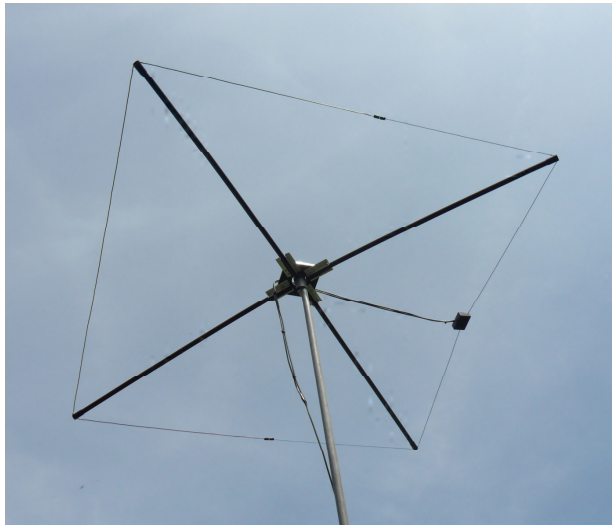
50MHz Collapsible 2 Element Mini Beam: An Overview the Development of the “6MBA”

Presented by:
Mike Parkin
GØJMI



(Design featured in RSGB’s September 2012 “Rad Com”)

Introduction

Mike Parkin:

- First licensed as G8NDJ in 1977.
- Became GØJMI in 1988.
- Interests in Radio have included:
  - Microwave Bands (Built from 23cm to 6mm)
  - 6m, 10m and 12m operating SSB/CW
  - 60m and 80m CW QRP
  - Building equipment (Tx, Rx, PSU)
  - Antennas (Designing, Building and Using)
  - Operating as /P
- QTH: Alton, Hampshire.
- BSC(Hons) MIET CEng MCGI (Electrical, Telecoms & Radio Engineer)

Presentation Content

1. Why?
2. Options.
3. First Attempts.
4. Back to Basics.
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6. 6m Mini-Beam Design.
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Why?

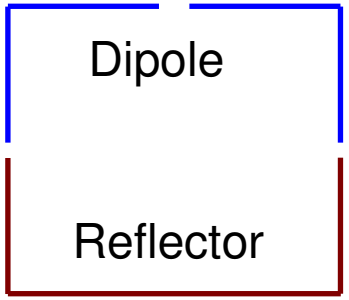
The Problem:

- Conventional 2 Element Yagi for 50MHz has a dimensions of approx' 3m by 1.5m (= Large).
- This a big antenna for a small garden with a significant "turning circle" (approx' 1.74m radius).
- Gets even worse for a 3 element beam for 6m!

Question:

"Can a 2 Element Beam be made more efficient space-wise?"

Options?



What Options are There:

- VK2ABQ Beam (Fred Caton)
  - A Wavelength of wire formed into a square with a dipole and reflector of equal lengths
  - Works well but can have impedance matching difficulties (balanced dipole = balanced feeder).
- The MOXON Beam (Les Moxon, G6XN)
  - Basically a 2 Element Yagi formed into an oblong shape.
  - Works well but has still a significant “turning circle”, easier to match to feeder.

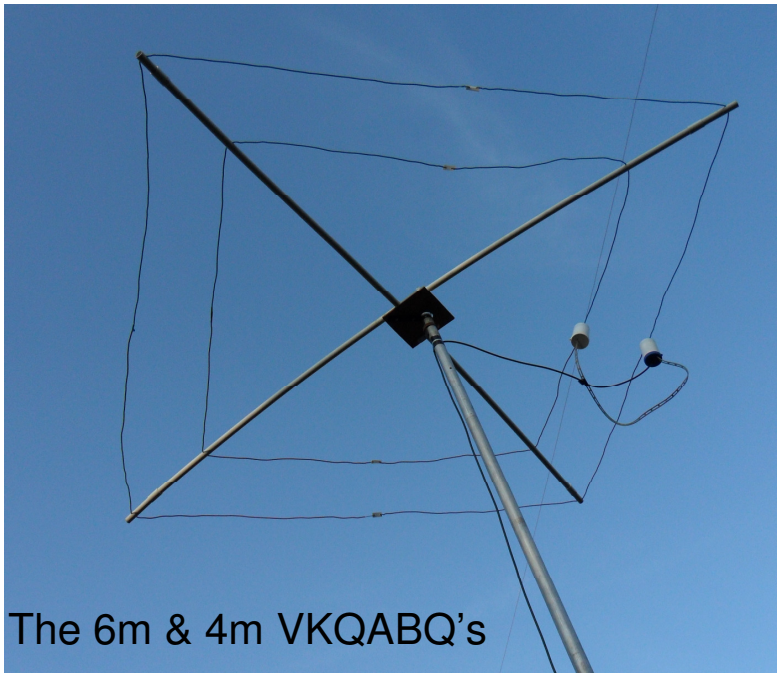
First Attempts:

