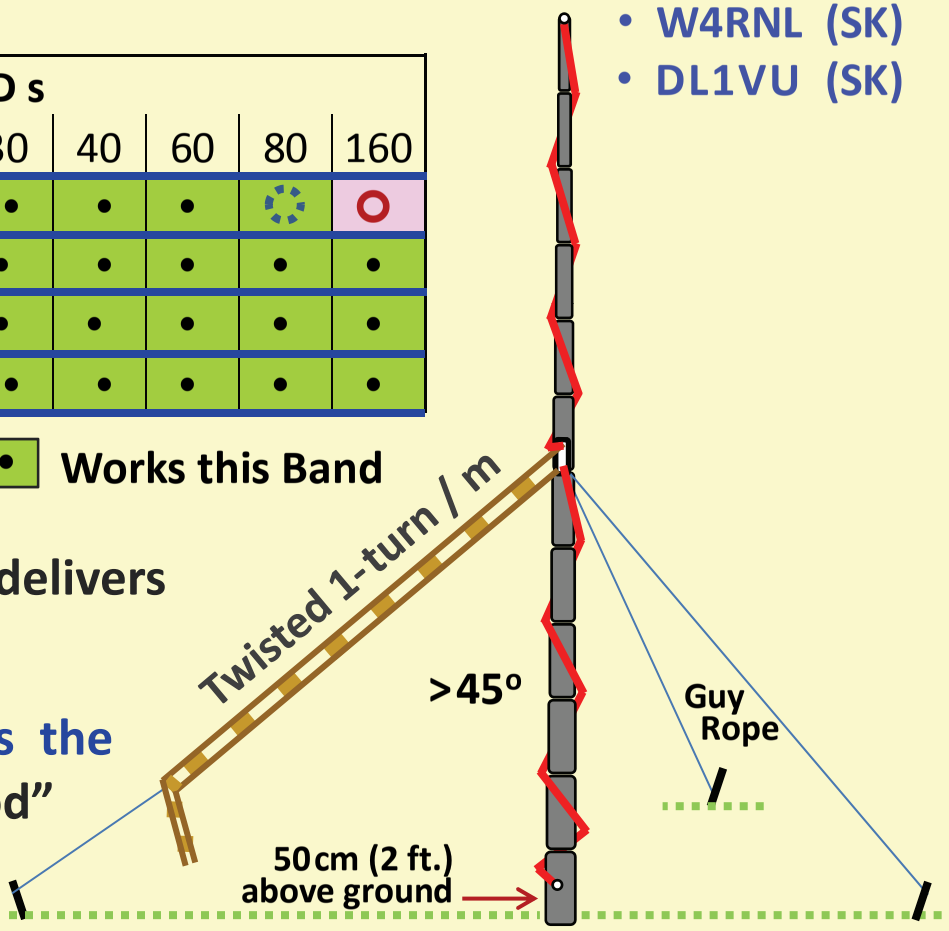
4x VERTICAL DIPOLE ANTENNAS

Spiderbeam Vertical Dipole Portfolio:

	Vertical Dipoles		BANDs									
	POLE	Legs	10	12	15	17	20	30	40	60	80	160
1	12m*	2 x 6m	•	•	•	•	•	•	•	•	◌	O
2	18m	2 x 9m	O	O	•	•	•	•	•	•	•	•
3	22m	2 x 11m	O	O	O	•	•	•	•	•	•	•
4	26m	2 x 13m	O	O	O	O	O	•	•	•	•	•

O Does NOT Work this Band • Works this Band

Recommended by:
- W4RNL (SK)
- DL1VU (SK)



For its size and simplicity, this antenna delivers amazing performance on many bands.

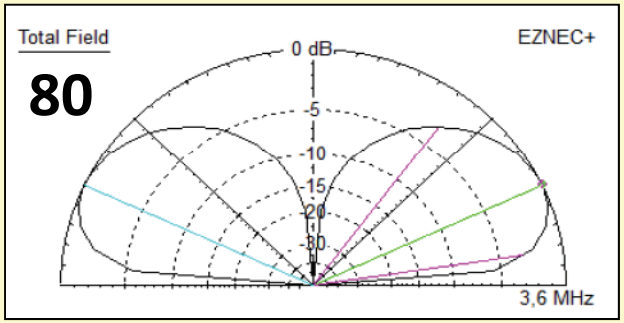
Surprisingly the smallest version covers the most number of bands, including "good" (not great) performance on 80m.

