Controlled Impedance "Cheap" Antennas

Kent Britain WA5VJB

If you're planning to build an EME array, don't use these antennas. But if you want to put together a VHF Rover with less than $500 in the antennas, read on.

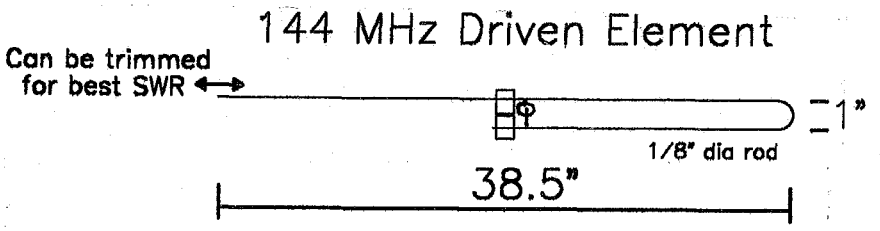
The simplified feed uses the structure of the antenna itself for impedance matching. So the design started with the feed and the elements were built around it. Typically a high gain antenna is designed in the computer, then you try to come up with a driven element matching arrangement for some weird impedance. In this design, compromises for the feed impedance, asymmetrical feed, simple measurements, wide bandwidth, the ability to grow with the same spacing, and trade offs for a very clean pattern cost about 1/2 dB of gain. But you can build these antennas for about $5!!!!

The antennas were designed with YagiMax, tweaked in NEC, and the driven elements experimentally determined on the antenna range.

The boom is 3/4" square, or 1/2 X 3/4" wood. The elements have been made from Silicon Bronze welding rod, Aluminum rod, Hobby tubing, and solid ground wire. You really want to solder to the Driven Element. Silicon Bronze Welding rod, Hobby tubing, and #10 or #12 solid copper wire have been used to make the driven element. A drop of "Super Glue", Epoxy, or RTV is used to hold the elements in place.

144 MHz

Driven Element: All versions



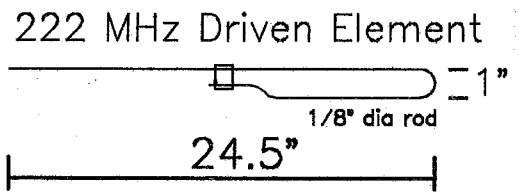
		Ref	DE	D1	D2	D3	D4	
3 Element	Length	41.0		37.0				All Dimensions
	Spacing	0	8.5	20.0				in inches.
4 Element	Length	41.0		37.5	33.0			All Elements 3/16" dia.
	Spacing	0	8.5	19.25	40.5			
6 Element	Length	40.5		37.5	36.5	36.5	32.75	
	Spacing	0	7.5	16.5	34.0	52.0	70.0	

While W5UN had very good luck with 16 element long boom wood antennas, I felt 6 elements was about the max for most rovers. The design is peaked at 144.2 MHz, but performance is still good at 146.5 MHz. (Emergency use only!)

222 MHz

This antenna is peaked at 222.1 MHz, but performance has barely changed at 223.5 MHz.
Mine has the mounting holes drilled so I can mount it Horiz or Vert.

Driven Element for all Versions:

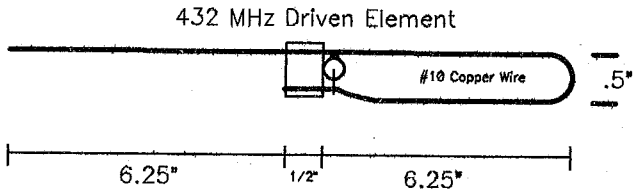


		Ref	DE	D1	D2	D3	D4
3 Element	Length	26.0		23.75			All Dimensions in Inches
	Spacing		0	5.5	13.5		All Elements 3/16" dia
4 Element	Length	26.25		24.1	22.0		
	Spacing	0	5.0	11.75	23.5		
6 Element	Length	26.25		24.1	23.5	23.5	21.0
	Spacing	0	5.0	10.75	22.0	33.75	45.5

432 MHz

At this band the antenna is getting very practical and easy to build.
Elements are 1/8" diameter

Driven Element for all versions:

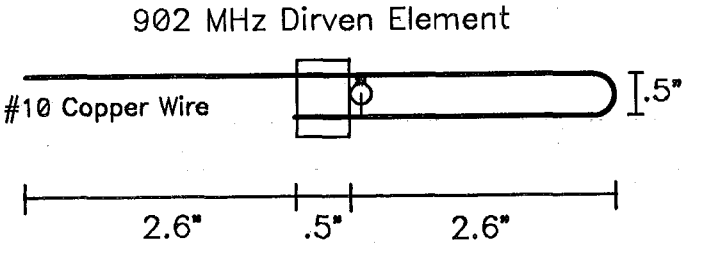


		Ref	DE	D1	D2	D3	D4	D5	D6	D7	D8	D9
6 Element	Length	13.5		12.5	12.0	12.0	11.0				All dimensions	
	Spacing		0	2.5	5.5	11.25	17.5	24.0			in inches	
8 Element	Length	13.5		12.5	12.0	12.0	12.0	12.0	11.25			
	Spacing		0	2.5	5.5	11.25	17.5	24.0	30.75	38.0		
11 Element	Length	13.5		12.5	12.0	12.0	12.0	12.0	12.0	11.75	11.75	11.0
	Spacing		0	2.5	5.5	11.25	17.5	24.0	30.75	38.0	45.5	53.0	59.5

902/903 MHz

This was the first antenna I built using the antenna to control the driven element impedance. The 2 1/2 ft length has proven practical so I haven't build any other versions.

Driven Element:



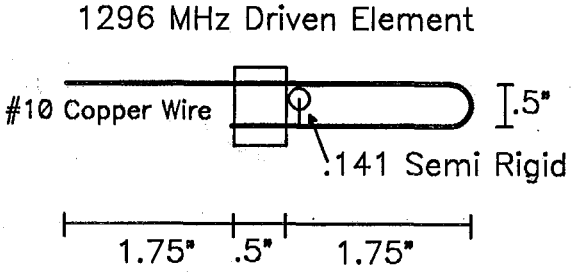
	Ref	DE	D1	D2	D3	D4	D5	D6	D7	D8
Length	6.2		5.6	5.5	5.5	5.4	5.3	5.2	5.1	5.1
Spacing	0	2.4	3.9	5.8	9.0	12.4	17.4	22.4	27.6	33.0

All dimensions in inches, elements 1/8" dia.

1296 MHz

This antenna is the veteran of several "Grid Peditions" and has measured 13.5 dBi on the CSVHFS antenna range. Dimensions must be followed with great care. The driven element is small enough to allow .141 simi-rigid to be used instead of RG-58. I used 1/8" Silicon Bronze welding rod for the elements, but any 1/8" dia material can be used.

Driven Element



	Ref	DE	D1	D2	D3	D4	D5	D6	D7	D8
Length	4.3		3.9	3.8	3.75	3.75	3.65	3.6	3.6	3.5
Position 0	1.7	2.8	4.0	6.3	8.7	12.2	15.6	19.3	23.0	

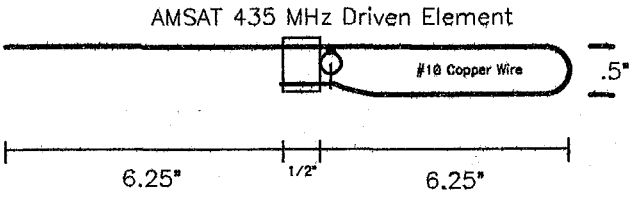
All Dimensions in inches

Note: I had been corresponding with KA9LNV about this design. Ed showed up with a copy of my antenna at the 1994 Central States VHF Society antenna contest. Ed won the 1296 MHz category, beating me by .2 dB with my own design!

435 MHz AMSAT

I appreciate the help and motivation from KA9LNV for these antennas. N5EM even built an array of 16, 11 element versions of these antennas for Field Day. A high Front to Back ratio was a major design consideration of all versions. The computer predicts 30 dB F/B for the 6 element, and over 40 dB for the others. Using 3/4" square wood for the boom makes it easy to build two antennas on the same boom cross polarized. Offset the two antennas 6 1/2" and feed in phase for Circular Polarization. Or just use one for portable operations.

Driven Element



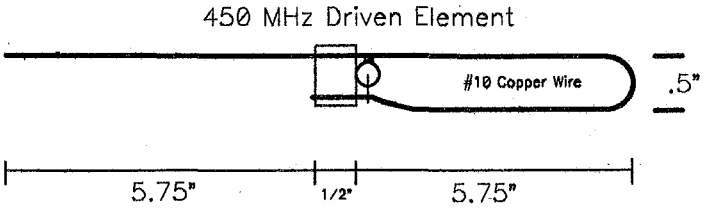
	Ref	DE	D1	D2	D3	D4	D5	D6	D7	D8	D9
Spacing all versions	0	2.5	5.5	11.25	17.5	24.0	30.5	37.75	45.0	52.0	59.5
6 Element length	13.4		12.4	12.0	12.0	11.0			All Dimensions in inches.		
8 Element length	13.4		12.4	12.0	12.0	12.0	12.0	11.1			
10 Element length	13.4		12.4	12.0	12.0	12.0	12.0	11.75	11.75	11.1	
11 Element length	13.4		12.4	12.0	12.0	12.0	12.0	11.75	11.75	11.75	11.1

NEC predicts 11.2 dBi for the 6 element, 12.6 dBi for the 8 element, and 13.5 for the 10 element, and 13.8 dBi for the 11 element.

