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RMHAM University

VHF/UHF DX

Weak signal operations, over-the horizon communications, meteor scatter, moon bounce and other fun things you can do with a technician license.

Weak Signal VHF/UHF

by Wayne Heinen, N0POH and Doug Sharp, K2AD

October 9, 2021

Willem says …

Our next RMHAM University is by Doug K2AD and Wayne N0POH on "Weak signal operations, over-the horizon communications, meteor scatter, moon bounce and other fun things you can do with a technician license."

And then he says, "I bumped you up on the schedule from March to October."

Doug says …

"WHAT?!?!?!? OK, I can do that. But I'm going to "borrow" a lot of the material. But I will put references at the bottom of each slide so you can look see the original articles.

Wayne says …

"OK. I'll get busy. But let's not wait until the last minute to create our presentation."

VHF / UHF Weak Signal

First, what it is NOT

- FM – both simplex and repeater operation
- Packet, ATV, RTTY
- High signal to noise ratios
- Line-of-Sight communications

What it is

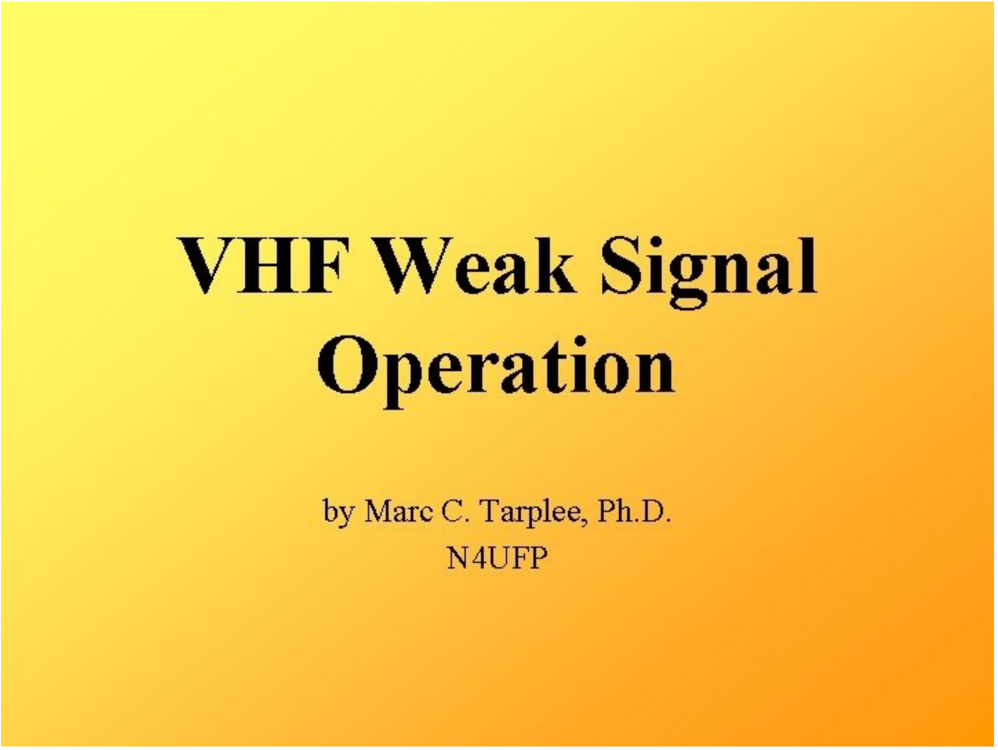
- Beyond Line-of-Sight communications
- Very low signal to noise ratios
- Communication at (or below) the noise floor
- An understanding of propagation is required
- Use of advanced operating modes

What is Line of Sight (LOS)?

Shown: Mount Greylock, MA – W2SZ/1 Mount Greylock Expeditionary Force. (Not stolen material – I'm a MGEF Member!)

Take a look at some great background material!

https://slidetodoc.com/vhf-weak-signal-operation-by-marc-c-tarplee/



I am "borrowing" a few of Dr Tarplee's slides without his permission but with credit.

VHF Weak Signal Operation

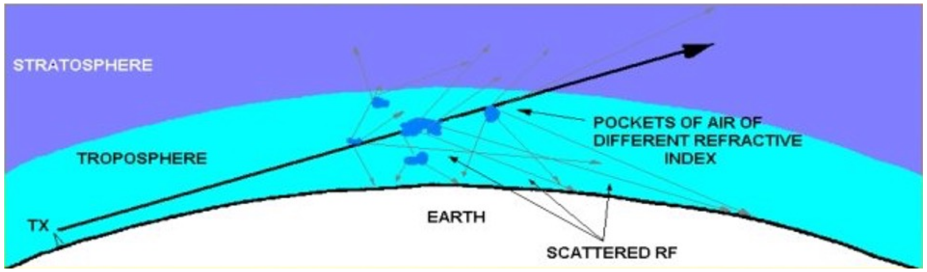
- **VHF weak signal operation uses a variety of propagation techniques:**
  - **Tropospheric scatter**
  - **Tropospheric ducting**
  - **Sporadic E**
  - **Meteor Scatter**
  - **Auroral backscatter**
  - **F-Layer propagation**
  - **Moonbounce**
- **The following modes are used in VHF weak signal operation:**
  - **CW, HSCW**
  - **SSB**
  - **FSK-441, JT6M**
  - **JT65**
- **VHF weak signal communications take place primarily on the 6m (50 MHz), 2m (144 MHz), and 1.25m (222 MHz) bands**

Reference: https://slidetodoc.com/vhf-weak-signal-operation-by-marc-c-tarplee/

Tropospheric Ducting and Scatter

Tropospheric Scatter

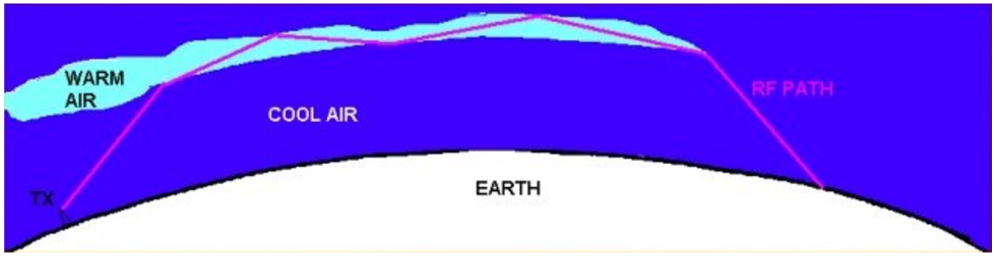
- Typically VHF / UHF signals are line of sight
- Humidity and variations in the troposphere can cause scattering of a VHF signal resulting in reception over the horizon



Artwork from: https://slidetodoc.com/vhf-weak-signal-operation-by-marc-c-tarplee/

Tropospheric Ducting

- Temperature Inversions can cause ducting of the VHF/UHF signal
- The signal becomes trapped within the duct before being “released” and returning to the Earth surface
- Typical ducting communications can occur over land across distances of 200 to 800 miles (your mileage may vary)
- Ducting over water has been observed over thousands of miles
    - Reference: Wayne Overbeck N6NB communications from CA to HI
- Can occur on occasion using FM repeaters



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Meteor Scatter

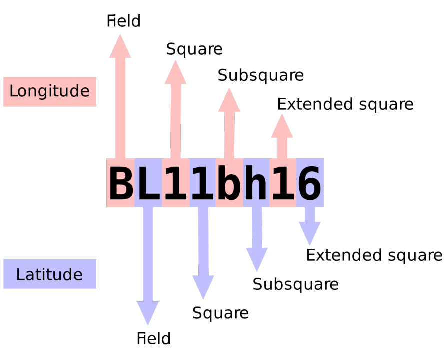
- As meteors are vaporized in the upper atmosphere, they leave behind ionized trails at heights of 60 – 70 miles that are sufficiently dense to reflect VHF
- A long trail lasts only 15 seconds – most trails are less than 1 second long
- Scattering of higher frequencies requires denser trails.
  - Large meteors that produce denser trails are relatively rare
  - The trail density decreases with time
  - Meteor scatter is much less effective on 2m and 1.25m than 6m
- Best time for meteor scatter is between midnight and 6:00 AM or during a meteor storm.
- Because the direction of arrival of meteors is not random, best scattering results generally occur when the antennas are pointed slightly to one side of the true bearing.

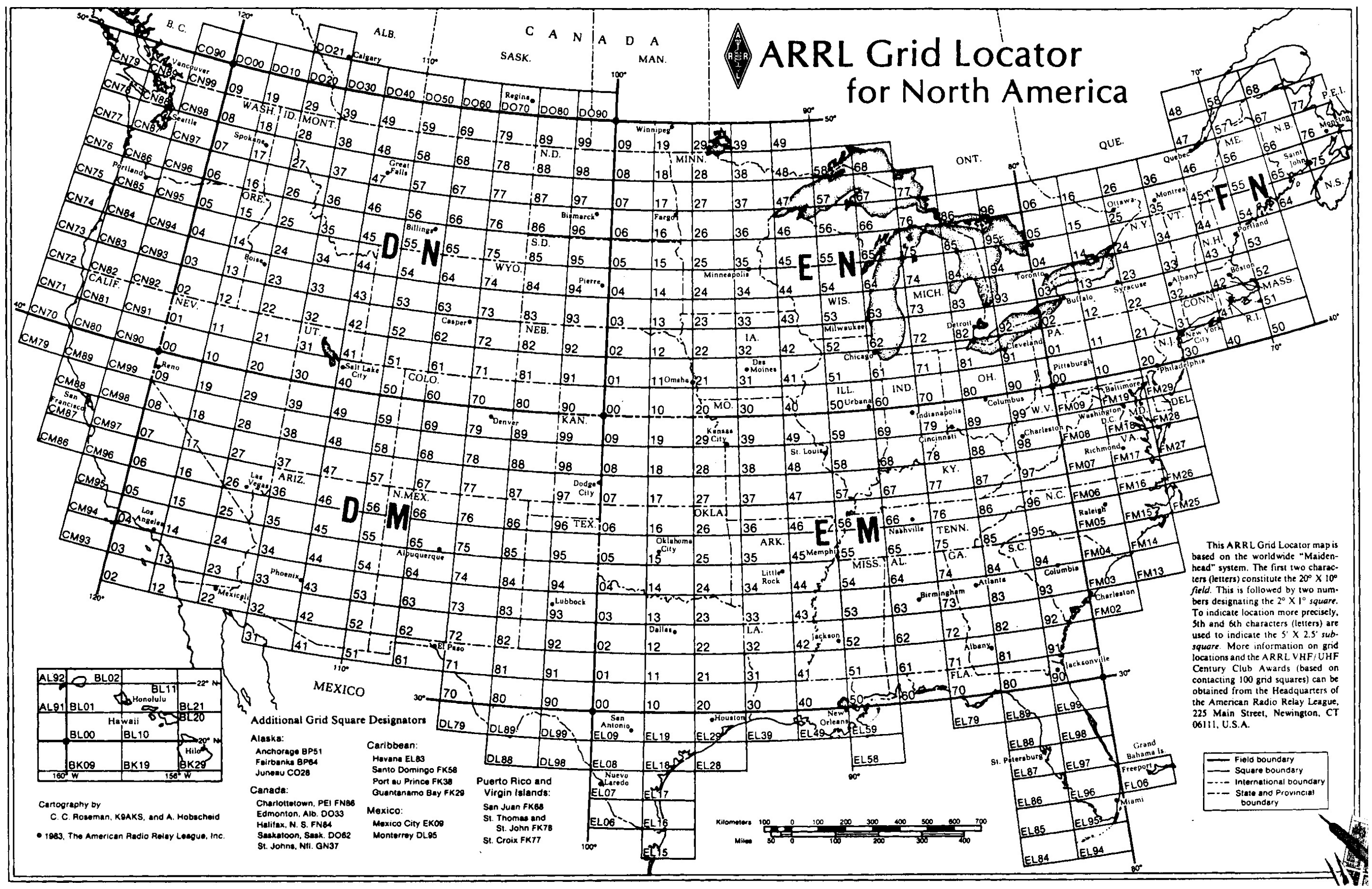
Reference: https://slidetodoc.com/vhf-weak-signal-operation-by-marc-c-tarplee/

Weak signal uses Grid Squares

Grid Squares

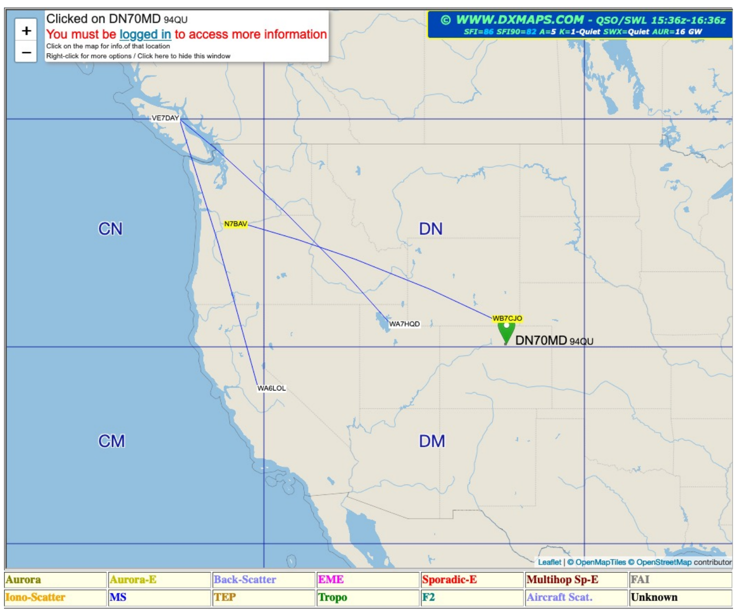
- Maidenhead Locator System
- Worldwide system
- 4 digit
    - 2 degrees x 1 degree
    - Example: DN70
- 6 digit
    - Example: DN70md
- 8 digit
    - Not commonly used but possible
    - Example: DN70MD12