My first prototype VK2ABQ beams for 6m and 4m on the same boom set-up in 2010 (made from scrap plastic conduit and 5A wire).

Where did we work? Best DX from IO91MD:

6m VK2ABQ:	**SV9GPV in Locator KM25**
	5B4AIF in Locator KM64
	UX1BZ in Locator KN29
4m VK2ABQ:	**M0SDA/P in Locator IO84WQ**
	GU6EFB in Locator IN89RK

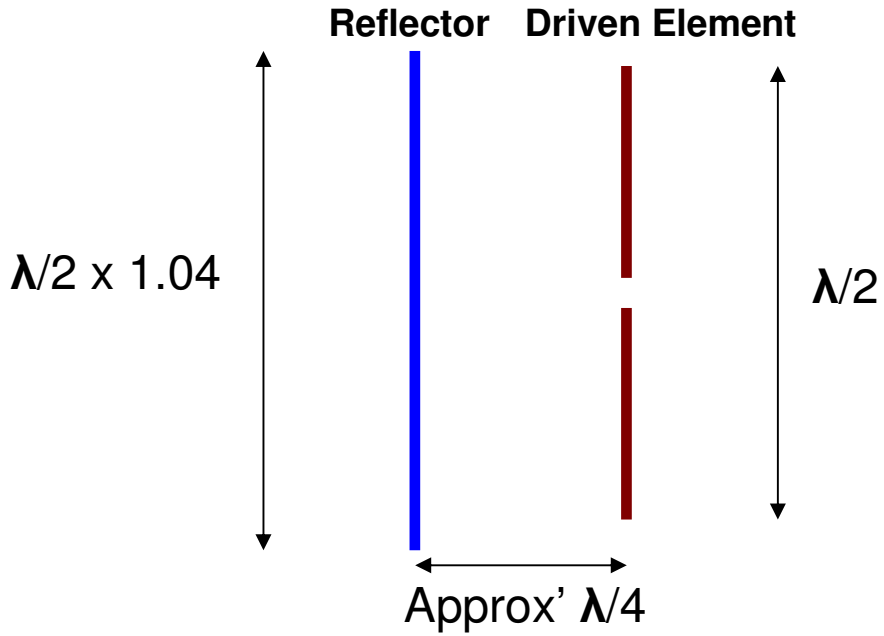
Conclusion: I think these antennas work, but can the matching be simplified?



The 6m & 4m VKQABQ's

Back To Basics

Question: Can a conventional 2 Element Yagi beam be folded up on itself and still present a reasonable match and perform well?