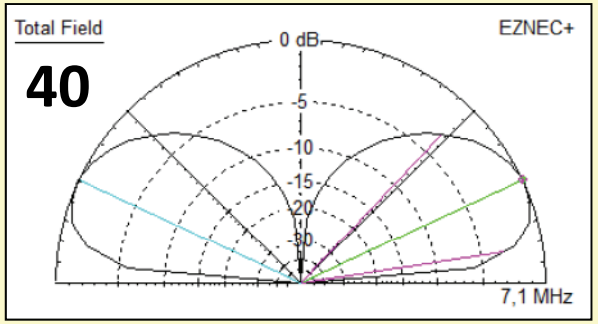
A good antenna matchbox is REQUIRED on all bands.

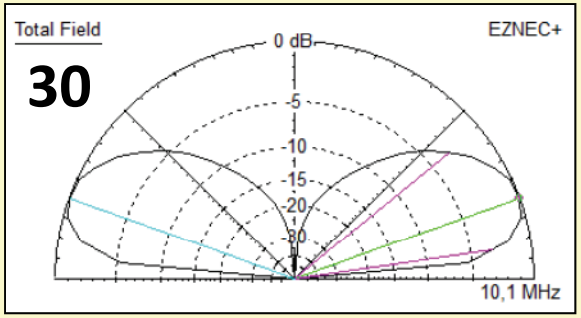
*Detailed Instructions available for the 12m Pole Version.

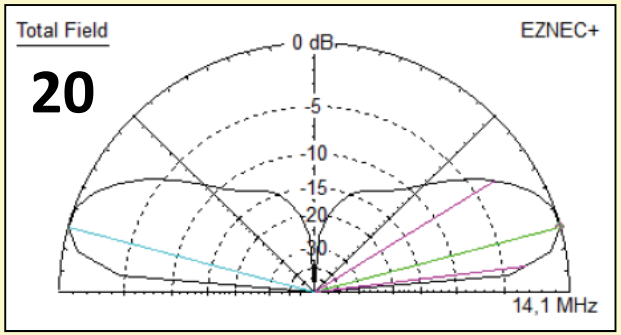
spiderbeam
high performance lightweight antennas