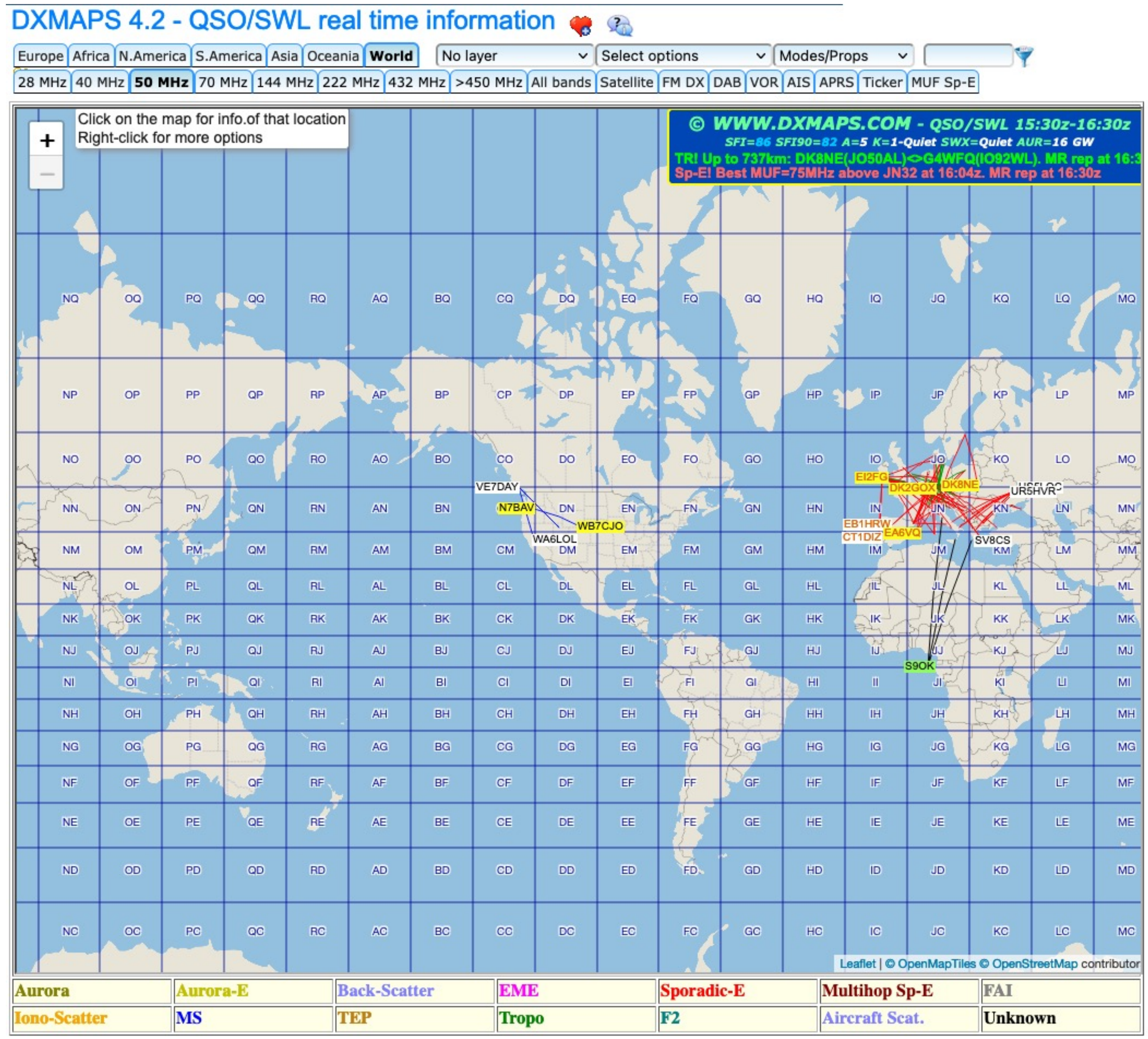




WWW.DXMAPS.COM

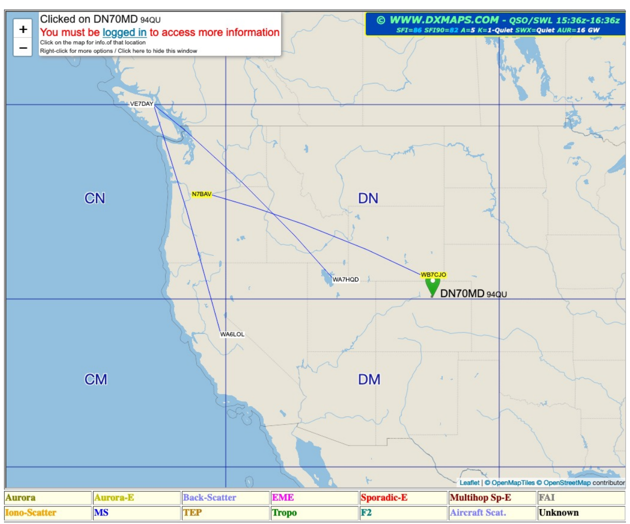
- Internet site that shows weak signal contacts worldwide

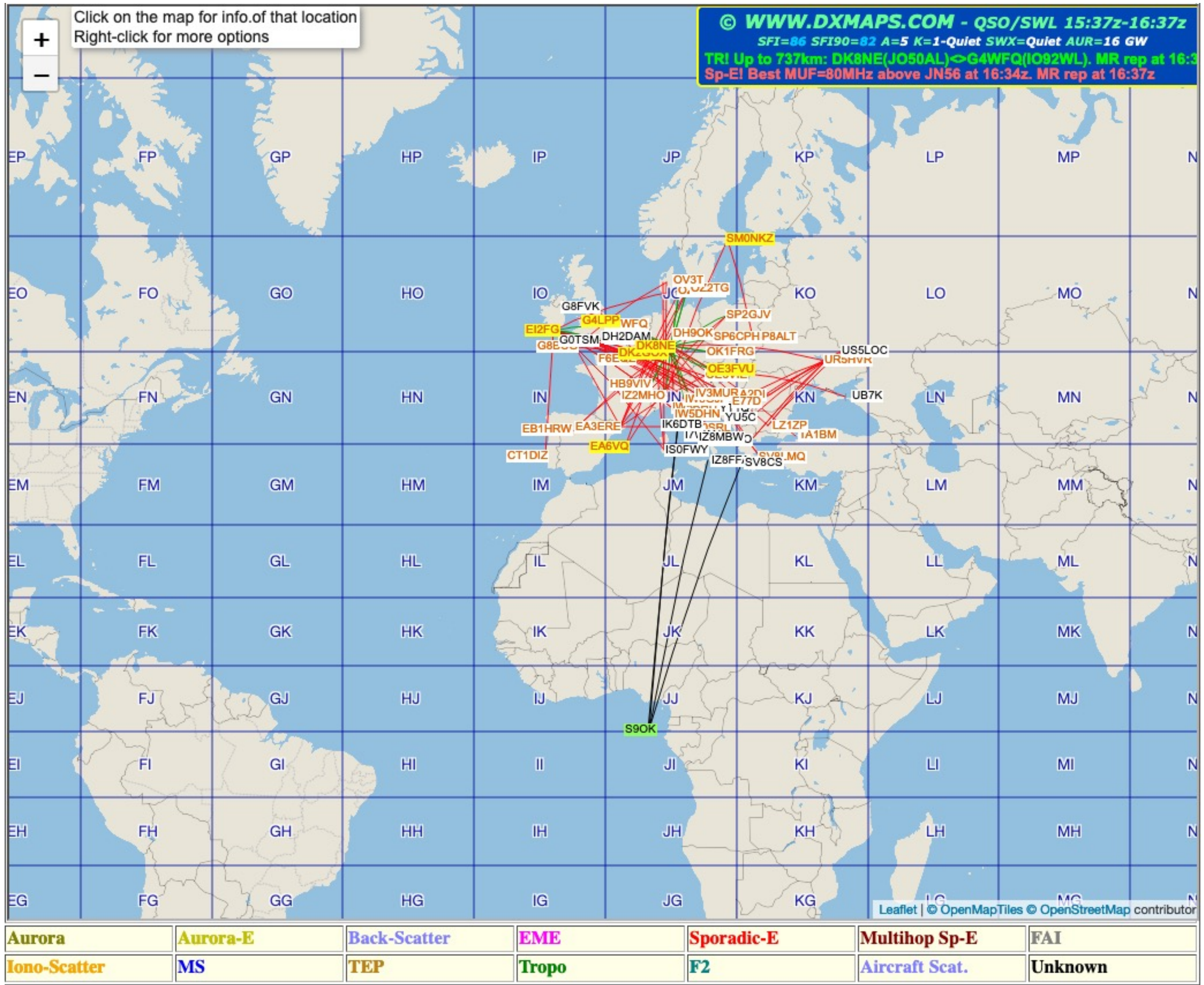




WWW.DXMAPS.COM

- Not much 50 MHz activity in NA
- The bands are open in EU



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Getting Started in Weak Signal VHF / UHF
Radios and Transverters

Radios – All-In-One

- HF + 50 MHz Transceiver
- HF + 50 + 144 MHz Transceiver
- 50 + 144 + 432 +1296 MHz Transceiver
- Simple one box solution
- More money than transverters

IC-746 - HF + 50 + 144

Elecraft K3 - HF + 50

IC-9100 - HF + 50 + 144 + 432 + 1296

IC-910 - 50 + 144 + 432

Transverters –

Kenwood TS-830S (circa 1980)

Kenwood TS-440S (circa 1990)

- Use as basic HF transceiver as your IF radio (likely on 28 MHz)
  - It can be modern
  - It can be a classic
- Transverter converts IF to the higher band
  - 28 MHz to 144 MHz
  - 28 MHz to 222 MHz
  - 28 MHz to 432 MHz
  - Etc …
- Several vendors
- I think the best is Down East Microwave

Down East 28 to 144 MHz

Down East 28 to 432 MHz

Getting Started in Weak Signal VHF / UHF

Antennas

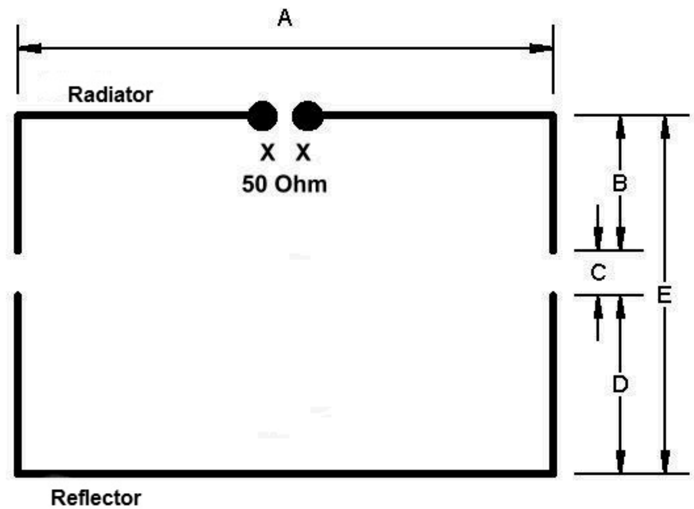
The Halo Antenna

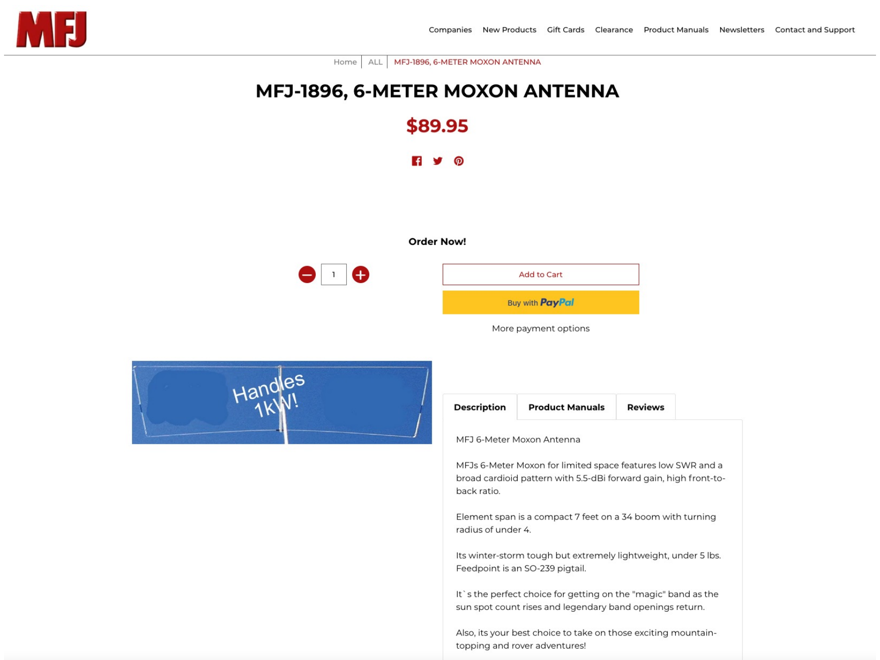
- Not a lot of gain
- Horizontally Polarized
- Omnidirectional

- Good starter antenna
- I used this antenna for my first 144MHz SSB contact with K1FO ("K 1 Far Out") at 75 miles
- My second contact with this antenna was with W2SZ/1 about 90 miles away
- It was mounted at 20 feet, on Radio Shack TV masts, tied to a post in the yard with lightweight rope.

The Moxin

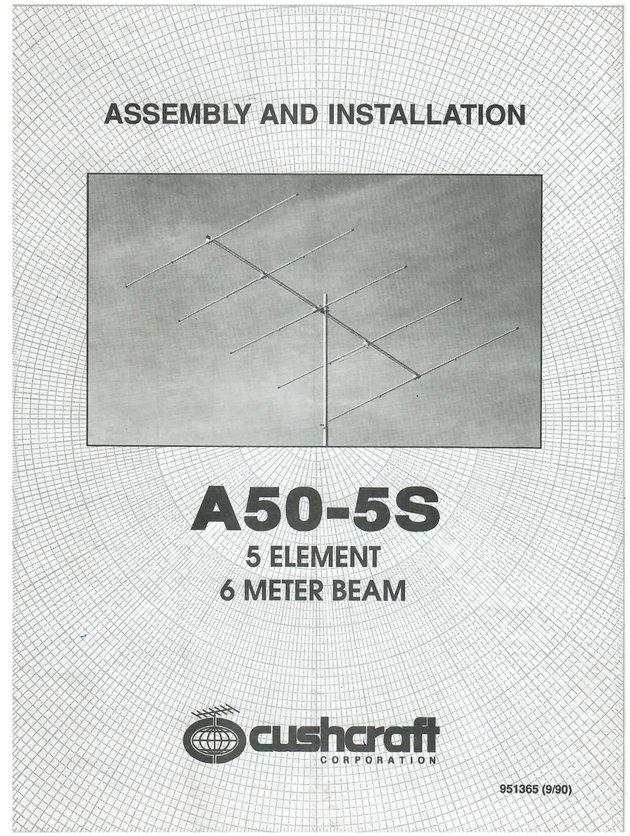
- Shortened or compact yagi
- W0ZQ article details optimization





Yagi Example – Cushcraft A50-5S

- Cushcraft now a MFJ Company
- Based upon old NBS (now NIST) design rules
- Has some gain on 50 MHz
- But limited directivity
- Low bandwidth
- Can be converted to 4-element design

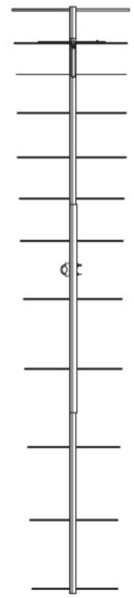


VHF Yagi Antenna

- Most common and popular antenna
- Boom lengths: Typical 6 feet to 32 feet
- Bigger is usually better

Directive Systems & Engineering
2702 Rodgers Terrace
Haymarket, VA 20169-1628
www.directivesystems.com
703-754-3876

12 Element 2.5 wl. K1FO Designed Yagi, Model DSEFO144-12



ELECTRICAL SPECIFICATIONS

Frequency range: MHz	144-146
Gain: dBd	12.6
Impedance: Ohms	50
Connector type	Type N(F) UG-58/U
Front -to- back ratio: dB	23
SWR: Typical at resonance	≅1.2:1
Beamwidth: degrees	
E- Plane	34°
H- Plane	37°
Sidelobe level: decibels	
E- Plane	-19
H- Plane	-16
Power rating, Continuous: Watts	1000
Stacking Distance: ft.(m)	
E- Plane	11'7" (3.53)
H- Plane	10'8" (3.25)

MECHANICAL SPECIFICATIONS

Boom length: ft. (m.)	17'4" (5.28)
Turning radius: in. (m.)	10'4" (3.15)
Weight Assembled: Lbs (kg.)	9.5 (4.32)
Max mast size: in. (cm.)	2" (5.08)
Wind surface area: Ft (m.)	1.5 (.14)
Wind Survival: Mph (km/hr)	100 (160)

PARTS LIST

Note: All hardware is Stainless Steel, unless otherwise noted.