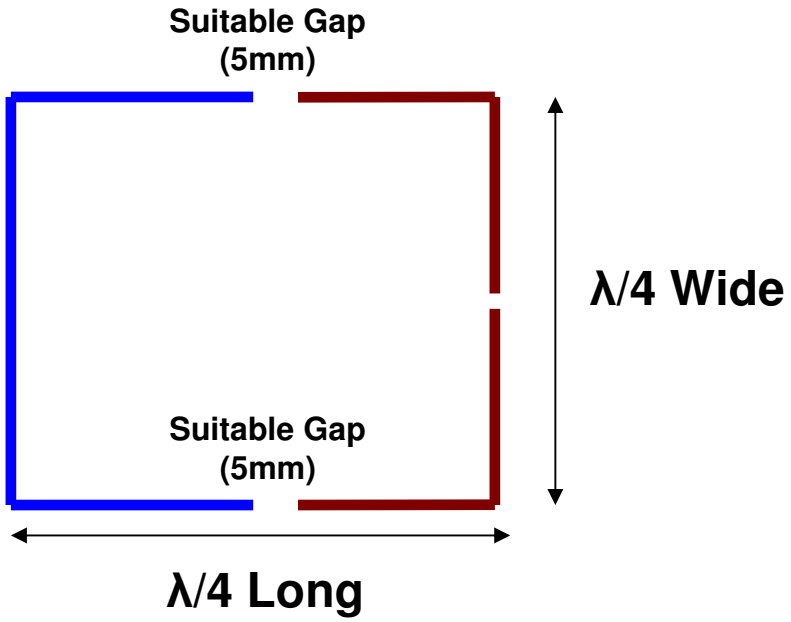


Feed impedance somewhere between 25Ω and 100Ω (SWR around 2:1).

But possible to match antenna to 50Ω co-ax cable using a suitable matching transformer.

Fundamental Design

2 Element Beam folded:



Found that feed impedance somewhere between 45Ω and 55Ω (SWR around 1.1:1).

Practical to match antenna to 50Ω co-ax cable using a suitable matching transformer.

6m Mini-Beam Design

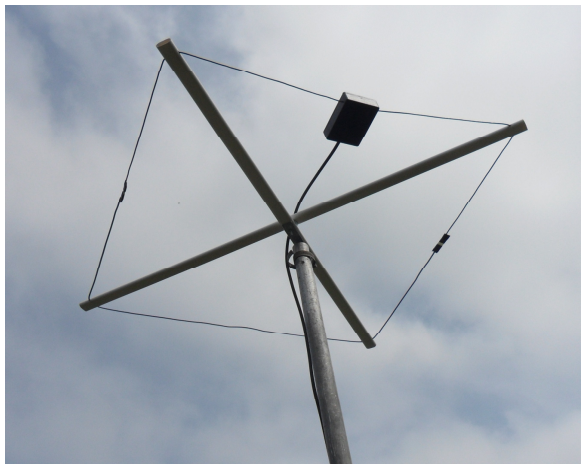
A 1/3 size prototype was made up and tested on 144.25MHz (λ is 2.08m).

This seemed to work well with a low SWR and reasonable radiation pattern.

This was then scaled up to the 6m band that also involved some “trial and error” development.

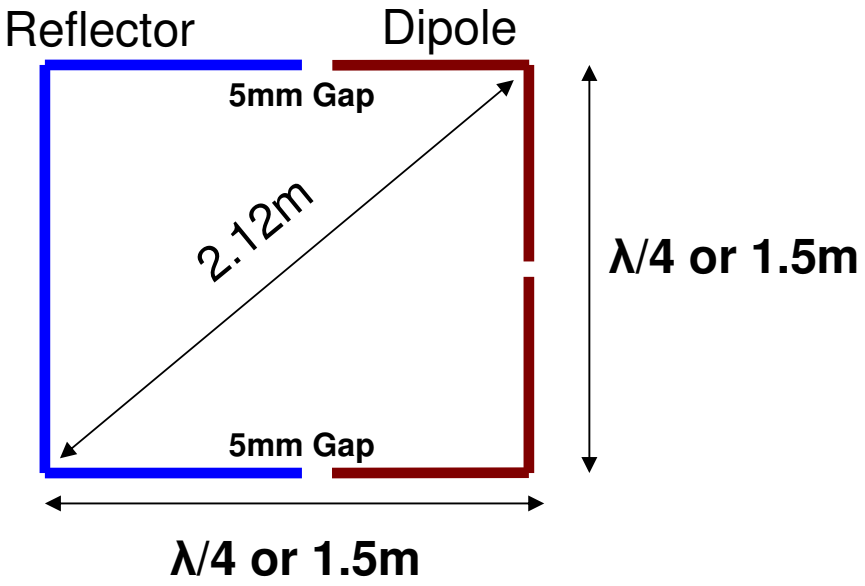
Nigel, M0VVQ, took one look at the 2m antenna and suggested there would be interest in this antenna design in its own right.

This prototype was the basis for the 144-146MHz 2MBA (best DX to-date using 2MBA is 460km to GM3HAM/P in IO74 from IO91).