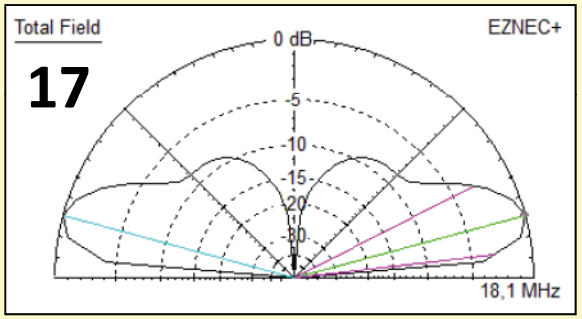
EXAMPLE: 12m VERTICAL DIPOLE

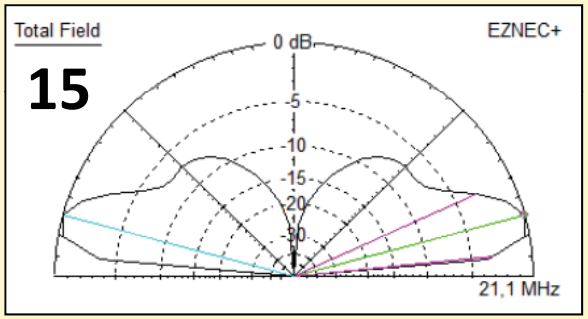


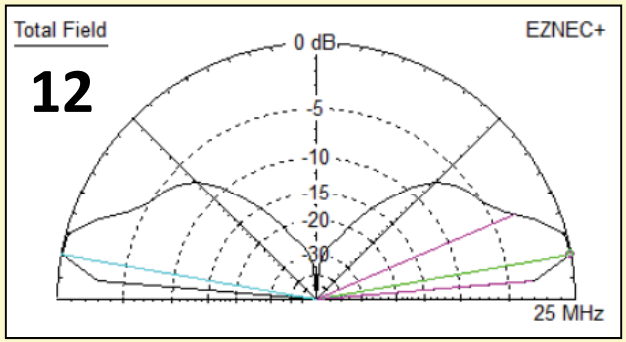


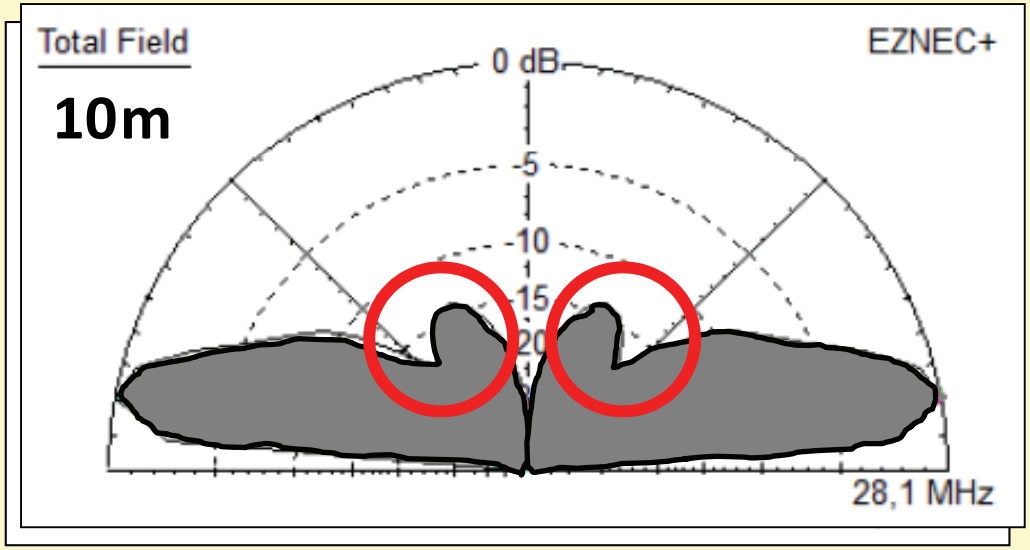












spiderbeam
high performance lightweight antennas

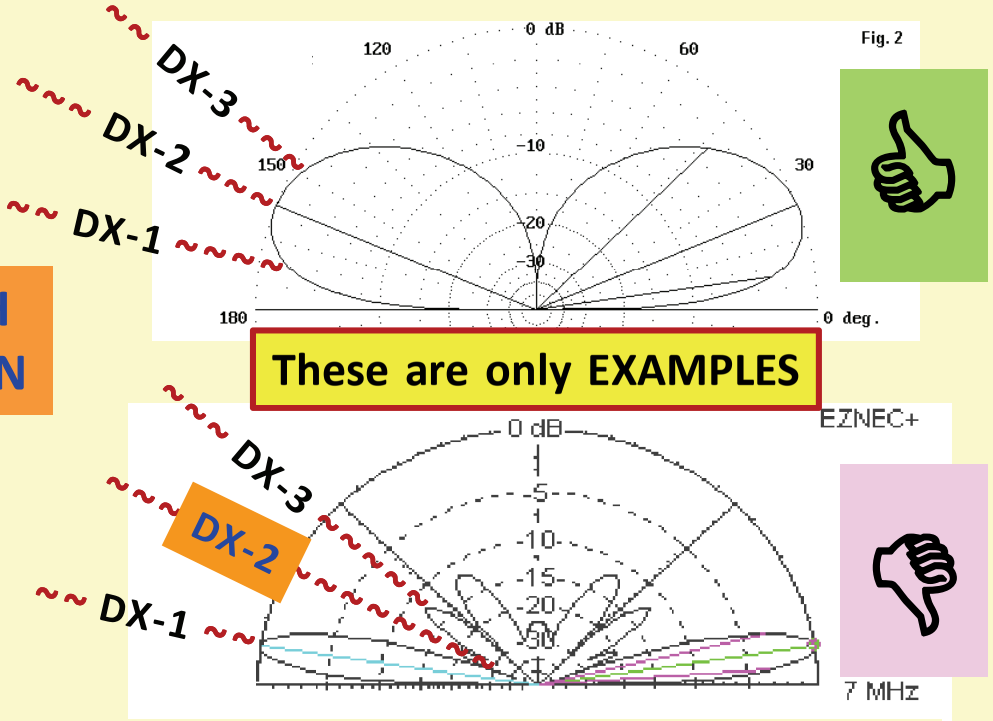
4x VERTICAL DIPOLE ANTENNAS

The problem when the Vertical Dipole is too Long:

Normally we have a low angle of radiation pattern in all directions around the VD.