Boom	
1 1/4" Rear Boom section	1 (match colors)
1 3/8" Center Boom section	1 (match colors)
1 1/4" Front Boom section	1 (match colors)
Element Bundle	
1/4" Elements	11
1/2" Driven Element	1
3/8" T-arms	2

DSEFO144-12 Rev 10/20

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Getting Started in Weak Signal VHF / UHF

Your First Contact

My First Contact –
Horizontal Halo with 10 watts Upper Sideband

I was using this …

Halo antenna @ 20 feet

Multi-2000 VHF XCVR @ 10 watts

First QSOs – K1FO “K 1 FAR OUT” at 50 miles and W2SZ/1 at 75 miles

My First Contact –
Horizontal Halo with 10 watts Upper Sideband

I was using this …

They (W2SZ) were using this …

TS-930S with XVTR @ 1500 watts and 8 x 12 element yagis

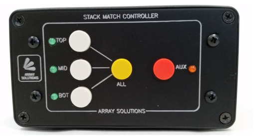
Wayne's Early 50 MHz Station

RMHAM N0SZ VHF Contest

- Operating from plateau near Pueblo

- 50 MHz station used three antenna arrays
  - ”High Stack”: 2 x 5 elements at 40 and 55 feet
  - “Low Stack” : 2 x 5 elements at 20 and 35 feet
  - “Extra Antenna” : 1 x 5 elements at 55 feet on QRV2

- Phasing Switch allows us to select any combination of these antennas with the push of a button



- Rig is Elecraft K3 (100 watts) with Alpha 8406 amplifier at 1500 watts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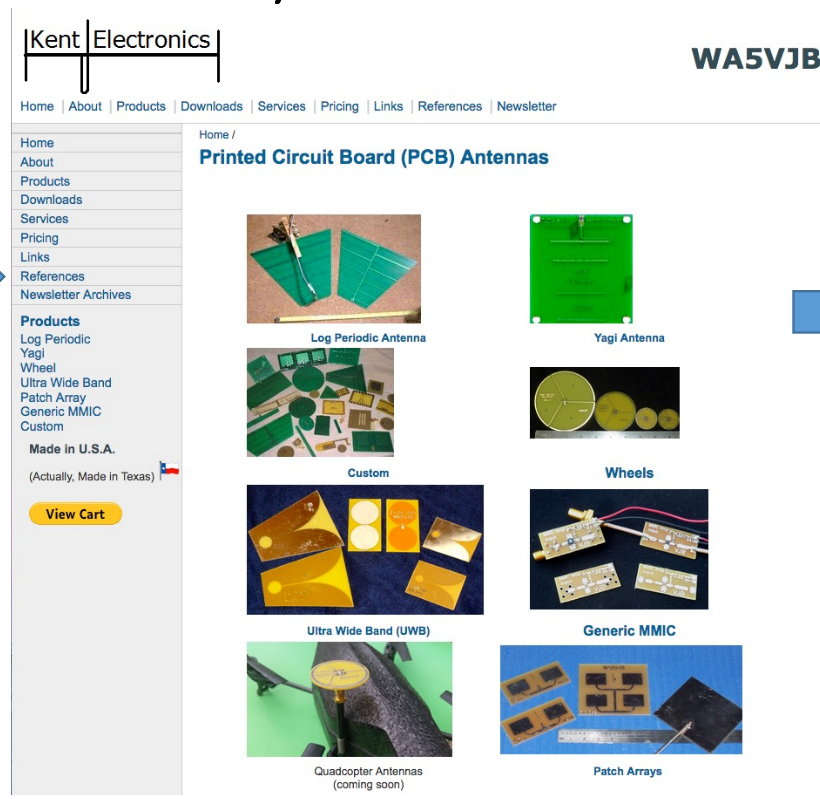
What’s best for you?

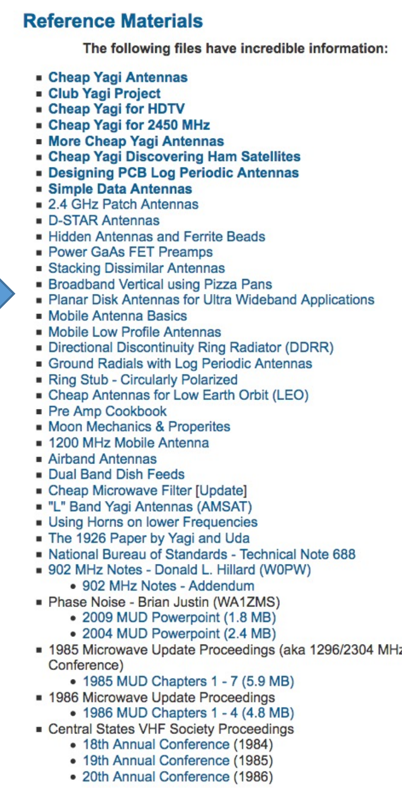
WA5VJB.COM

- Kent has a lot of great info on his web site
- Presents "VHF 101" each year at Central States VHF Conference

Check out the references tab



Voila



WA5VJB.COM – Cheap Yagi Antenna

- You can build this!
- You can build this antenna on a budget

- As Kent says, “If you are planning to build an EME array, don’t use these antennas.”
- But use them for a good home station yagi or rover station.

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.

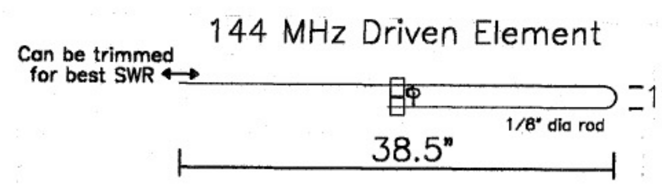
The simplified feed uses the structure of the antenna itself for impedance matching. So the design started with the feed and the elements were built around it. Typically a high gain antenna is designed in the computer, then you try to come up with a driven element matching arrangement for some weird 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



LEO antennas / Satellite antennas

- You can build this!
- It's lightweight
- You can aim it at a satellite or ISS by hand
- Not a lot of gain, but enough

Cheap Antennas for the AMSAT LEO's
Kent Britain -- WA5VJB

Cheap LEO Antenna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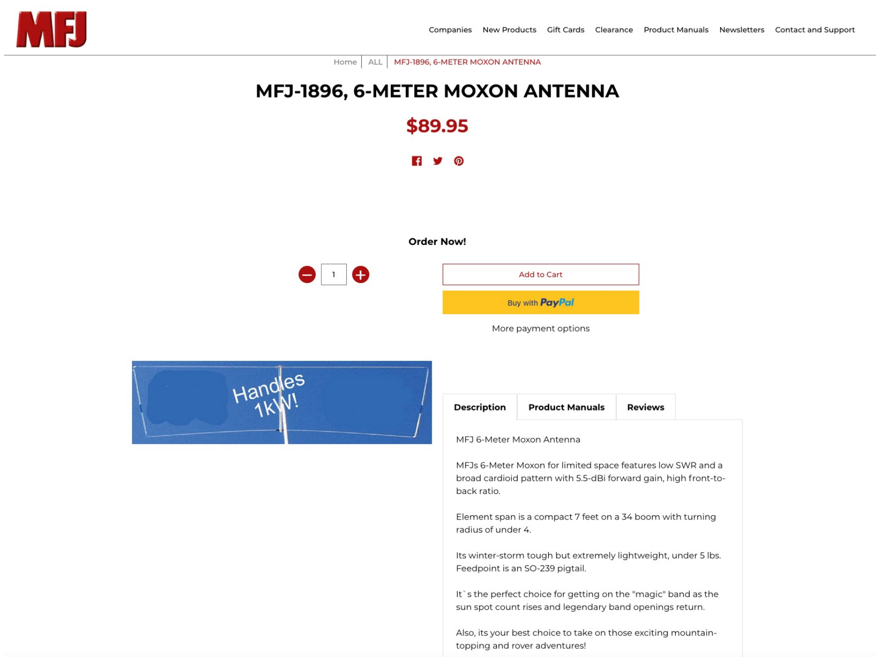
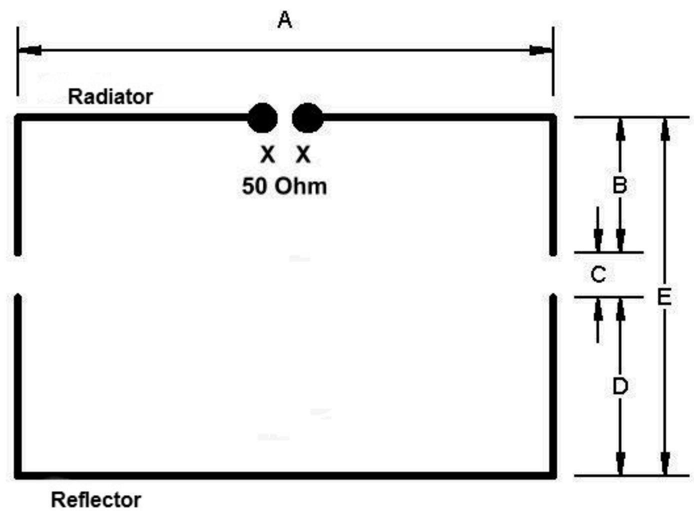
50 MHz – “The Magic Band”

The Moxin

- Shortened or compact yagi
- W0ZQ article details optimization





Yagi Example – Cushcraft A50-5S

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- Based upon old NBS (now NIST) design rules

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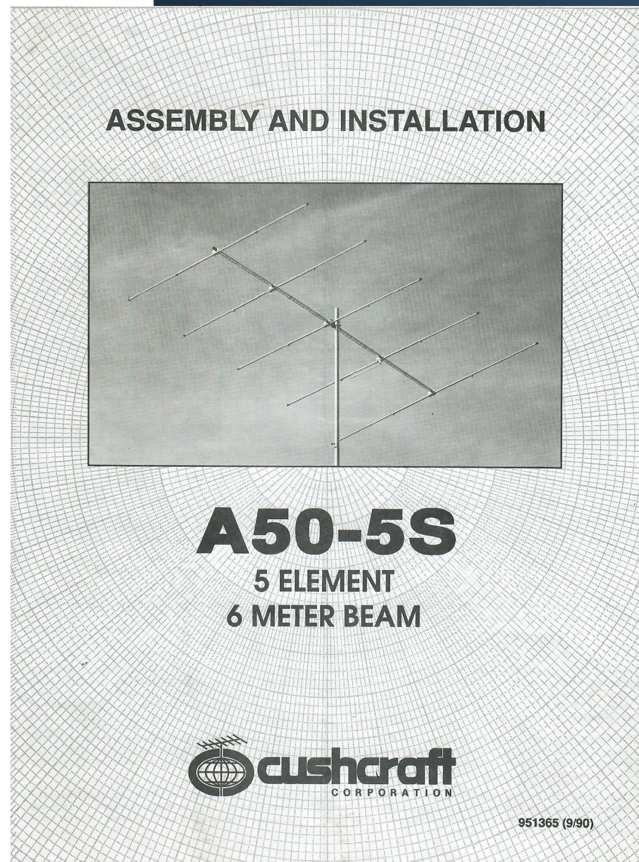
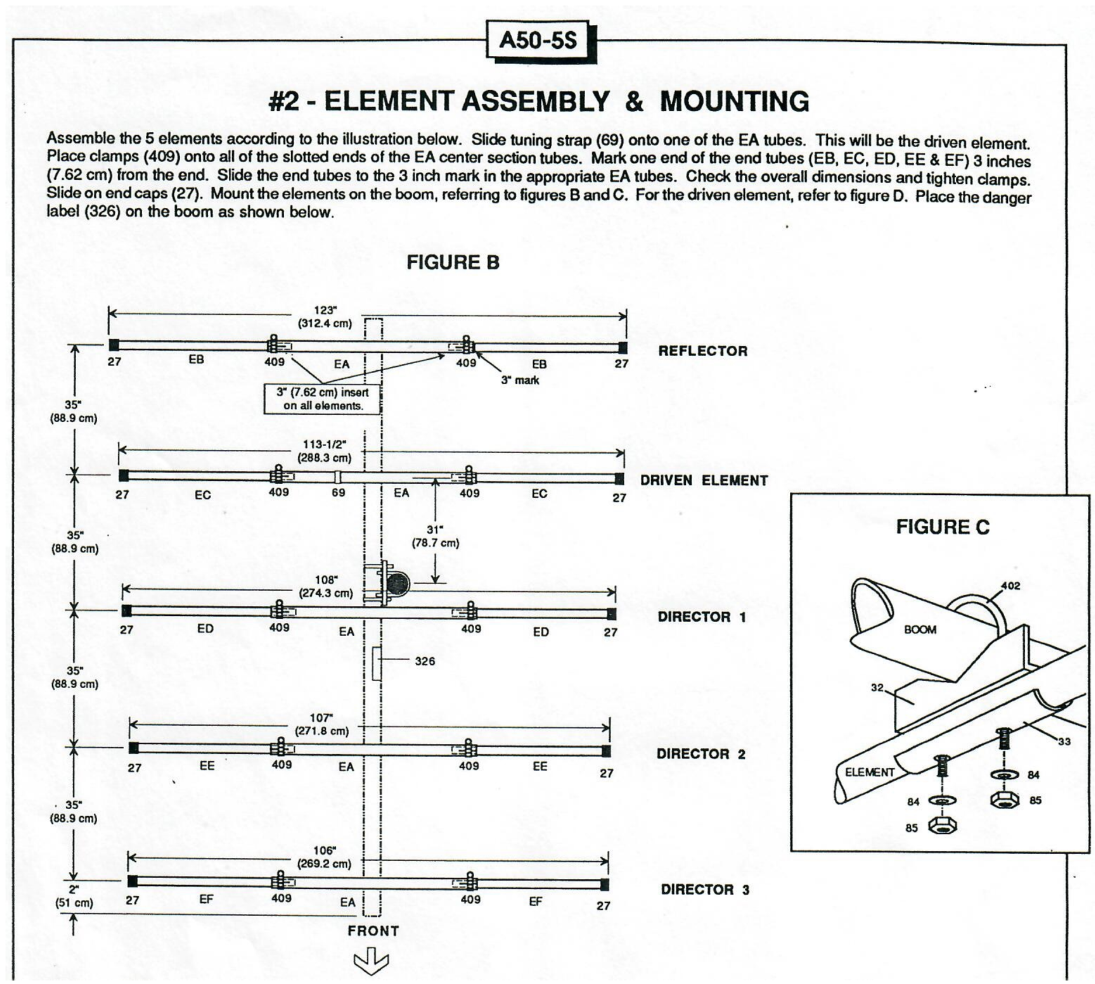