6m Mini-Beam Design

Design Frequency was 50.15MHz or 5.98m

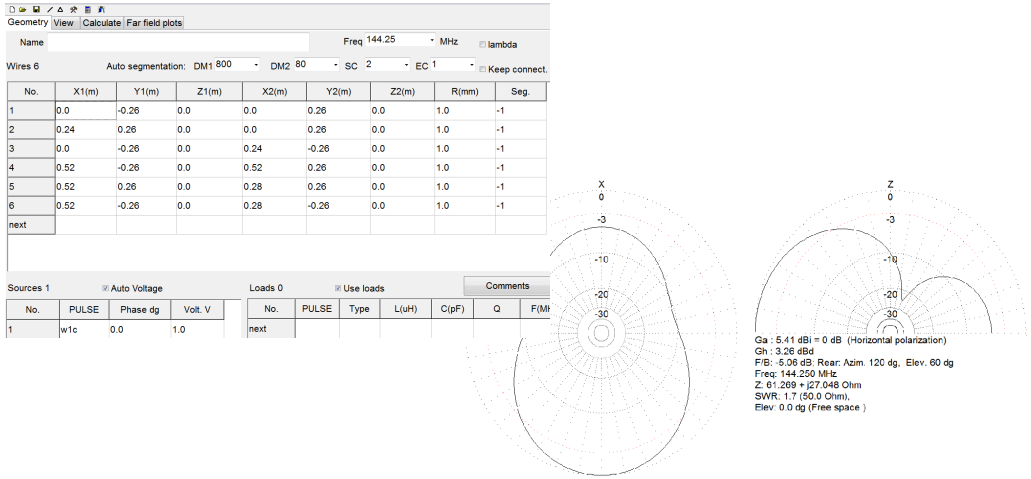


The maths:

- Dipole is 2.88m long allowing for velocity factor (96% of λ, found by "trail and error" as mentioned previously)
- Reflector is 3.11m long (1.04 x λ/2)
- Turning radius reduces to 1.06m (from 1.74m for a 2 Element Beam)

6m Mini-Beam Design

The MMANA-GAL aerial modelling software (free from RGSB) was used to verify the measurements made and results gained from the antenna's development and testing.

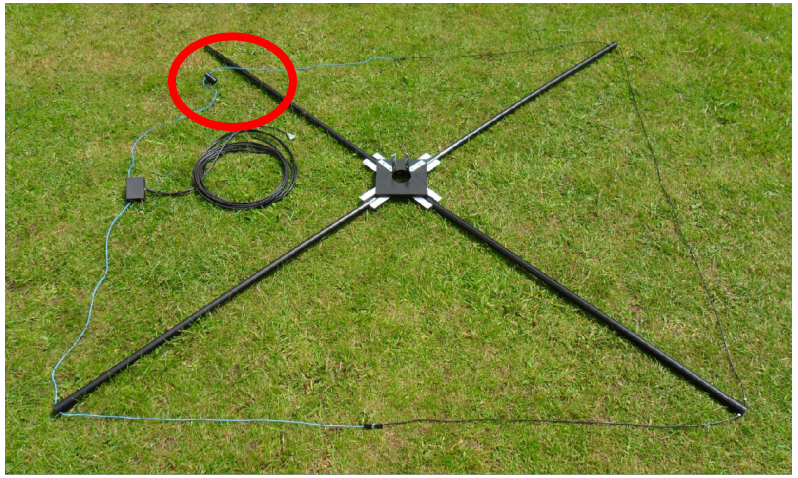


The Prototype

- Let's make it collapsible for portable use or to ease putting the antenna in the loft.
- Keep the weight as low as practical (use 20mm conduit)
- "Legs" hinge and lock under gravity.
- Be able to mount the antenna on a mast.
- Keep the design simple.

The Prototype

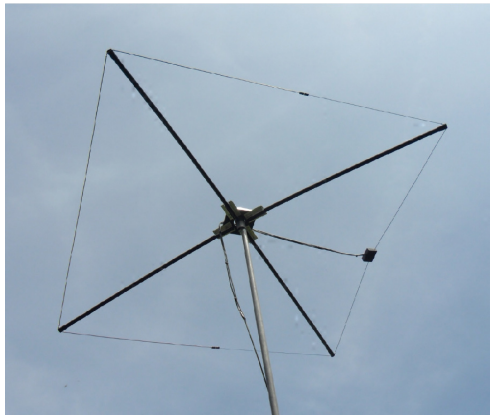
- Antenna is detachable. Uses conduit couplings.
- Holes are suitably drilled in the couplings to carry the antenna allow antenna to be detachable.