450 MHz

Yea, Yea, I understand, it's FM, but sometimes a newcomer needs a cheap antenna to get into a repeater or give you a simplex QSO during a contest. Radio Shack 1/8" dia Aluminum ground wire Catalog # 15-035 was used in the prototype for all the elements except the Driven element. Other 1/8" dia material could be used.

Driven Element



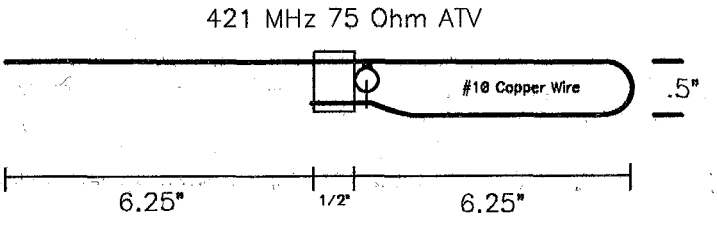
	Ref	DE	D1	D2	D3	D4	
Length	13.0		12.1	11.75	11.75	10.75	All dimensions in
Position 0	2.5	5.5	11.0	18.0	28.5		inches.

75 Ohm Versions

421.25 MHz ATV

421 MHz Vestigial SideBand Video is popular in North Texas for receiving the FM video input repeaters. These antennas are made of 421 MHz use and the driven element is designed for 75 Ohms. So RG-59, or an 'F' adapter to RG-6 can be directly connected to a cable TV converter/Cable Ready TV on channel 57.

Driven Element:



	Ref	DE	D1	D2	D3	D4	D5	D6	D7	D8	D9
Spacing 0 all versions		3.0	6.5	12.25	17.75	24.5	30.5	36.0	43.0	50.25	57.25
6 element length	14.0		12.5	12.25	12.25	11.0					
9 element length	14.0		12.5	12.25	12.25	12.0	12.0	11.25			
11 element length	14.0		12.5	12.25	12.25	12.0	12.0	12.0	11.75	11.75	11.5

Sliding a quarter wave sleeve along the coax had little effect, so there's not much RF on the outside of the coax.

I've had a Polyurethane varnished 902 MHz version in the air for two years now with little deterioration. The life of the antenna is determined by what you coat it with.

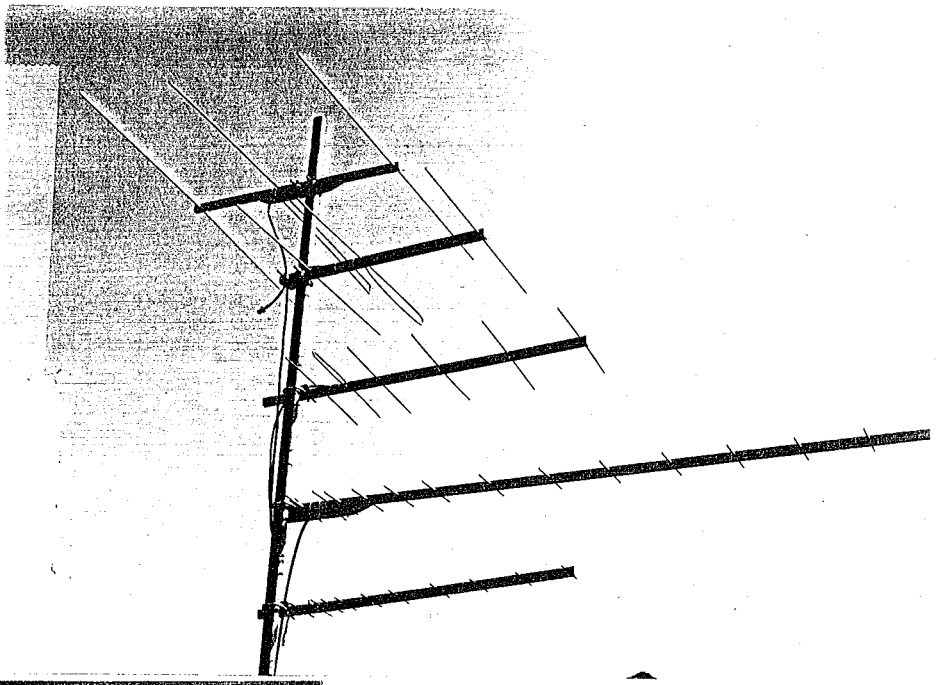
These antennas have been carefully designed to have the highest dB's/Dollar ratio of anything around.