Yagi Example – Cushcraft A50-5S

- Traditional Gamma Match design
- Equal spaced elements (characteristic of NBS design rules)
- Great Field Day or Rover operation antenna


A50-5S

#2 - ELEMENT ASSEMBLY & MOUNTING

Assemble the 5 elements according to the illustration below. Slide tuning strap (69) onto one of the EA tubes. This will be the driven element. Place clamps (409) onto all of the slotted ends of the EA center section tubes. Mark one end of the end tubes (EB, EC, ED, EE & EF) 3 inches (7.62 cm) from the end. Slide the end tubes to the 3 inch mark in the appropriate EA tubes. Check the overall dimensions and tighten clamps. Slide on end caps (27). Mount the elements on the boom, referring to figures B and C. For the driven element, refer to figure D. Place the danger label (326) on the boom as shown below.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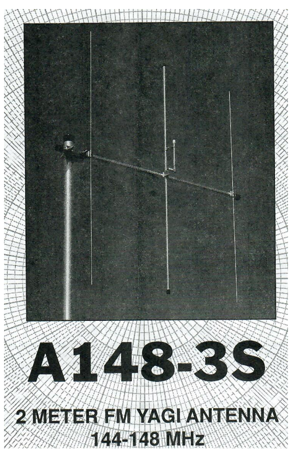
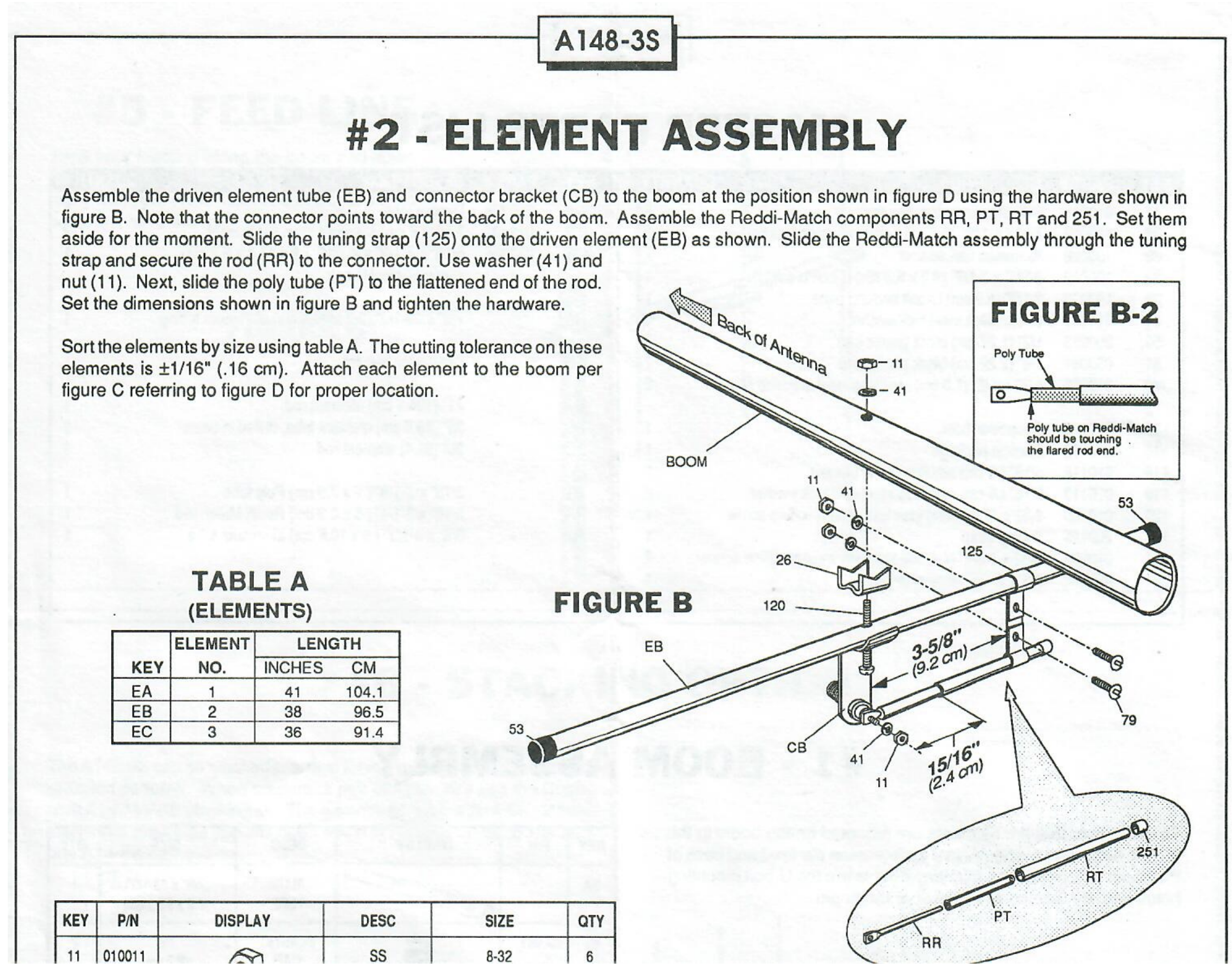
144 / 222 / 432 MHz

Yagi Example – Cushcraft A144-3

- Simple low-cost antenna
- Based upon old NBS (now NIST) design rules
- Gamma Match driven element





A148-3S

#2 - ELEMENT ASSEMBLY

Assemble the driven element tube (EB) and connector bracket (CB) to the boom at the position shown in figure D using the hardware shown in figure B. Note that the connector points toward the back of the boom. Assemble the Reddi-Match components RR, PT, RT and 251. Set them aside for the moment. Slide the tuning strap (125) onto the driven element (EB) as shown. Slide the Reddi-Match assembly through the tuning strap and secure the rod (RR) to the connector. Use washer (41) and nut (11). Next, slide the poly tube (PT) to the flattened end of the rod. Set the dimensions shown in figure B and tighten the hardware.

Sort the elements by size using table A. The cutting tolerance on these elements is ±1/16" (.16 cm). Attach each element to the boom per figure C referring to figure D for proper location.

TABLE A
(ELEMENTS)

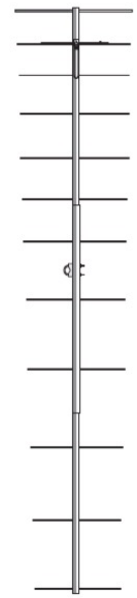
KEY	ELEMENT NO.	LENGTH INCHES	LENGTH CM
EA	1	41	104.1
EB	2	38	96.5
EC	3	36	91.4

KEY	P/N	DISPLAY	DESC	SIZE	QTY
11	010011		SS	8-32	6

VHF Yagi Antenna

- Most common and popular antenna
- Boom lengths: Typical 6 feet to 32 feet
- Bigger is usually better

Directive Systems & Engineering
2702 Rodgers Terrace
Haymarket, VA 20169-1628
www.directivesystems.com
703-754-3876



12 Element 2.5 wl. K1FO Designed Yagi, Model DSEFO144-12

ELECTRICAL SPECIFICATIONS

Frequency range: MHz	144-146
Gain: dBd	12.6
Impedance: Ohms	50
Connector type	Type N(F) UG-58/U
Front -to- back ratio: dB	23
SWR: Typical at resonance	≅1.2:1
Beamwidth: degrees	
E- Plane	34°
H- Plane	37°
Sidelobe level: decibels	
E- Plane	-19
H- Plane	-16
Power rating, Continuous: Watts	1000
Stacking Distance: ft.(m)	
E- Plane	11'7" (3.53)
H- Plane	10'8" (3.25)

MECHANICAL SPECIFICATIONS

Boom length: ft. (m.)	17'4" (5.28)
Turning radius: in. (m.)	10'4" (3.15)
Weight Assembled: Lbs (kg.)	9.5 (4.32)
Max mast size: in. (cm.)	2" (5.08)
Wind surface area: Ft (m.)	1.5 (.14)
Wind Survival: Mph (km/hr)	100 (160)

PARTS LIST

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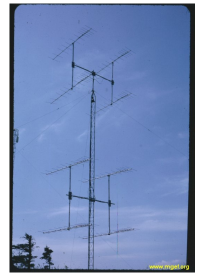
Element Bundle	
1/4" Elements	11
1/2" Driven Element	1
3/8" T-arms	2

DSEFO144-12 Rev 10/20

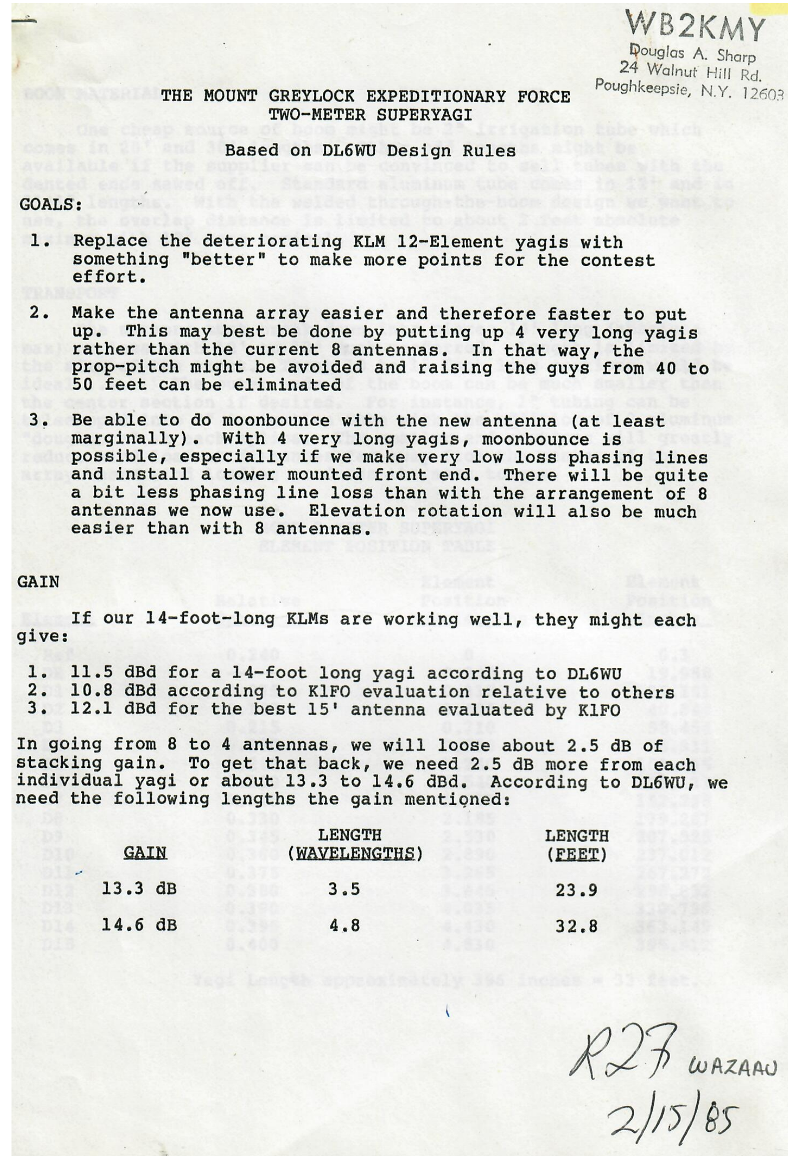
MGEF 144 MHz Super Yagi by WA2AAU and K2AD (ex WB2KMY)

- We needed an antenna to replace our existing 8x KLM 12-element array



- We decided to deploy 4x longer boom antennas with similar overall gain
- We would no longer need a 50’ tall rotating tower

- EME would be possible with an azimuth-elevation rotator



WB2KMY
Douglas A. Sharp
24 Walnut Hill Rd.
Poughkeepsie, N.Y. 12603

THE MOUNT GREYLOCK EXPEDITIONARY FORCE
TWO-METER SUPERYAGI

Based on DL6WU Design Rules

GOALS:

1. Replace the deteriorating KLM 12-Element yagis with something "better" to make more points for the contest effort.

2. Make the antenna array easier and therefore faster to put up. This may best be done by putting up 4 very long yagis rather than the current 8 antennas. In that way, the prop-pitch might be avoided and raising the guys from 40 to 50 feet can be eliminated

3. Be able to do moonbounce with the new antenna (at least marginally). With 4 very long yagis, moonbounce is possible, especially if we make very low loss phasing lines and install a tower mounted front end. There will be quite a bit less phasing line loss than with the arrangement of 8 antennas we now use. Elevation rotation will also be much easier than with 8 antennas.