SPLIT LOBES IN THE HIGH BAND RADIATION PATTERN

If we make the radiator too long, the radiation pattern on the highest band will begin to split into multiple lobes.



If we make it too short, we lose efficiency on the low bands.
The challenge is to make antenna as long as possible until just before the lobes begin to split on the highest band of operation.

spiderbeam
high performance lightweight antennas

4x VERTICAL DIPOLE ANTENNAS

Longer VD's are more efficient on the low bands!

AGAIN
AGAIN

	Vertical Dipoles		B A N D s									
	POLE	Legs	10	12	15	17	20	30	40	60	80	160
1	12m*	2 x 6m	•	•	•	•	•	•	•	•	◌	O
2	18m	2 x 9m	O	O	•	•	•	•	•	•	•	•
3	22m	2 x 11m	O	O	O	•	•	•	•	•	•	•
4	26m	2 x 13m	O	O	O	O	O	•	•	•	•	•

O Does NOT Work this Band • Works this Band

ANTENNA MATCHBOX: **Tcvr. Built-in ATU's are generally NOT good enough.**

MFJ-974B

- The **MFJ-974B** is a good matchbox for this job.
- If you use a classical "T-Match", you should **NOT** use its built-in 4:1 BALUN. Instead use an external 1:1 Guanella BALUN. **Otherwise: no match on the low bands!**

A good antenna matchbox is REQUIRED on all bands.

spiderbeam
high performance lightweight antennas

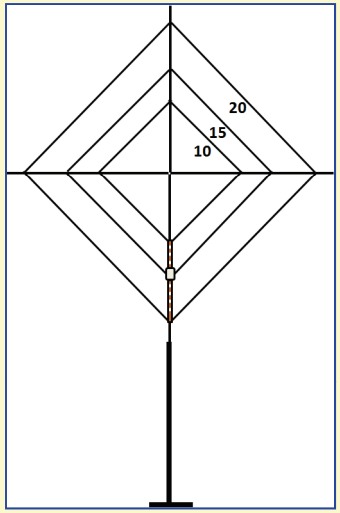
2x VERTICAL LOOP ANTENNAS

Resonant Quad Loop(s)

- 10/15/20m Bands
- Low Profile
- Footprint: 8m of space
- No Matchbox required
- Easily installed by one person

*** CP6/DG9FR ***
All-Time High Score
Continental Winner (LP) of WAE CW for
South America
"this antenna"

Bolivia



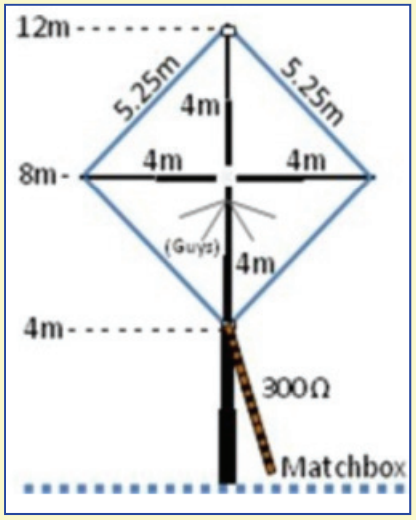
DOWNLOAD INSTRUCTIONS HERE:
www.dj0ip.de/spiderbeam/mono-loop-quad/

For: 12m or 18m Pole

Non-Resonant Multi-Band Loop

- 10/12/15/17/20/30/40m Bands
- Low Profile
- Footprint: 8m of space
- Easily installed by one person
- REQUIRES: Matchbox on ALL Bands
- Favorite antenna of many Campers

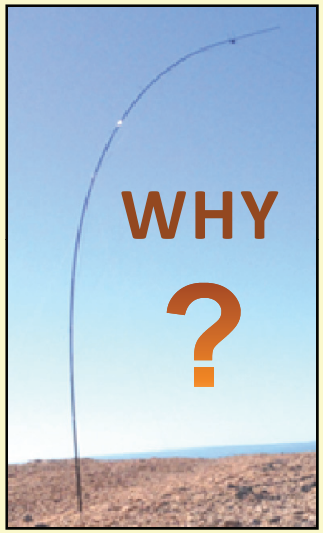
CAMPERS



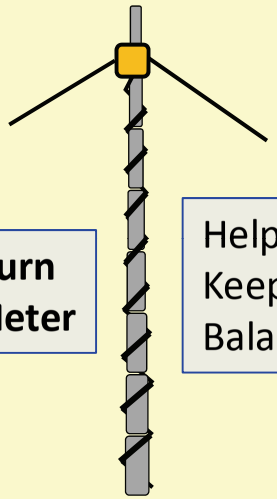
spiderbeam
high performance lightweight antennas

