

*BUILDING A 4 ELEMENT CUBICAL QUAD FOR 28 MHz*  
*AN ARTICLE BY 2E0DBD*



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**PARTS LIST**

1.5 Metres of 12mm steel bar [to make 16 spreader arm holders] Find a scrap dealer.  
**Source:** Find a scrap dealer. [Expect to pay around £5]

1 Metre steel scaffold tube [to make 4 hubs]  
**Source:** Find a scrap dealer. [Expect to pay around £5]

40 Metres of 1.5mm multi stranded wire [to make 4 wire loops]  
**Source:** Find a scrap dealer. [Expect to pay around £5]

12 metres of 12mm aluminium [to make 738 mm spreader arms x 16]  
**Source:** Suggest South West Stainless near Lyneham or Alcan in Bristol

2 Metres x 9mm fibreglass rods x 16 [to make spreader arms]  
**Source:** Kite shops or ask a farmer for fibreglass electric fence supports!!

**OR** 2 Metres x 9mm dowelling x 16  
**Source:** Homebase or Wickes. [Expect to pay around £2 each]

15mm Hose clamps x 16  
**Source:** Homebase or Wickes.

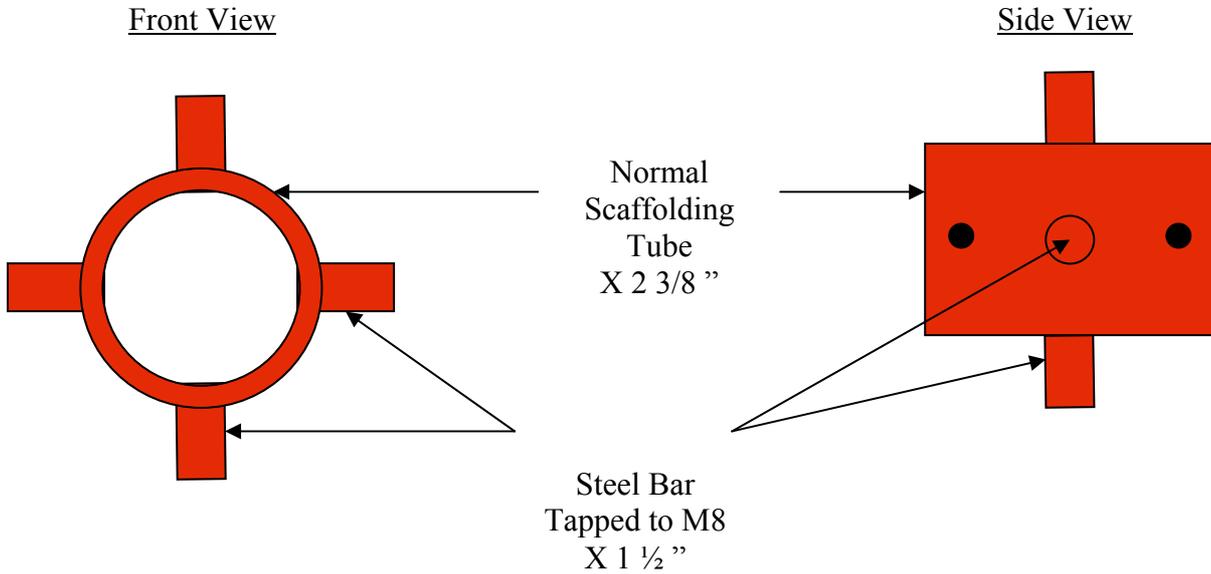
I would say that the total cost of making **MY** antenna was around £40, the bulk cost of which was for the aluminium.

I know a scrap dealer[steel bar], a scaffolder [scaffold pole] and a farmer [fibreglass rod] so I was able to make mine on the cheap!!

Do not be afraid to ask people if they know of anywhere to get the above items, as you may get a pleasant surprise!!

Also remember you have to make the spreader arms out of whatever you can. Perhaps you could have less aluminium tube and more dowelling to save costs!!