GAIN

If our 14-foot-long KLMs are working well, they might each give:

1. 11.5 dBd for a 14-foot long yagi according to DL6WU
2. 10.8 dBd according to K1FO evaluation relative to others
3. 12.1 dBd for the best 15' antenna evaluated by K1FO

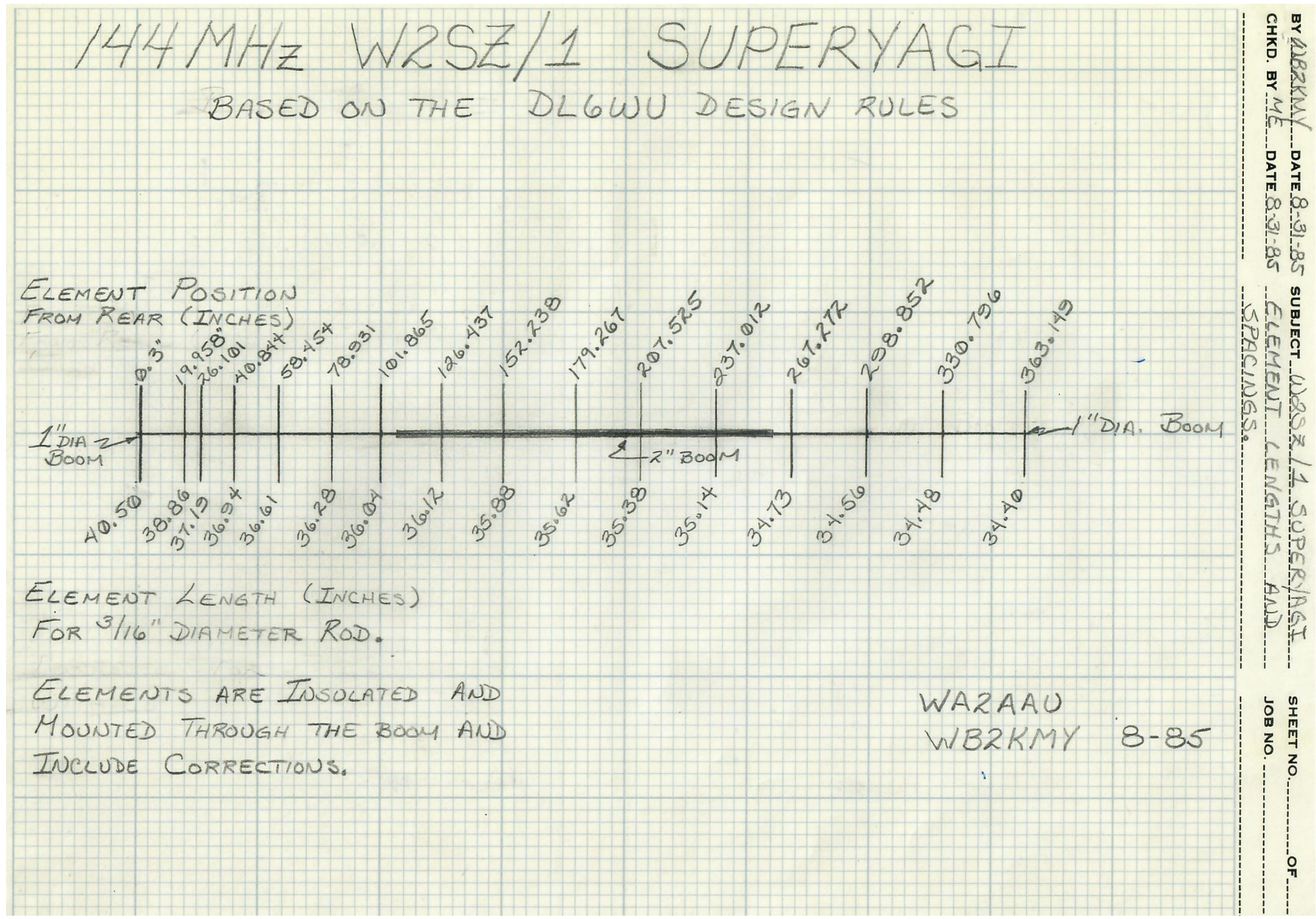
In going from 8 to 4 antennas, we will loose about 2.5 dB of stacking gain. To get that back, we need 2.5 dB more from each individual yagi or about 13.3 to 14.6 dBd. According to DL6WU, we need the following lengths the gain mentioned:

GAIN	LENGTH (WAVELENGTHS)	LENGTH (FEET)
13.3 dB	3.5	23.9
14.6 dB	4.8	32.8

R27 WA2AAU
2/15/85

MGEF 144 MHz Super Yagi by WA2AAU and K2AD (ex WB2KMY)

- Homebrew design
- Based upon DL6WU design rules
- Varied Boom size
  - 2” OD center sections
  - 1” OD end sections
- Element lengths were corrected for mounting method and boom diameter
- Extremely clean radiation pattern

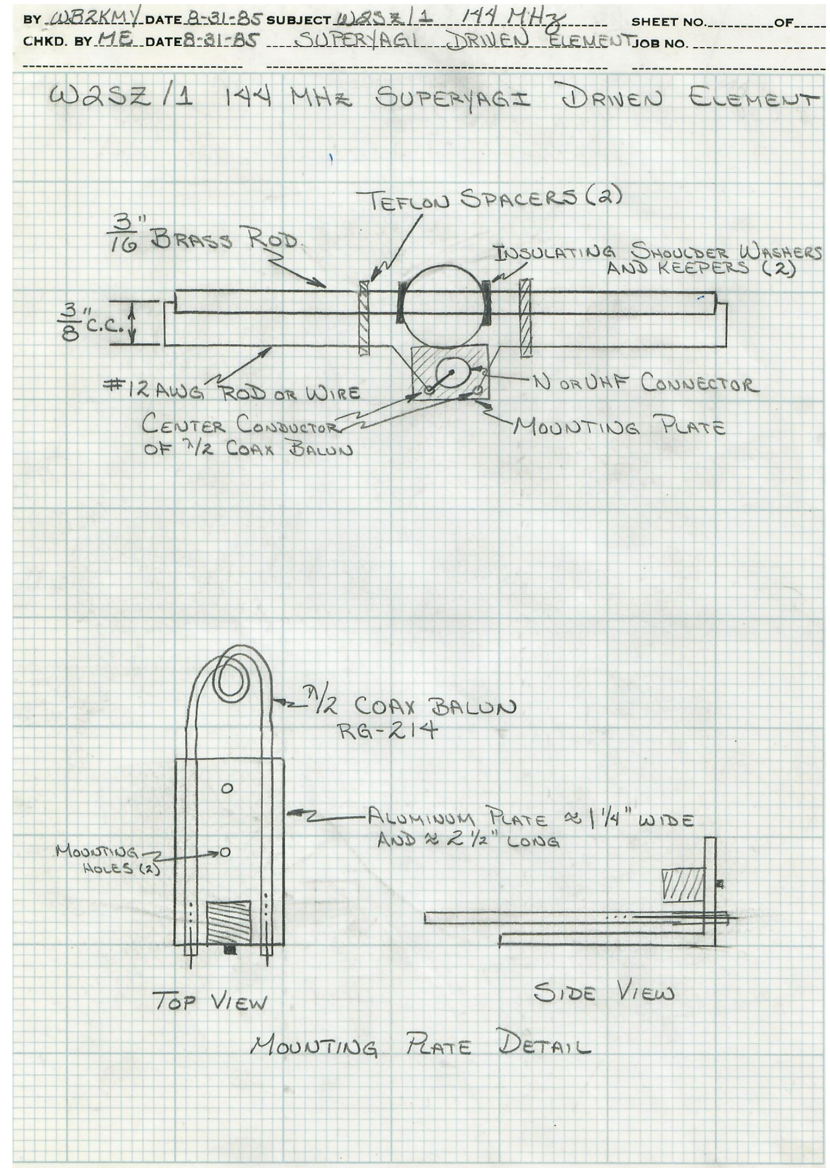


MGEF 144 MHz Super Yagi by WA2AAU and K2AD (ex WB2KMY)

- We needed a driven element (DE)
- Doug started experimenting with
  - T-Match
  - Gamma Match

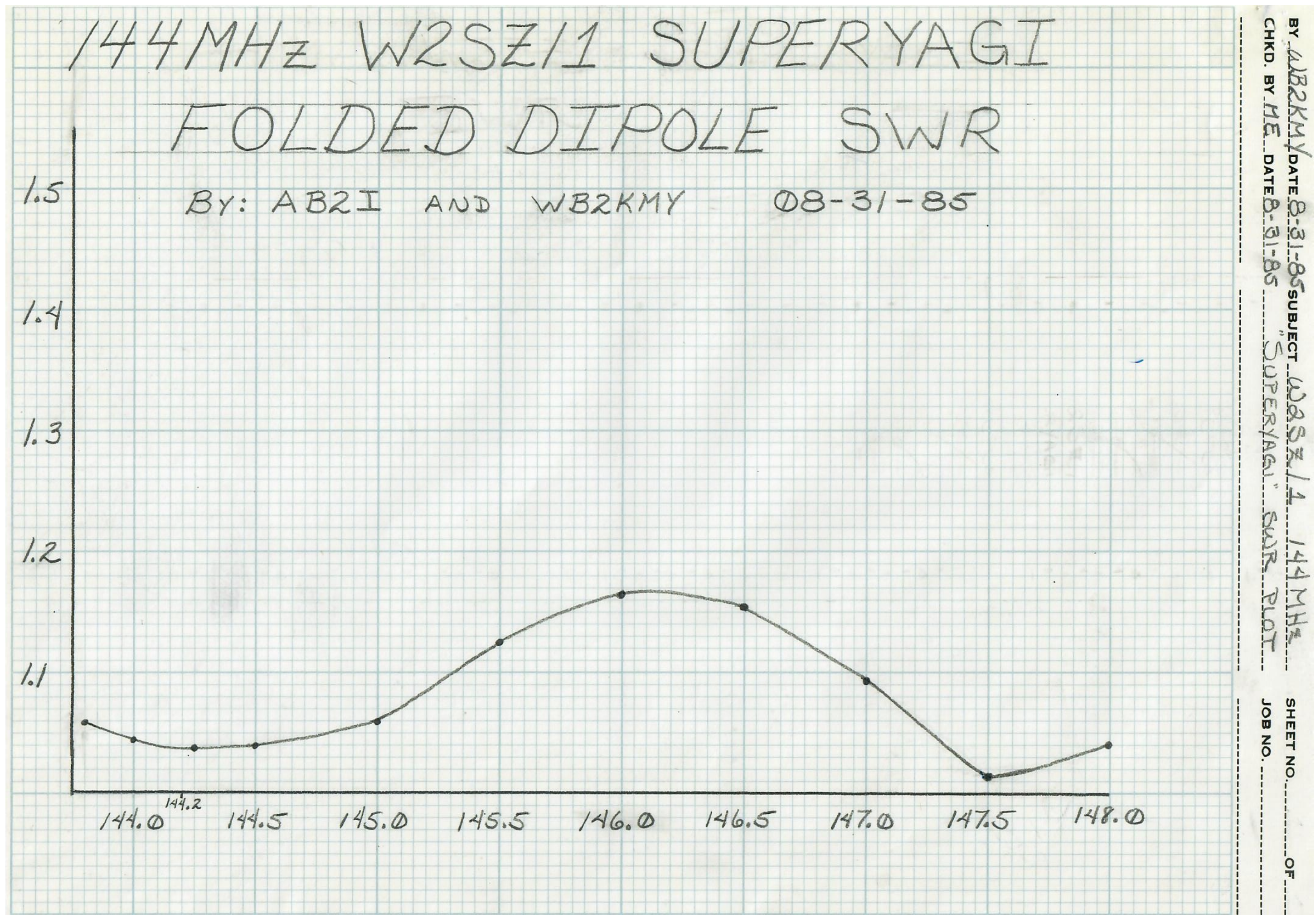
  I just could not find a matching network that worked.

- Final DE was a folded dipole with half wave matching balun
- It worked, but was not rugged
- Minor mechanical re-design to survive setup and take-down at many VHF contests

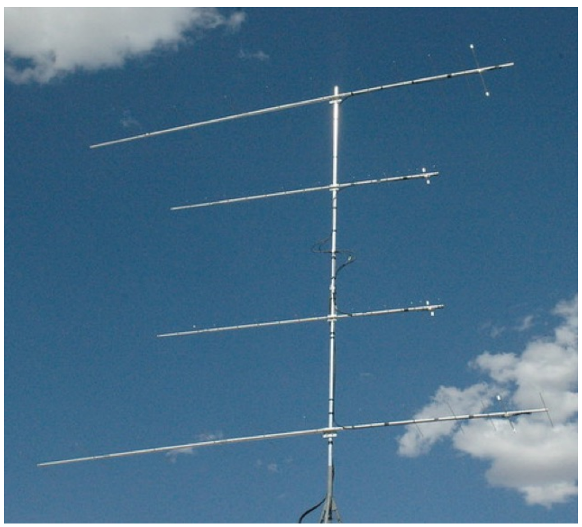


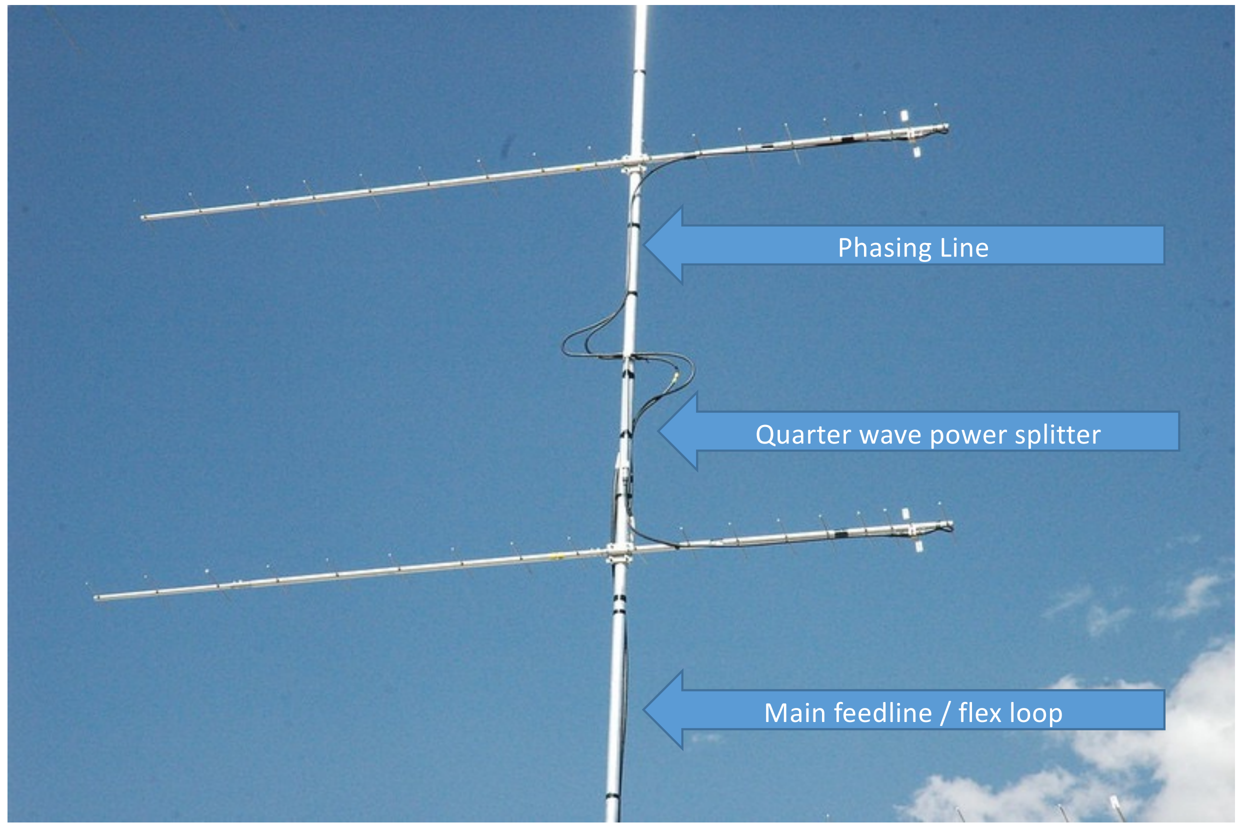
MGEF 144 MHz Super Yagi by WA2AAU and K2AD (ex WB2KMY)

- Here was the result of the new Driven Element
- Incredible match and bandwidth
- And when this antenna was placed on the antenna range … the pattern was incredible
- Maybe too clean and focused



Phasing Yagis at RMHAM VHF Contest N0SZ



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Insane Station Examples

50 MHz Antenna Stacks

2x 6-ele yagis on 50 MHz at W2SZ/1

- Great antenna
- Easy to erect

2x 5-ele yagis at RMHAM N0SZ (one of two stacks)

4x 6-ele yagis on 50 MHz at W2SZ/1

- If two is good … four is better

If one antenna is good, two are great, four or eight is “mo better”