CONSTRUCTION TIPS: The di-POLE

LIGHTWEIGHT FIBERGLASS POLES AS MASTS REQUIRE SPECIAL CONSIDERATIONS



Top Heavy

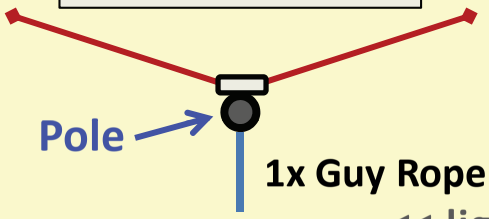


1 – turn per Meter

Helps Keep Balance

Spiral the Coax Down the Pole

Bend the Dipole Slightly



This will keep the pole straight and raise the feedpoint by one meter!

Aerial-51 Model 404-UL

Ultra-Lightweight

Multi-Band OCF-Dipole **(7-Bands)**

- 26-AWG wire (0,5mm diameter)
- RG-174 HCU Lightweight Coax
- Special Lightweight Balun

Overlap: Strongest Point

Top

Attach→

Feed Point

spiderbeam
high performance lightweight antennas

An Email from Crocodile Andy:

I would like to express my full satisfaction with **Aerial-51 Model 404-UL** provided for IOTA DX-pedition to IOTA OC-266 Viney Island in September 2016.

The antenna is just a jewel - very easy to install, extremely lightweight, but robust.

More than 1000 QSO have been made in very harsh conditions.

For sure it will be my main antenna for the next IOTA activation.

My congratulations with such great product.

Best regards,
Andy VK5MAV.

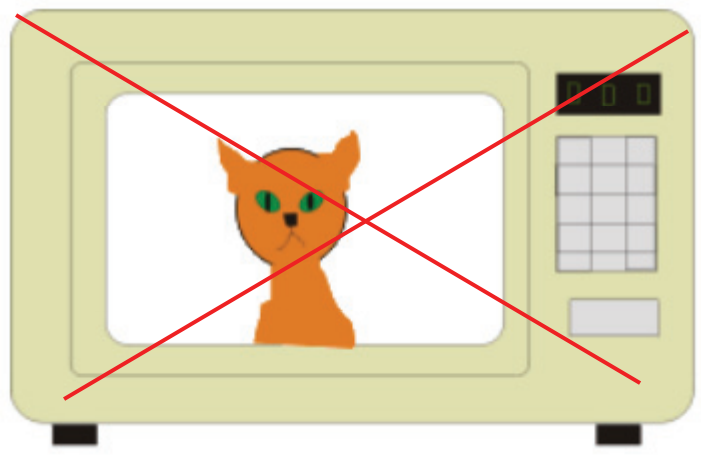
We also sponsored the Crocodile

After losing the tent to the Crocodile, Andy set up operation under a canopy.

VK5MAV/6
Viney Island

spiderbeam
high performance lightweight antennas

W A R N I N G



DO NOT PUT CAT IN MICROWAVE

DO NOT DRILL HOLES IN SPIDERPOLES !

spiderbeam
high performance lightweight antennas

MORE INFORMATION

16-Page Book 2,00 €

Available from:

- **Spiderbeam**
- **Appello**

www.DJ0IP.de

- Vertical Antennas
- Loop Antennas
- Spiderbeam Poles

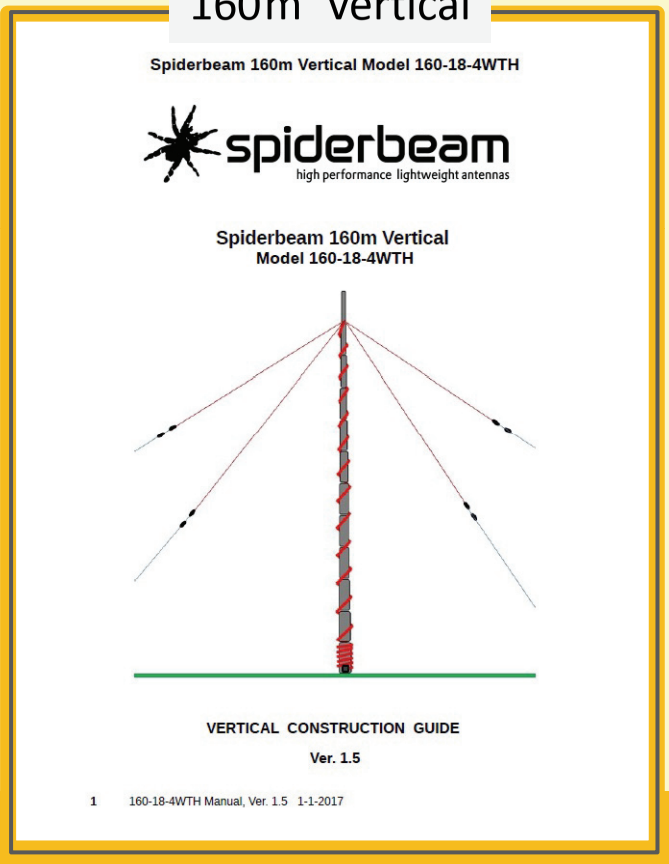
www.Aerial-51.com

- OCFD Antennas

Info@Spiderbeam.com

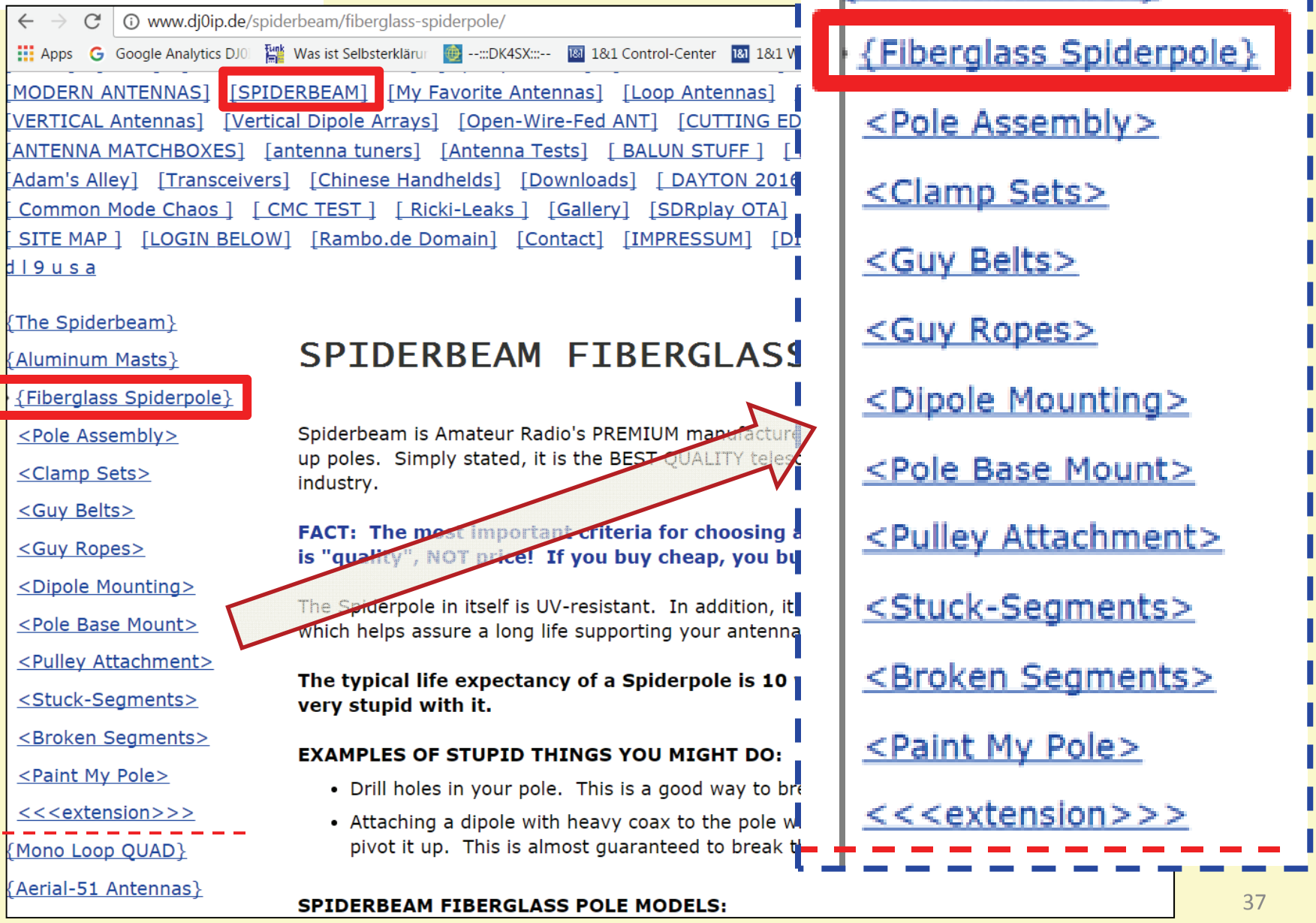
32-Page Instruction Manual

160m Vertical



FREE DOWNLOAD:
www.spiderbeam.com/pdf_files/160-18-4WTH.pdf