- A one-to-one λ/4 balun was made up to match the balanced antenna to co-axial cable (RG58).

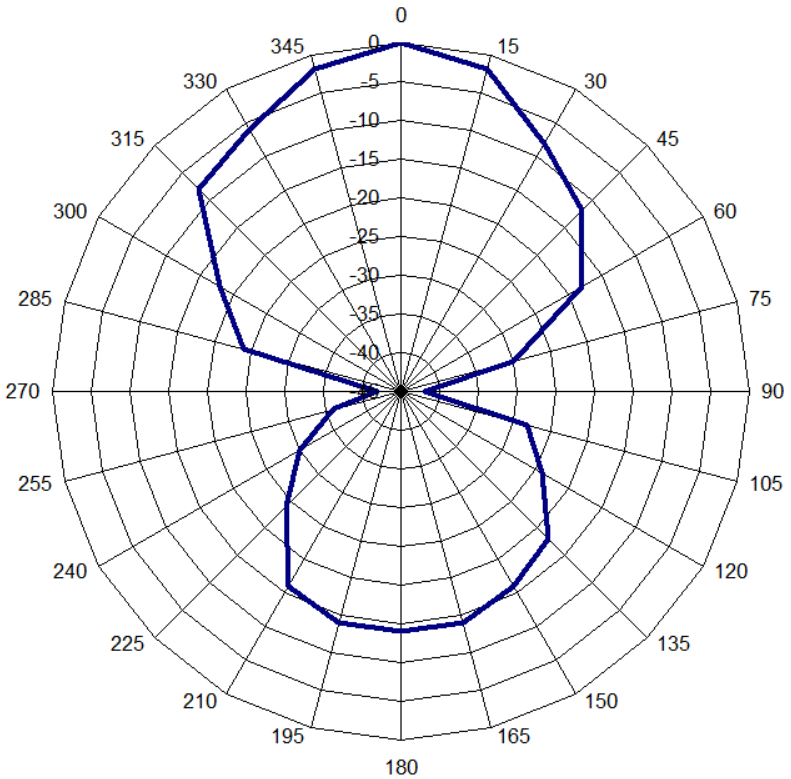
Performance

- SWR: Better than 1.5:1 between 50.0 and 51.0MHz.
- Transmit Power Capability: Able to handle safely 50w CW/FM/SSB signals.
- Gain: About 3dBd (measured).
- Front to Back Ratio: Better than 14dB (measured).
- Weight is approximately 1.5kg.
- Weather resistant.



Performance

Measured Polar Plot (Horizontal Polarisation):



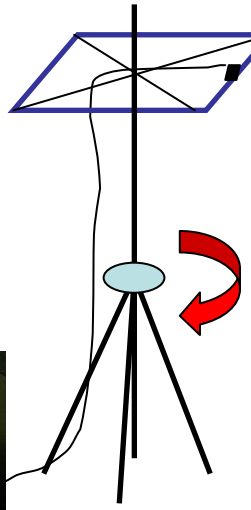
Performance is similar to a 2 Element Yagi Beam.

Performance

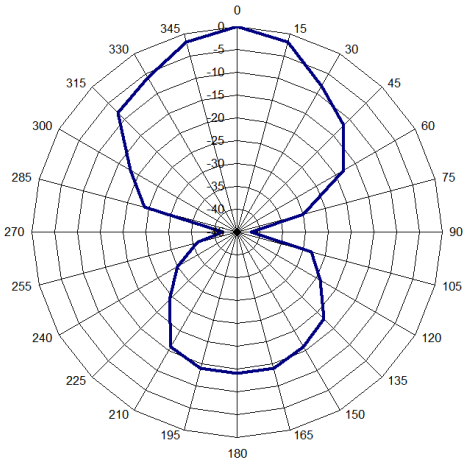
Measurement Technique:

360º Protractor

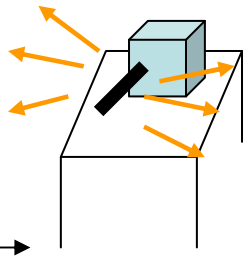
Suitable Receiver with Accurate “S” Meter



Approx’ 3m

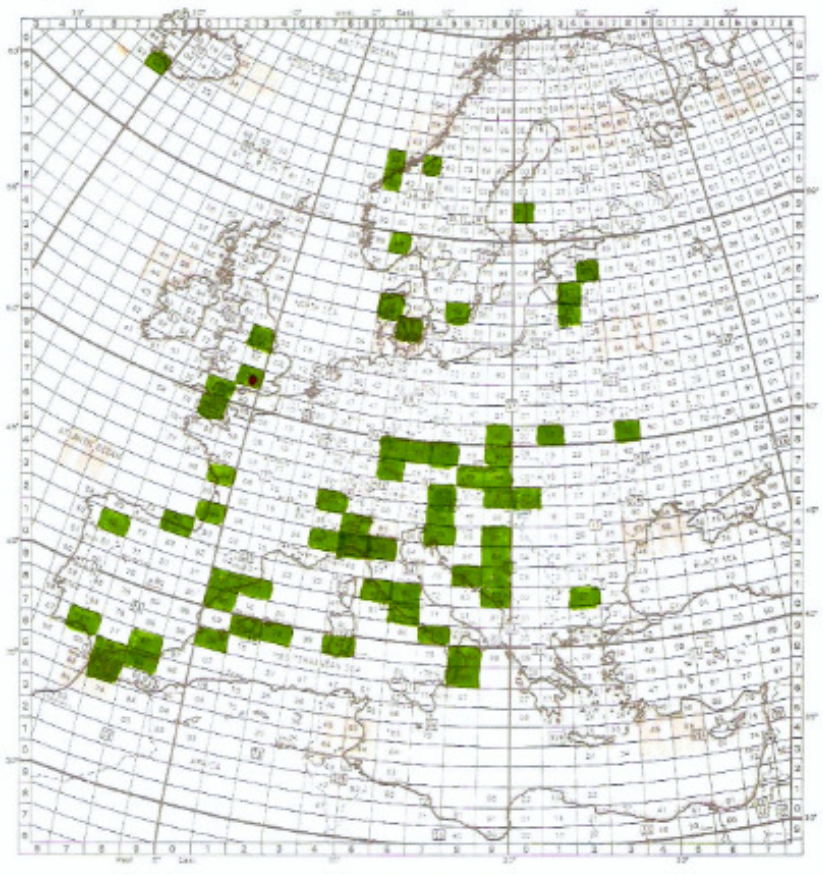


Adjustable Low Power Signal Source



Approx’ 20m

The Results

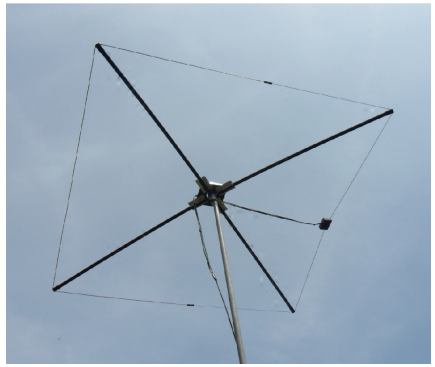


The map illustrates the QRA Locator Squares worked from IO91MD (Alton) during 2012 on 50MHz.

The power used was 10w and the modes were SSB or CW.

Best DX was to EA8CQS at 2,800km in IL18AT (square not shown).

Objectives Met?

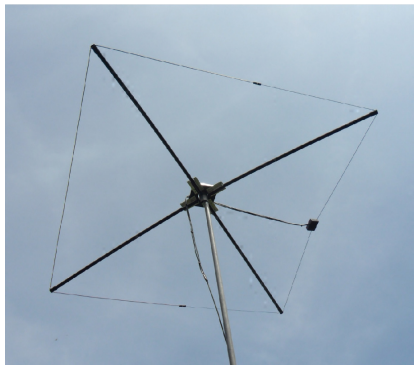


The 6m Mini-Beam:

- Smaller turning circle (compared to a conventional 2 Element Beam).
- Lightweight but sturdy and robust.
- Able to be set-up and taken-down quickly.
- Able to match to 50Ω feeder.
- Comparable gain to a 2 Element Beam (3dBd).
- Comparable Front/Back Ratio to 2 Element Beam.