222 MHz Deployment Example

8 yagis on 222 MHz
- Great antenna
- Challenging to erect
- I’m getting too old for this

4 yagis on 222 MHz
- Optimized design
- Same gain as 8-stack
- Easier to erect

144 MHz Deployment Example

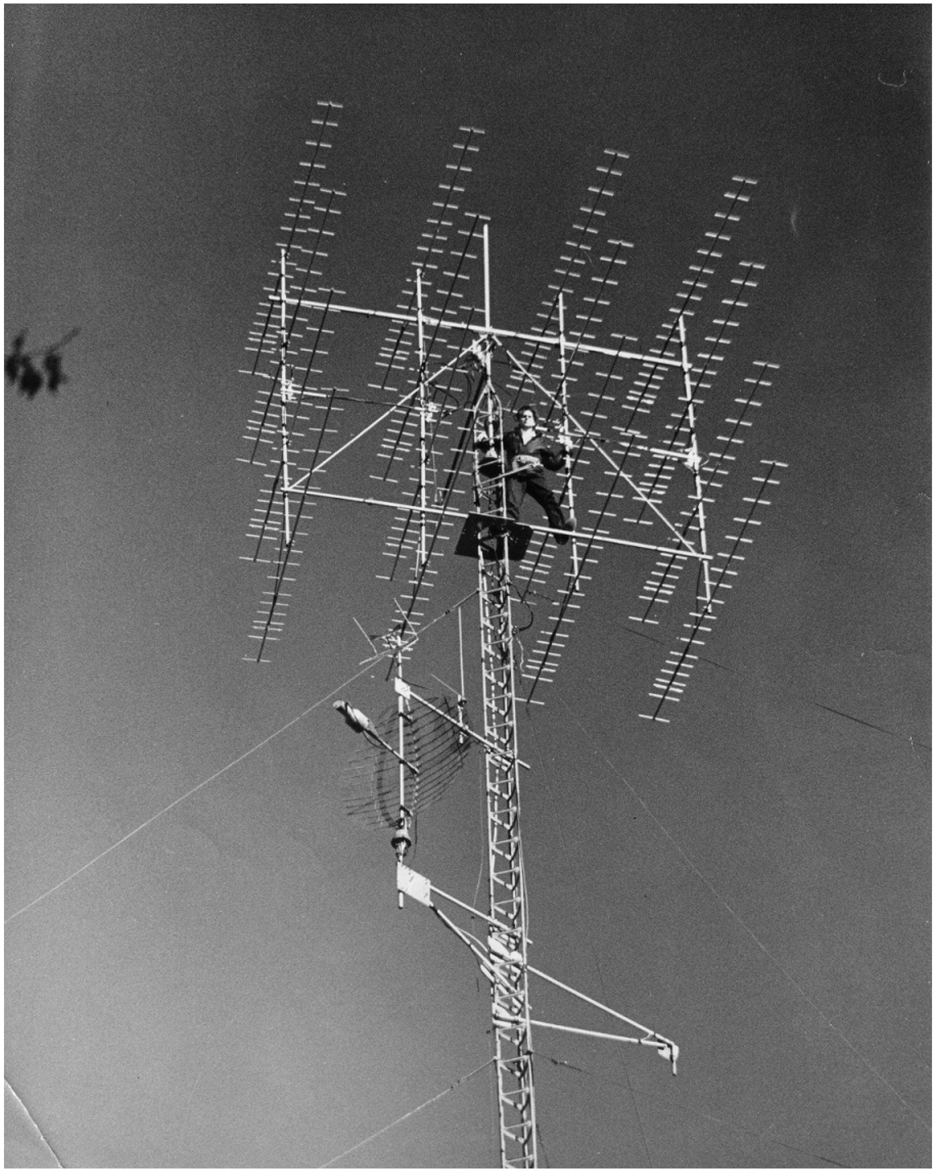
8 yagis on 144 MHz
- Great antenna
- Major effort to erect for temp operation

What's better than 8 yagis?

That's easy –

16 yagis

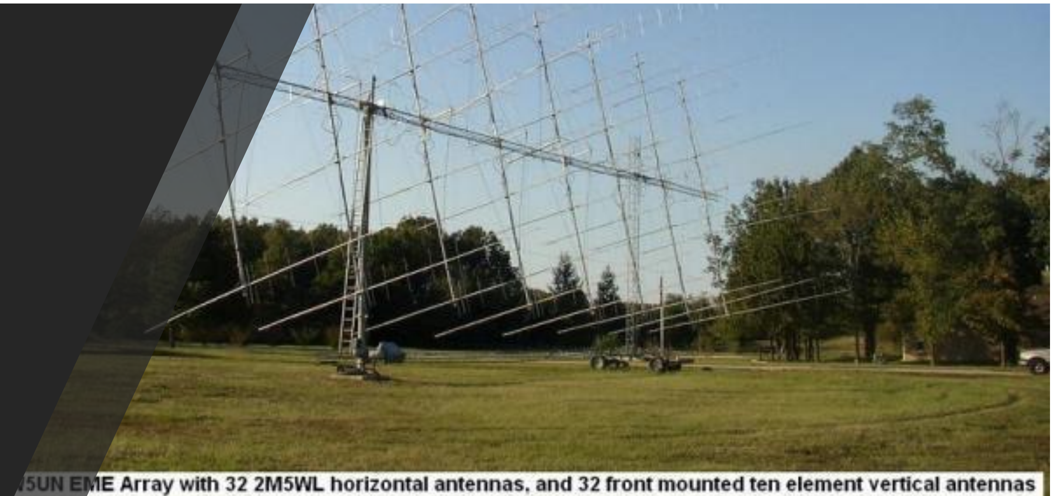
An old photo of Dick K2RIW and his monster 432 MHz array



One of the largest EME antennas I have ever seen

Dave - W5UN

Sky Moon Ranch, TX



Are we done yet?

Maybe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Reference Material
Antenna Design - from my class last year

Gut Feel Rules

<u>Antenna Gain</u>

- Gain is good ..... as long as it is in the right direction.
- Gain indicates the ability of an antenna to "focus" or direct radio frequency energy. Newton said, "Energy cannot be created nor destroyed." An antenna follows this same rule ..... it cannot create RF energy, only focus or direct that energy.
- Antenna gain is measured in decibels (dB) and referenced to a "standard reference antenna", usually an isotropic or a dipole.
- An isotropic is an imaginary antenna that radiates equally well in all directions. It is defined to have 0 dB gain (0 dBi).
- The half wave dipole is the most common reference antenna since it can be built! It is defined as having 0 dBd of gain, or 2.3 dBi of gain.
- Antenna ranges are used to measure antenna gain, and results can vary greatly. The National Institute of Standards and Technology (NIST, formerly NBS) have a published standard that is becoming widely accepted.
- When shopping for antennas in the magazines make sure you are comparing apples to apples!
- As gain increases, the beamwidth of the antenna decreases. And vice versa.
- Antenna gain is proportional to antenna size or apature. If you double the size of an antenna you can obtain <u>up to</u> 3 dB gain.
- Antenna gain can be obtained by stacking antennas. If you double the number of antennas you can achieve <u>up to</u> 3 dB of gain.

Stolen from an old presentation to the Lynchburg Amateur Radio Club, October 8, 1993 by WB2KMY

More “stolen” material from WB2 Kiss My Yagi

Yagi Antenna Design

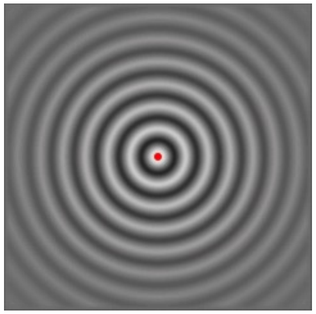
- Use a good cookbook design or design rules.
- HF - W2PV, K8CC, NBS, Handbook, Antenna book.
- VHF - DL6WU, K1FO, NBS, W1JR.
- Construction will change design. W2PV book is excellent bible.
- Element Mounting - boom connection or not. Thru or top mount.
- Must be stable over time from weathering.
- More elements do not mean more gain. Boomlength is important.
- Elements should be tapered at HF to reduce windloading.
- VHF elements usually one size material.
- Build to last!

<u>Antenna Stacking</u>

- Antennas can be stacked to obtain more gain.
- Up to 3 dB gain can be achieved.
- Stacking distance must be correct otherwise gain and pattern will degrade.
- Make sure the antennas are in phase!
- Use power splitters or odd multiple 1/4 wave cables.

From an old presentation to the Lynchburg Amateur Radio Club, October 8, 1993 by WB2KMY / now K2AD

Isotropic Radiators

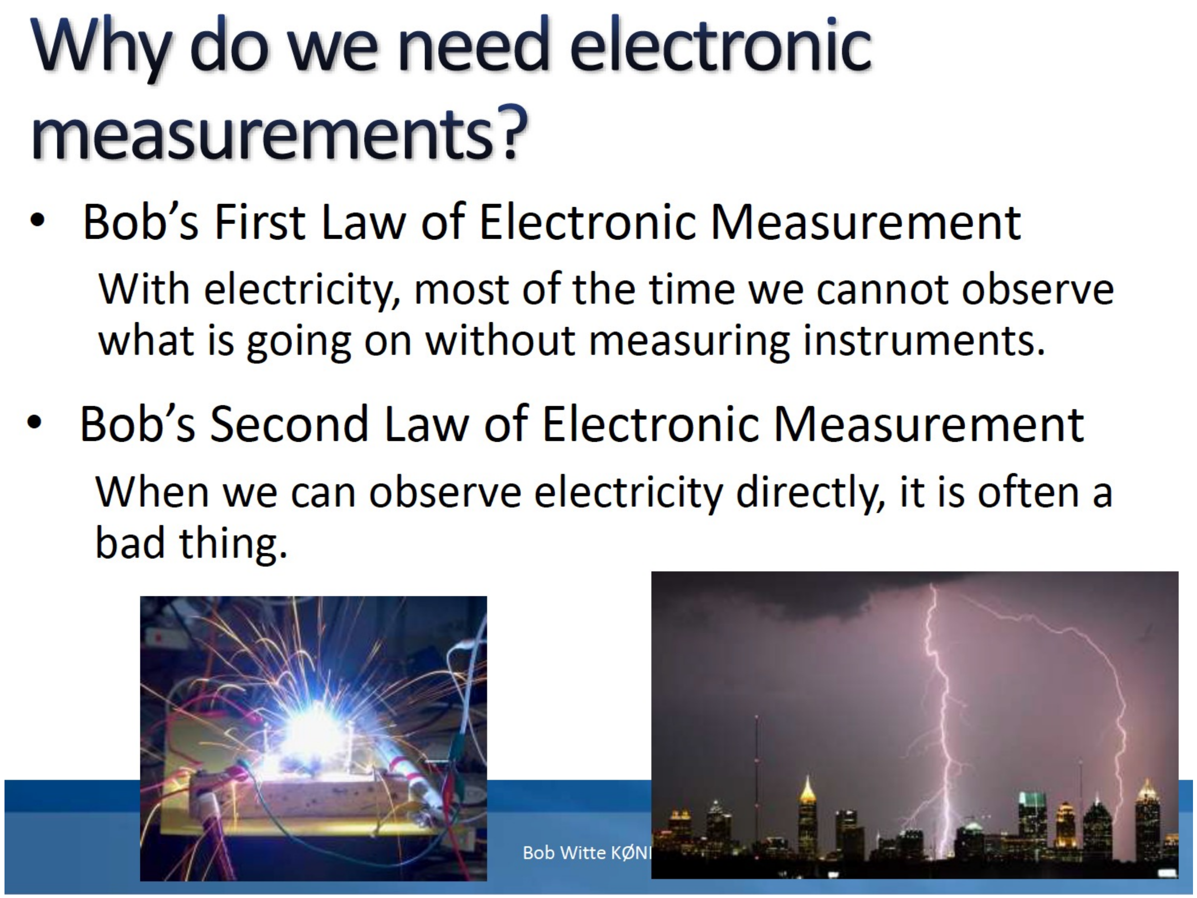


From Wikipedia

- An **isotropic radiator** is a theoretical point source of electromagnetic or sound waves which radiates the same intensity of radiation in all directions. It has no preferred direction of radiation. It radiates uniformly in all directions over a sphere centred on the source. Isotropic radiators are used as reference radiators with which other sources are compared, for example in determining the gain of antennas
- You can't actually build it
- Antenna gain often referenced with respect to an isotropic (dBi)

Test and Measurement Equipment

From the December 2018 RMHAM University by Bob Witte, K0NR

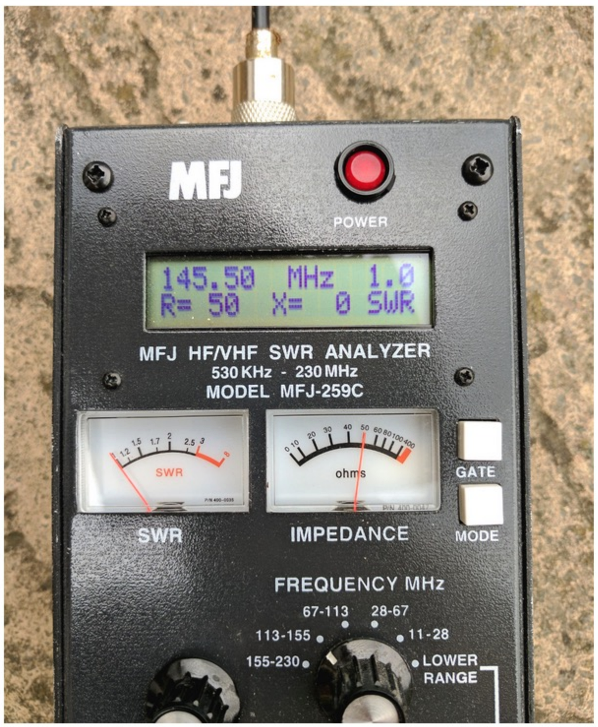


It’s not just good … it’s good enough!

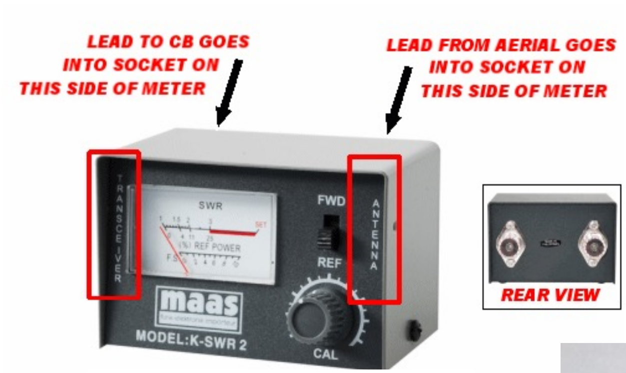
How do I know if it works?

- Antenna analyzer

And, the impedance and reactance are perfect!