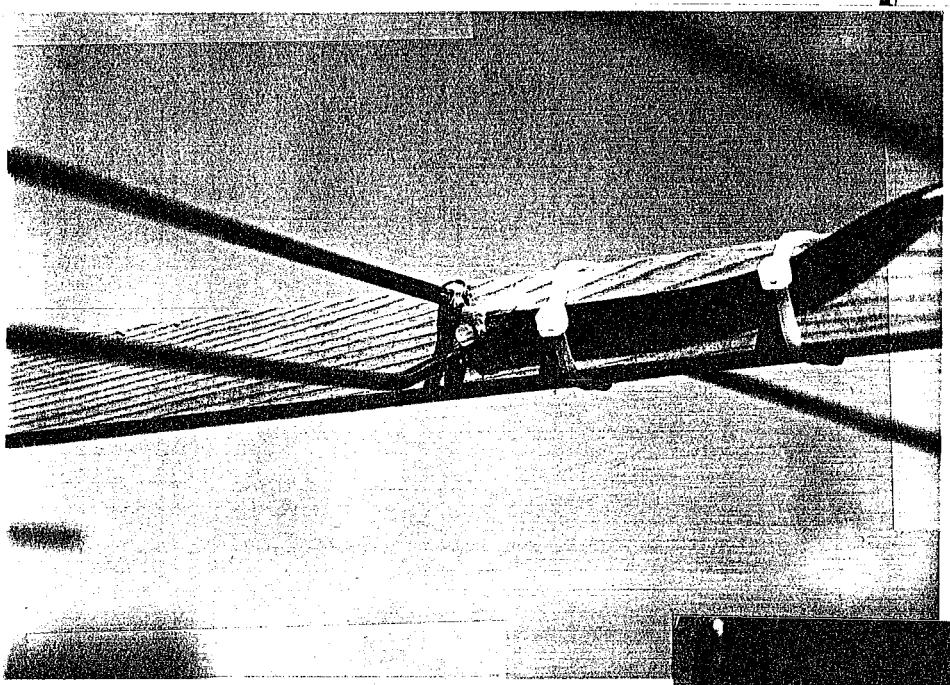
I recently saw a 20 Meter antenna with the dimensions specified in 1/10,000 thousands of an inch!! That guy needs to get real! A 1 degree change in temperature would change the lengths more than that! I kept dimensions to tenths of an inch to make these antennas easier to build.

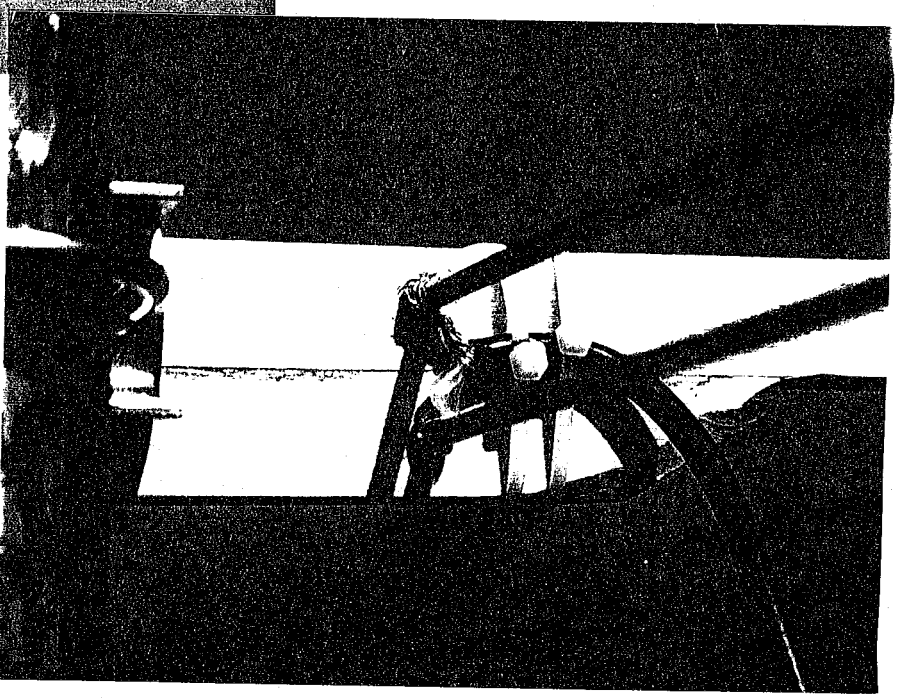
Finally a bit of history on the design of these antenna. In 1993 at Oklahoma City Central States VHF Society Arnie CO2KK spoke on the difficulties building VHF antennas in non-industrialized nations. Sure, just run down to the store and pick up some Delrin Insulators and .141 Teflon Coax??? Arnie's tales were the motivation to use advanced technology to come up with something simple.

Stack of Prototypes:

144 through 1296 MHz







Driven Element Detail