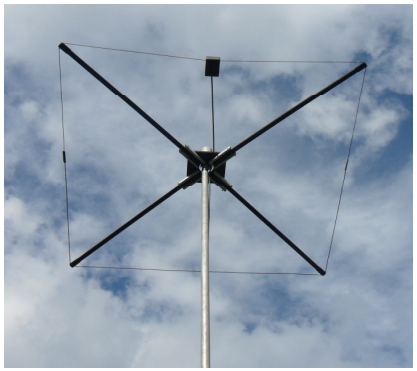
Progression

The prototype 6m Mini-Beam became the basis for the 6MBA, 4MBA and 2MBA (Mini Beam Antennas).



6MBA

Design featured in RSGB's September 2012 "Rad Com"



4MBA

2MBA

Antenna collapsed.

Summary

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- Options.
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- Objectives Met?
- Progression.

Thank you for listening

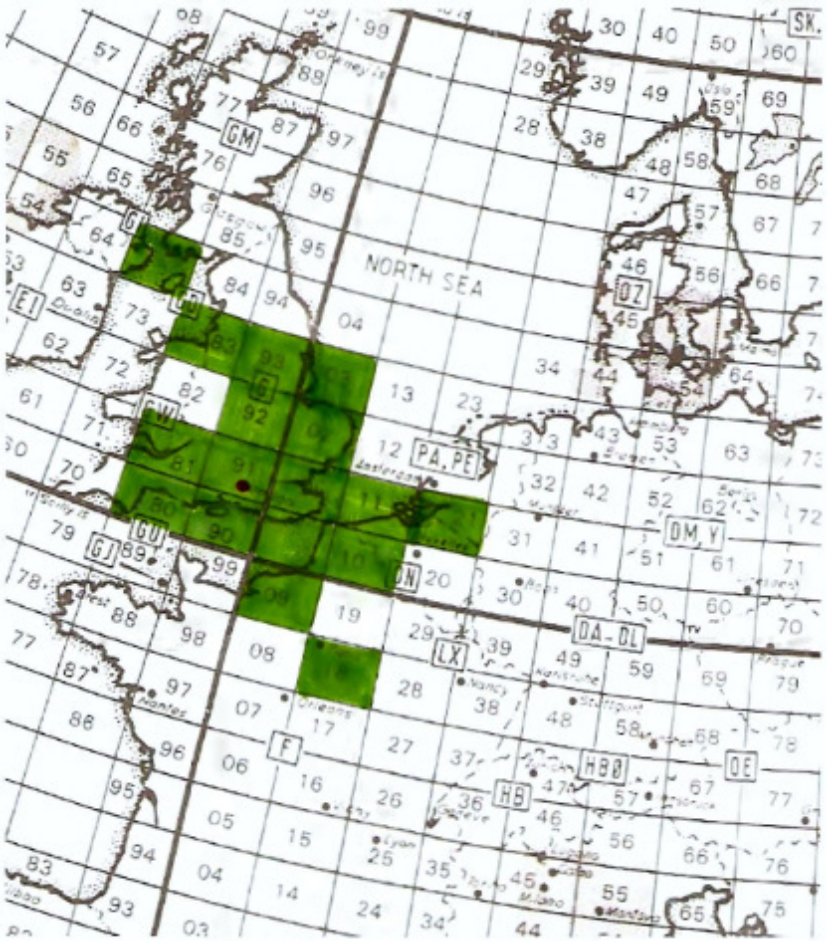
Question Session

50MHz Collapsible 2 Element Mini Beam: An Overview of It's Development into the "6MBA"

- End -

Website: http://aaa001.webeden.co.uk/

Annex 1: 2MBA Results



The map illustrates the QRA Locator Squares worked from IO91ME (Holybourn Down, Alton) during 2012 on 144MHz.

The power used was 10w and the modes were SSB or CW.

Best DX was to GM3HAM/P at 460km in IO74WV.