- simple VSWR meter



- Return Loss Meter

VSWR to Return Loss

VSWR TO RETURN LOSS AND RETURN LOSS TO VSWR

RETURN LOSS (DB)	VSWR	VOLTAGE REFLECTION COEFFICIENT
1	17.391	0.891
2	8.724	0.794
3	5.848	0.708
4	4.419	0.631
5	3.570	0.562
6	3.010	0.501
7	2.615	0.447
8	2.323	0.398
9	2.100	0.355
10	1.925	0.316
11	1.785	0.282
12	1.671	0.251
13	1.577	0.224
14	1.499	0.200
15	1.433	0.178
16	1.377	0.158
17	1.329	0.141
18	1.288	0.126
19	1.253	0.112
20	1.222	0.100
21	1.196	0.089
22	1.173	0.079
23	1.152	0.071
24	1.135	0.063
25	1.119	0.056
26	1.105	0.050
27	1.094	0.045
28	1.083	0.040
29	1.074	0.035
30	1.065	0.032

$$\mathrm{SWR} = \frac{1 + \sqrt{P_r/P_f}}{1 - \sqrt{P_r/P_f}}$$

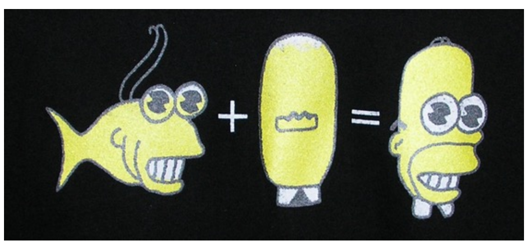
$$RL(\mathrm{dB}) = 10\log_{10}\frac{P_\mathrm{i}}{P_\mathrm{r}}$$

Measuring Gain of an Antenna

Antenna Range - It's not that complicated. You just need some calibrated test equipment.

- Transmitting location
- Receiving location
- Free space in-between
- First measure a reference antenna
- Now measure the test antenna
- Turn the test antenna
- Measure gain while turning

And there you have it fish bulb

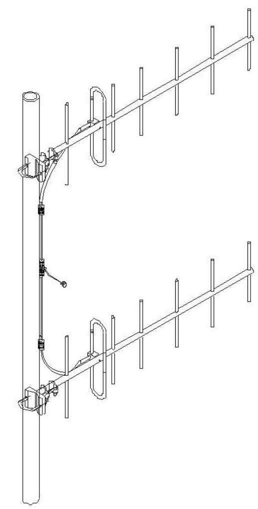


Marc Thorson, WBØTEM, has run our VHF/UHF antenna range for many years now. He maintains a family of reference antennas. These are erected in the same field as the "antenna under test". Detectors are measured on an HP-416A Ratiometer. On the right is Marc's source trailer with the 6m antenna currently transmitting. Above, you can see Kent, KA2KQM, and Bruce, W9FZ, assisting on the range. In the photos below, you can see Dave, KBØPE, and Ron, KOØZ measuring a 6m beam.

Part of the antenna range at the Central States VHF Conference

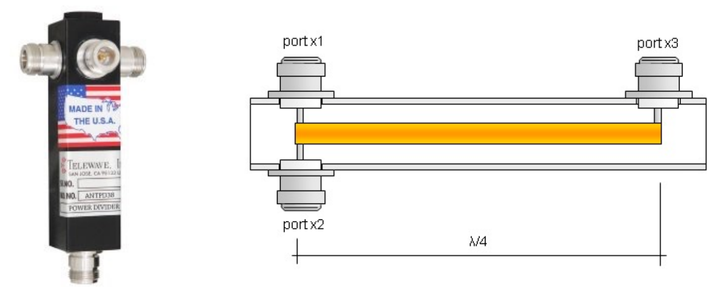
Stacking yagis

- Phasing Lines
- Power splitters
- Stacking Distance

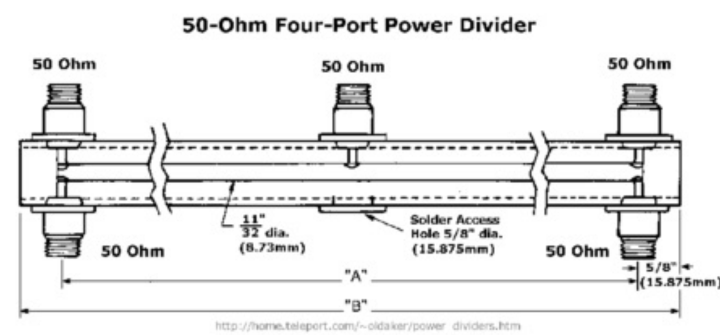


Polarization	Stacking	H Plane	E Plane
Vertical	Vertical	46	21
Vertical	Horizontal	23	41
Horizontal	Vertical	41	23
Horizontal	Horizontal	21	46

using Phasing Lines



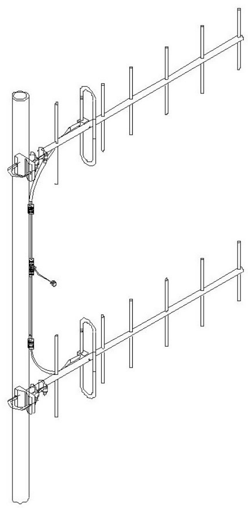
Quarter Wave power splitter



Half Wave Power Splitter

https://www.qsl.net/w4sat/fdipole.htm

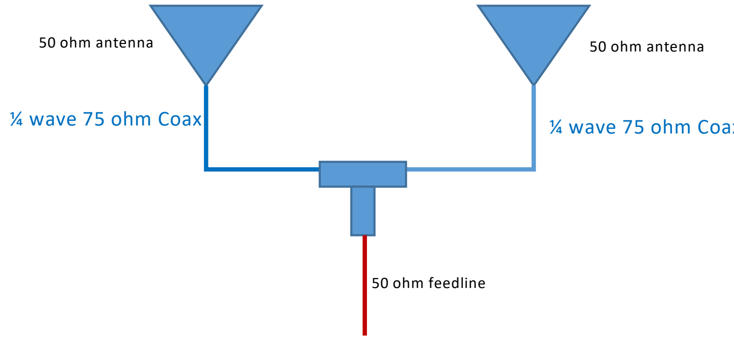
Stacking yagis – Using Phasing Lines



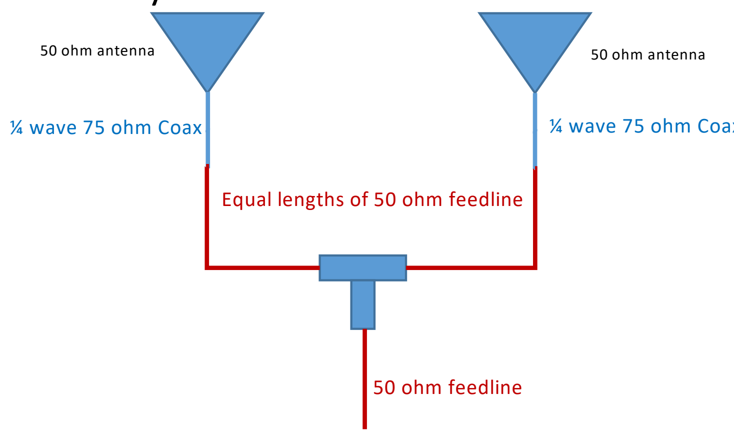
Polarization	Stacking	H Plane	E Plane
Vertical	Vertical	46	21
Vertical	Horizontal	23	41
Horizontal	Vertical	41	23
Horizontal	Horizontal	21	46

using Phasing Lines

To phase just use a ¼ wavelength of 75 ohm feedline

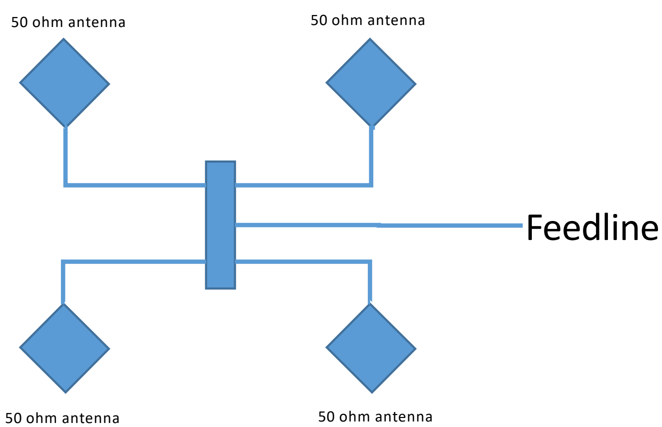


What if my antennas are more than a ¼ wavelength apart?

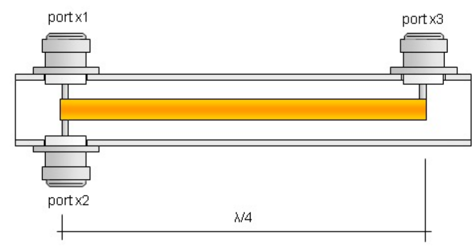


Stacking yagis – Power Splitters

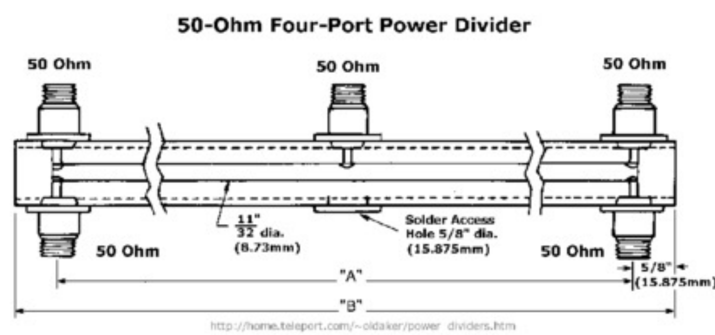
- Use either a ¼ wave or ½ wave power splitter
- Equal length 50 ohm phasing lines



All coaxial lines are 50 ohms



Quarter Wave power splitter



Half Wave Power Splitter

https://www.qsl.net/w4sat/fdipole.htm

VHF yagis

More material than we can talk about in this session. So let's touch the top of the clouds …

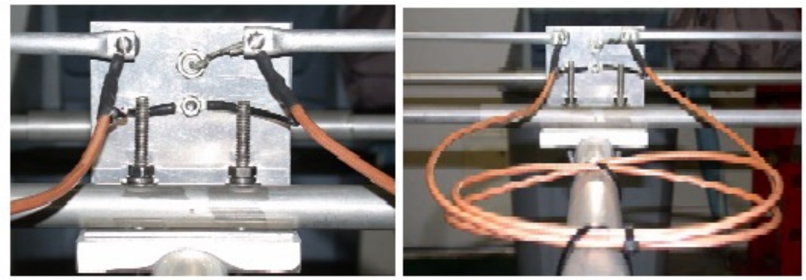
- Easy to build
- Element mounting and lengths
- Optimization
- Does boom length equal gain / performance
- Are more elements better?
- "best" designs

VHF Yagi driven elements

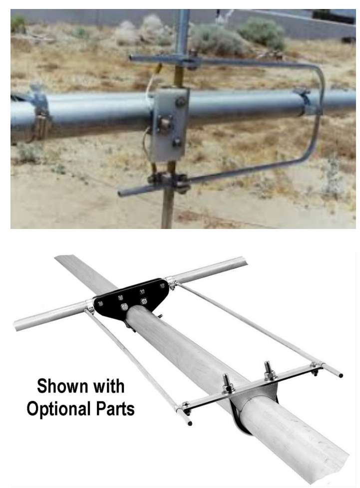
Still more material than we can talk about in this session. Let's look at the most popular

- How to match?
- What is important?
- Stacks of yagis
- Driven Elements
  - Beta match
  - Delta Match
  - T-match
  - Balun match

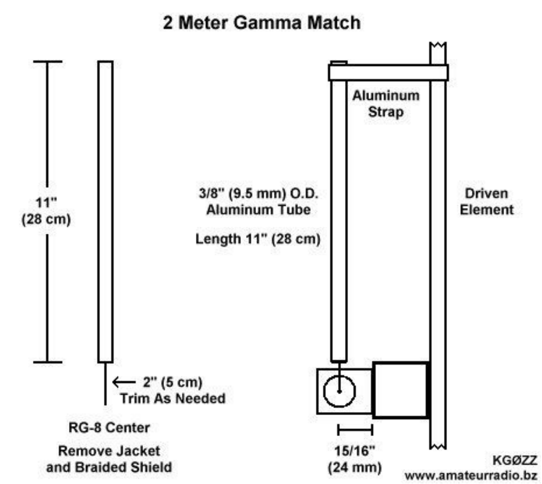
T Match



Beta Match

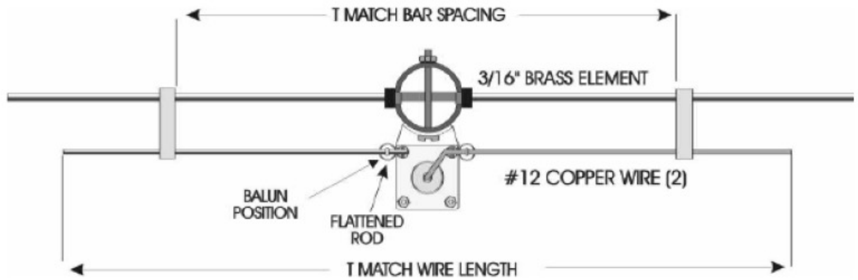


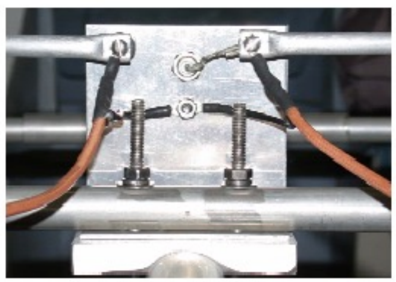
Gamma Match

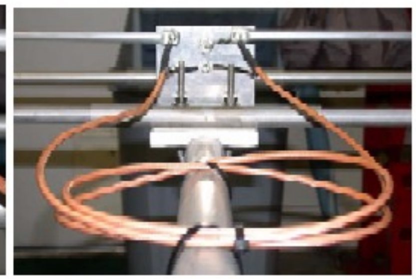


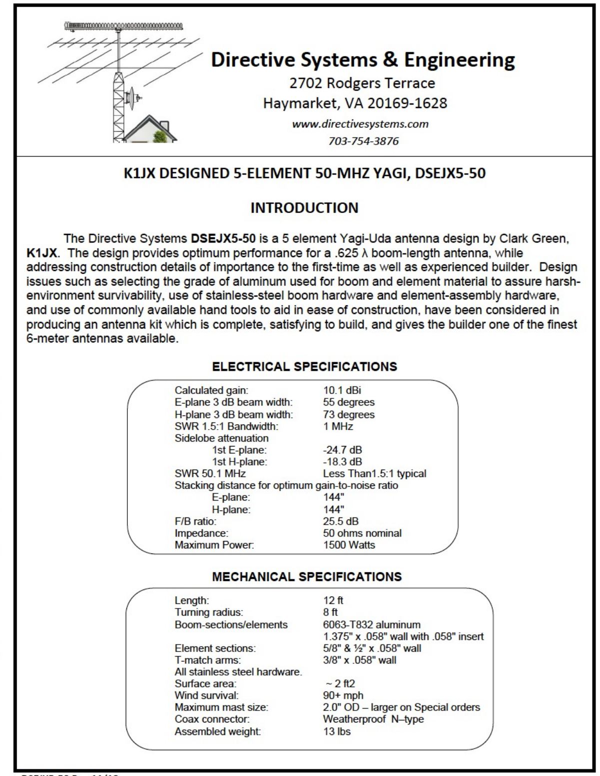
VHF Yagis – T Match

- Great article from Directive Systems
- Used on many of my homebrew antenna projects
- But don't forget the coaxial balun









Directive Systems & Engineering
2702 Rodgers Terrace
Haymarket, VA 20169-1628
www.directivesystems.com
703-754-3876

K1JX DESIGNED 5-ELEMENT 50-MHZ YAGI, DSEJX5-50

INTRODUCTION

The Directive Systems **DSEJX5-50** is a 5 element Yagi-Uda antenna design by Clark Green, **K1JX**. The design provides optimum performance for a .625 λ boom-length antenna, while addressing construction details of importance to the first-time as well as experienced builder. Design issues such as selecting the grade of aluminum used for boom and element material to assure harsh-environment survivability, use of stainless-steel boom hardware and element-assembly hardware, and use of commonly available hand tools to aid in ease of construction, have been considered in producing an antenna kit which is complete, satisfying to build, and gives the builder one of the finest 6-meter antennas available.