CONSTRUCTION TIPS for Fiberglass Poles

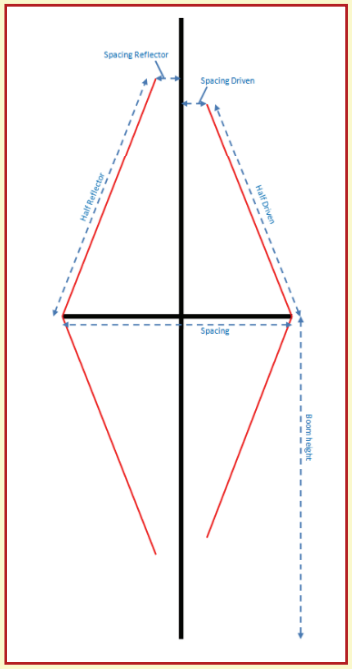


spiderbeam
high performance lightweight antennas

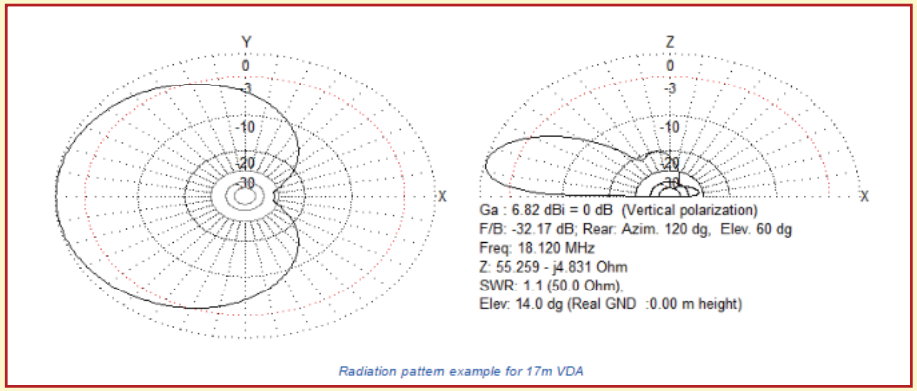
F4BKV

The VDA Site

www.f4bkv.net/index.php



More Info



Radiation pattern example for 17m VDA

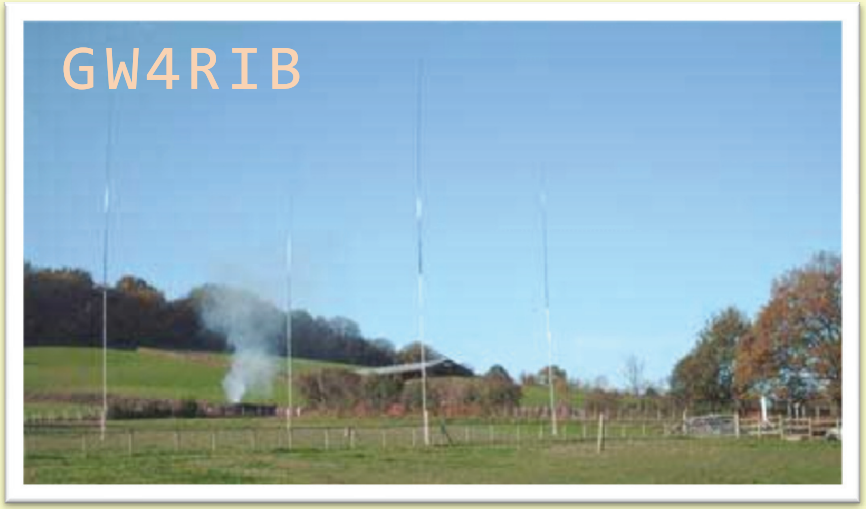
spiderbeam
high performance lightweight antennas