## HUB ASSEMBLY

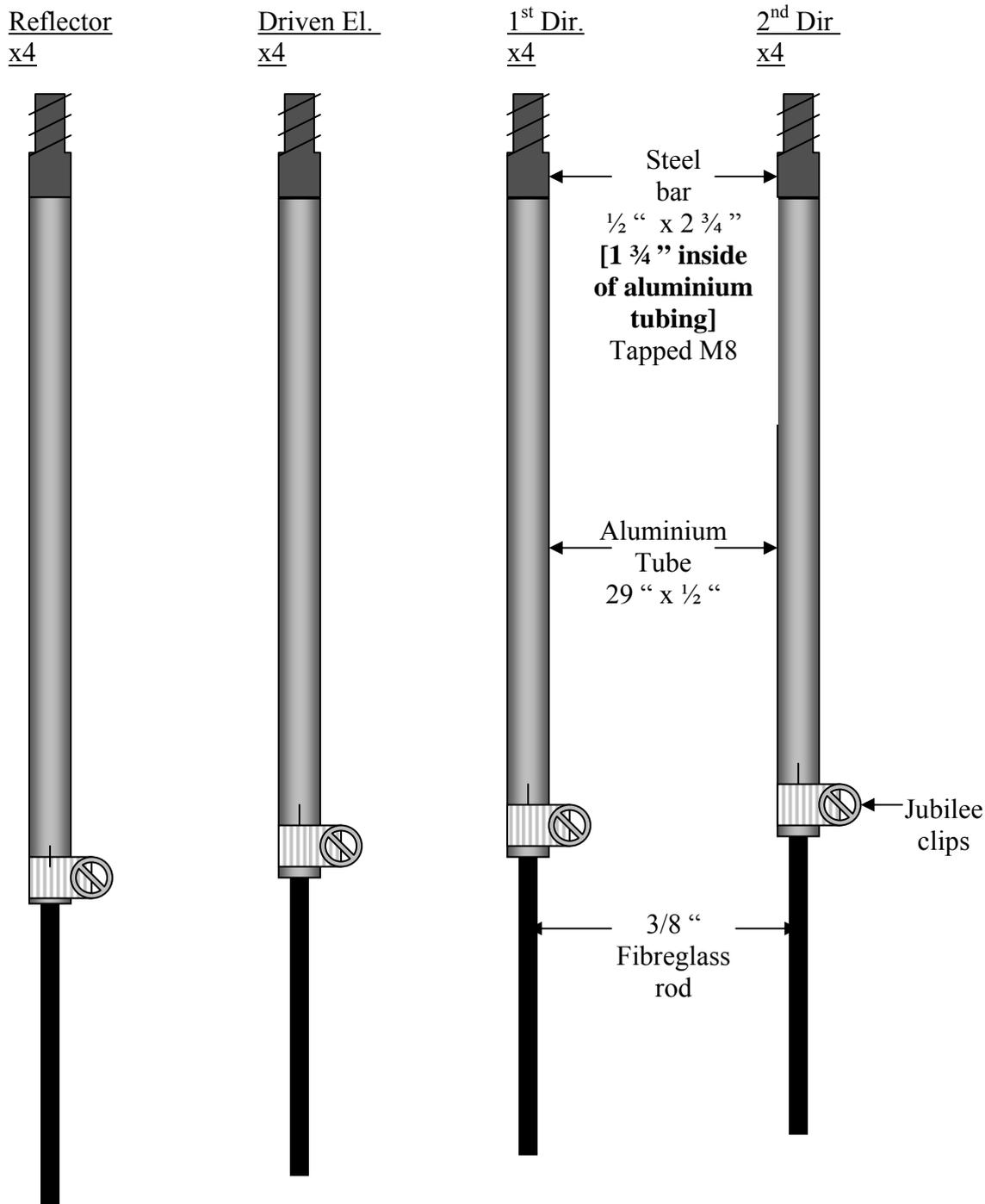


The scaffolding tube is 2 3/8 " long and has 4 steel bars tapped to M8 on their outer tips.

The steel bars are welded to the scaffold pole tube in a cross shape at 90 degrees to each other. Take care, as the galvanising on the scaffold tube is very toxic!

There are 2 holes marked as ● in the side view above, these are locator holes and are threaded 10mm and 10mm bolts are tightened up for correct positioning of the hub to the boom.