ELECTRICAL SPECIFICATIONS

Calculated gain:	10.1 dBi
E-plane 3 dB beam width:	55 degrees
H-plane 3 dB beam width:	73 degrees
SWR 1.5:1 Bandwidth:	1 MHz
Sidelobe attenuation	
1st E-plane:	-24.7 dB
1st H-plane:	-18.3 dB
SWR 50.1 MHz	Less Than1.5:1 typical
Stacking distance for optimum gain-to-noise ratio	
E-plane:	144"
H-plane:	144"
F/B ratio:	25.5 dB
Impedance:	50 ohms nominal
Maximum Power:	1500 Watts

MECHANICAL SPECIFICATIONS

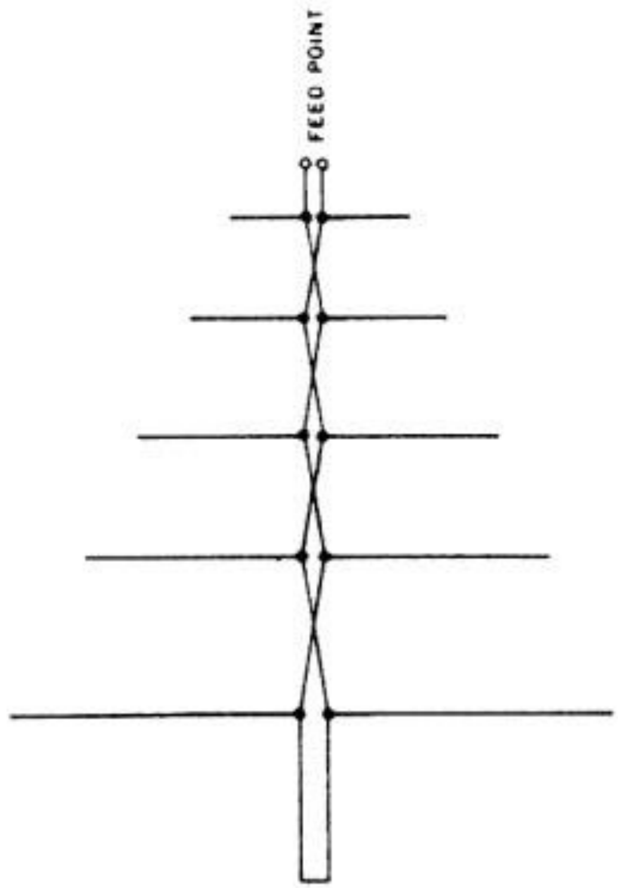
Length:	12 ft
Turning radius:	8 ft
Boom-sections/elements	6063-T832 aluminum
	1.375" x .058" wall with .058" insert
Element sections:	5/8" & ½" x .058" wall
T-match arms:	3/8" x .058" wall
All stainless steel hardware.	
Surface area:	~ 2 ft2
Wind survival:	90+ mph
Maximum mast size:	2.0" OD – larger on Special orders
Coax connector:	Weatherproof N–type
Assembled weight:	13 lbs

DSEJX5-50 Rev 11/18

More info: https://directivesystems.com/50-mhz/dsejx5-50/

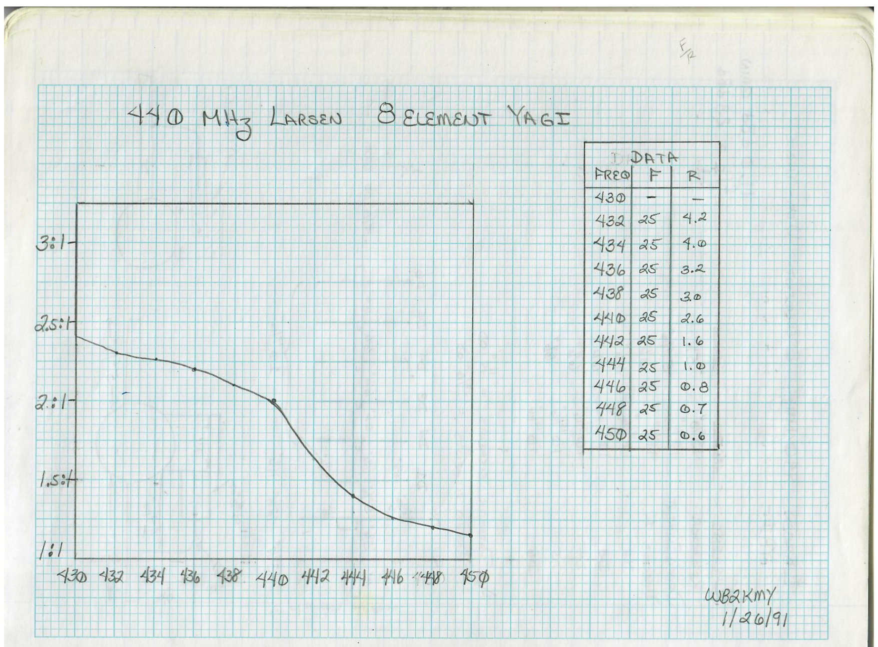
Log periodic antennas

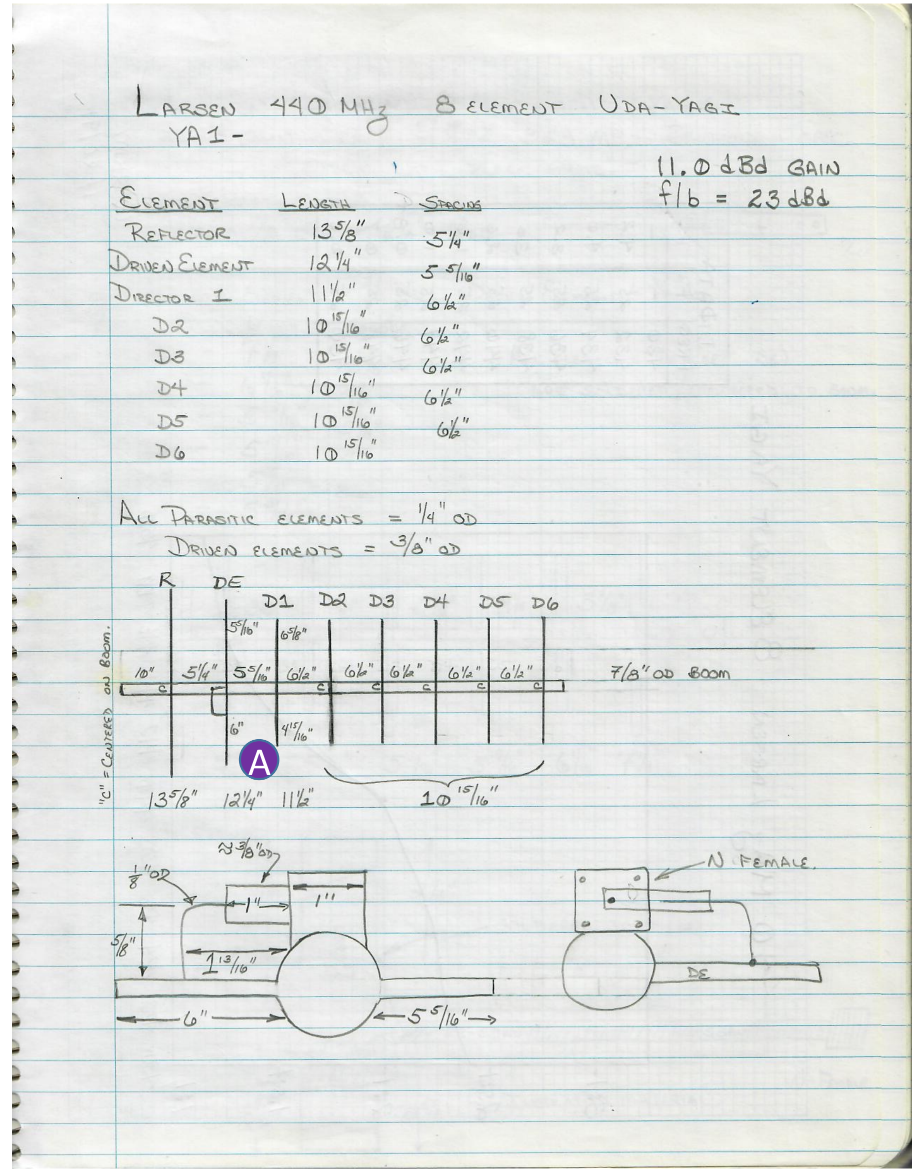
- Different from yagis?
- Broadband
- How much gain?



Larsen Yagi – 440 MHz

- No longer manufactured
- Welded elements to boom
- Basic gamma match
- Acceptable performance despite elements not welded on boom in centers (A)
- Reasonable price point

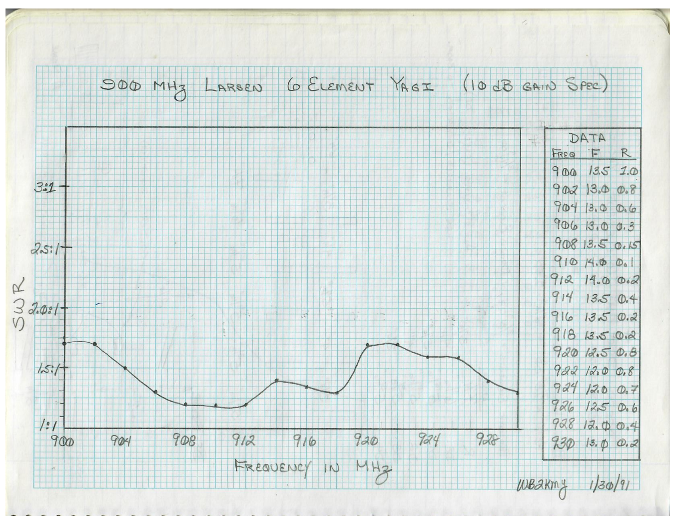


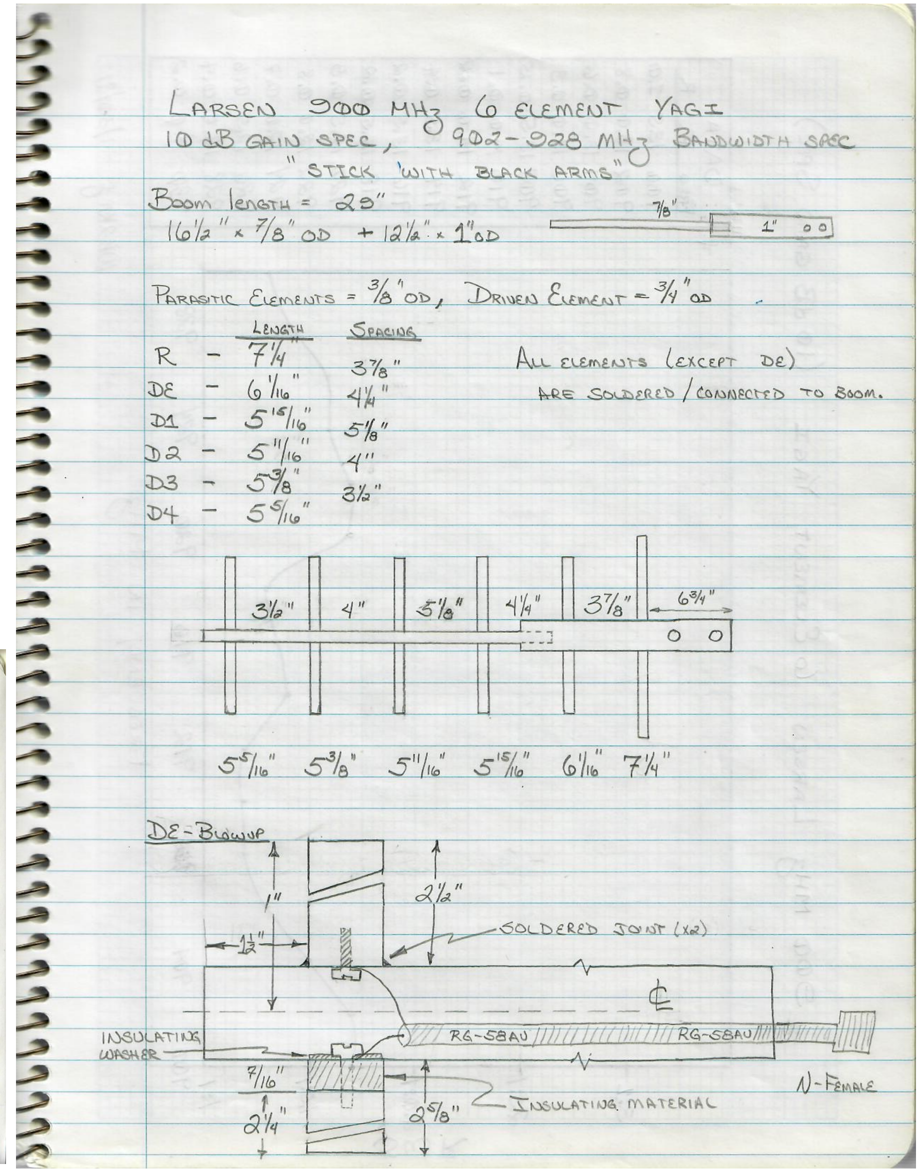


Larsen Yagi – 920 MHz

- No longer manufactured
- Welded elements to boom
- Basic "let's split the coax and try to match this thing" feed
- Had an acceptable match or SWR
- Found directivity or pattern was "poor"
- Reasonable price point but did not work well

Bottom Line – You get what you pay for. Test your antennas!





Rocky Mountain Ham Radio

Teach...learn...operate...support. Be a part of our team.

Are we done yet?

Yea, Doug is finished. Wayne is next!

Questions for Doug?