www.4-square.co.uk/uk/gw4rib/index.html

More Info

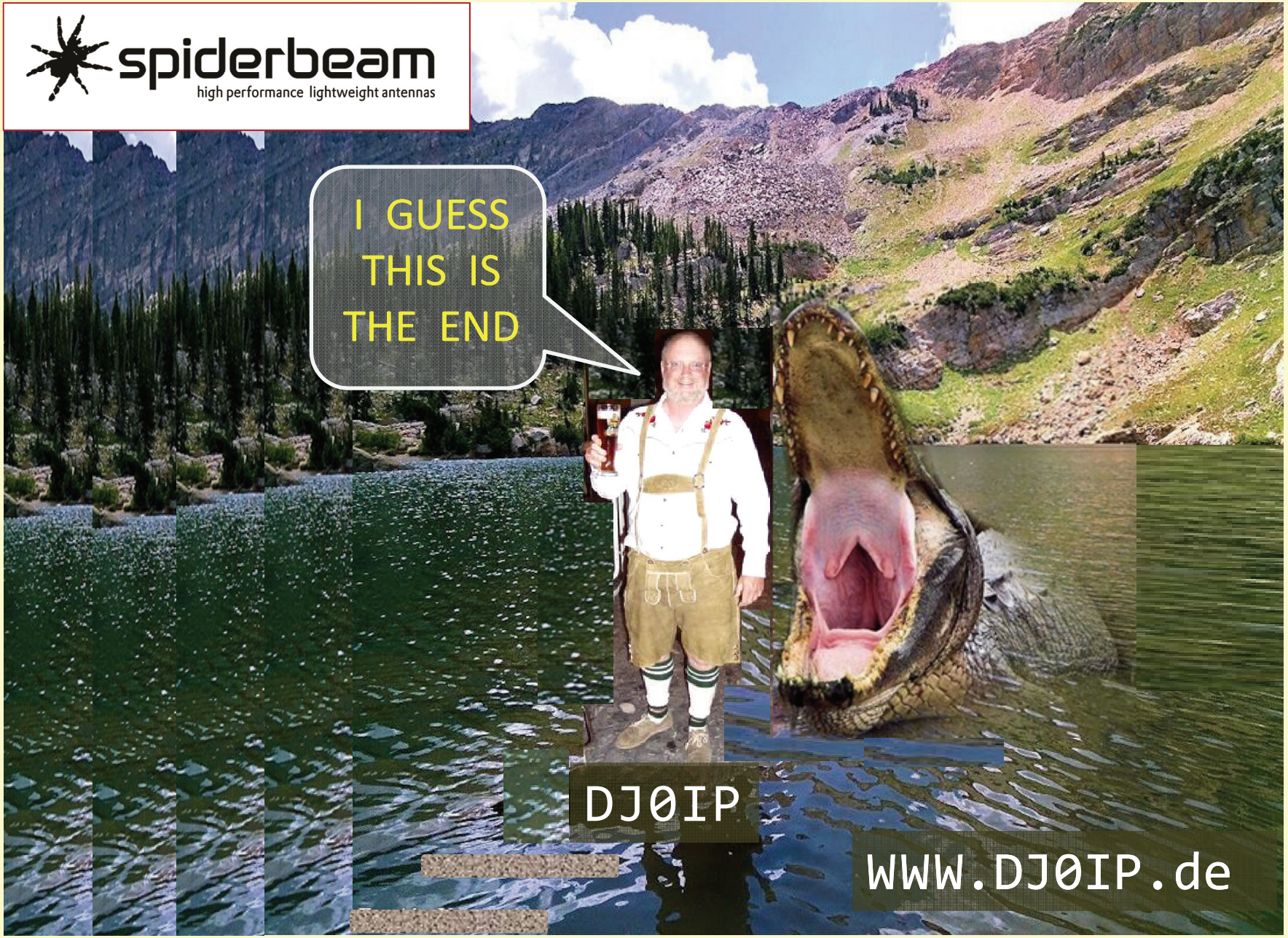
The 4-Square Site

Hybrid Poles
12m Fiberglass Poles
On top of
Aluminum Masts



80M 4-SQUARE: GW4RIB - WALES

It does not have to be perfect to work good.


spiderbeam
high performance lightweight antennas
I GUESS
THIS IS
THE END
DJ0IP
WWW.DJ0IP.de