## SPREADER/SUPPORT ARM ASSEMBLY



Turn the steel bars down on a lathe to make an interference fit to the aluminium tubing, as it is not important to make an electrical connection. At the other end where the fibreglass enters the aluminium tubing, make 2 slits about 10mm long in the tube, this allows the hose clamp to "bite" down on the fibreglass or dowel. I like this method as it allows fine adjustment of the spreader arm length. It also allows you to make other loops for different frequencies fit the spreader arms

## DIMENSIONS OF EACH SUPPORT ARM

### Reflector

Length of each support arm                      1.88 Metres  
Total width from tip to tip                      3.76 Metres

### Driven Element

Length of each support arm                      1.81 Metres  
Total width from tip to tip                      3.62 Metres

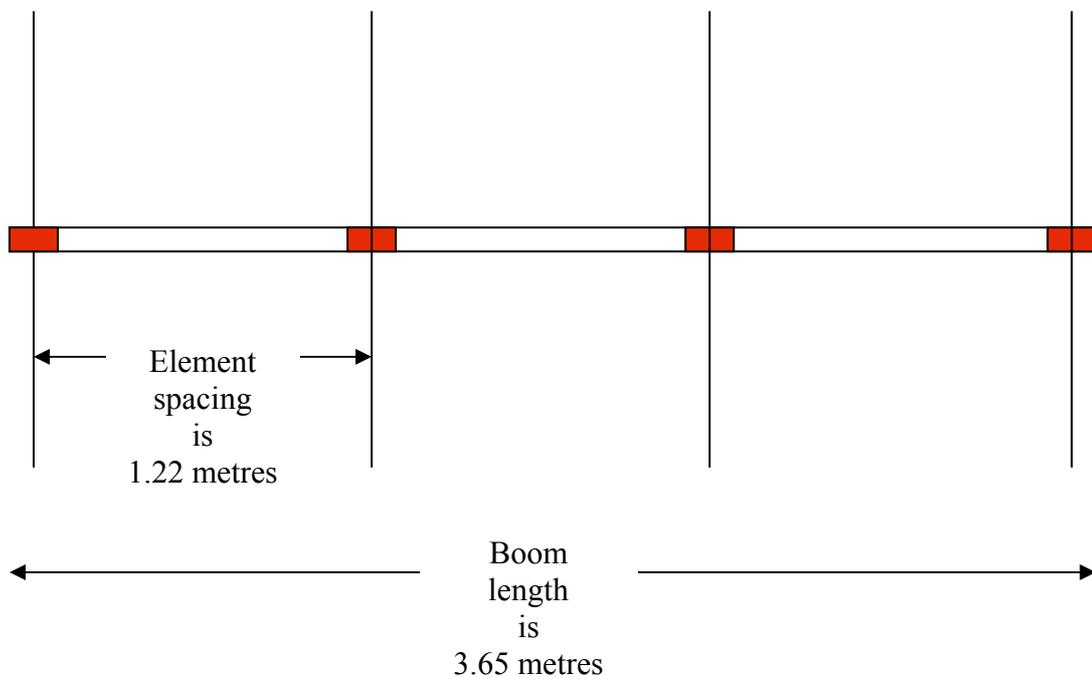
### Director # 1

Length of each support arm                      1.77 Metres  
Total width from tip to tip                      3.54 Metres

### Director # 2

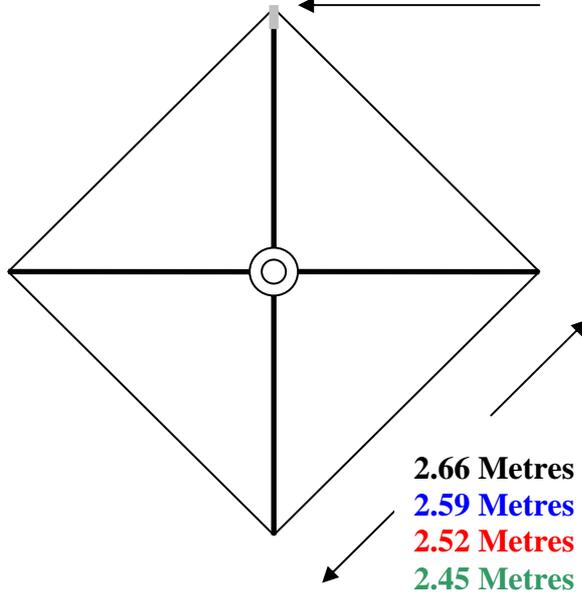
Length of each support arm                      1.72 Metres  
Total width from tip to tip                      3.44 Metres

### Quad Dimensions Side view

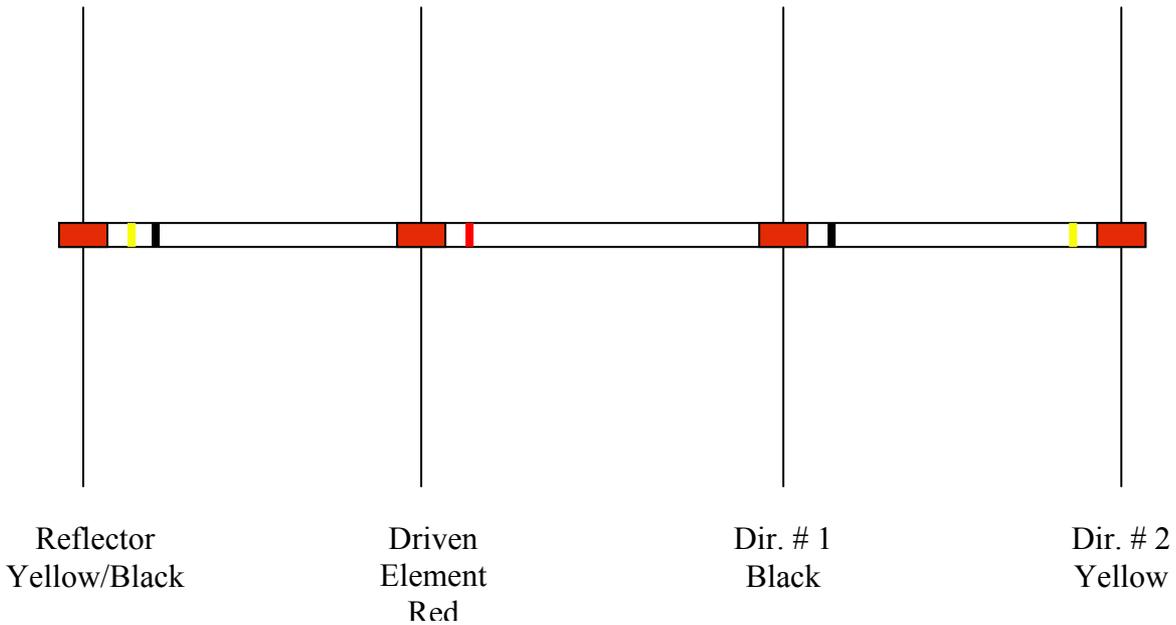


**Quad Dimensions**  
**End view**

**Reflector**  
**Driven Element**  
**Director # 1**  
**Director # 2**



**Quad Colour Code**



## Feeding the Quad Antenna

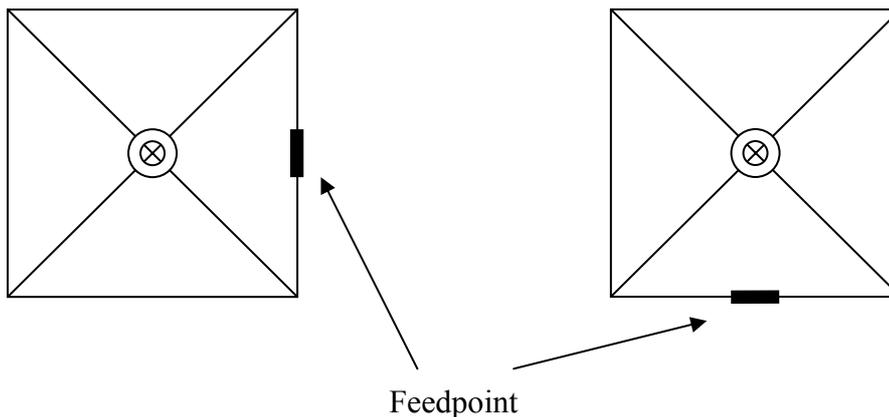
The Quad can be fed in a number of different ways.

Purists would almost certainly feed the antenna with a 1:1 Balun, although I preferred to use a choke balun.

This was both cheap, and simple to make. I fed 4 turns of RG223 50Ω cable through a 2" ferrite ring, and terminated either end with a PL259 plug, this joins the main RG214 50Ω cable at one end, and the antenna junction box at the other.

You can also feed the quad by fitting a matching section of 75Ω cable RG59 that is an electrical half wavelength long. [Found by multiplying a half wavelength x the VF of the cable]. Obviously sound weatherproofing techniques required here. I used several layers of self-amalgamating tape.

The quad can be fed either at the bottom [horizontally polarised] or at one side [vertically polarised]. The choice is up to the user, although I would recommend horizontally polarised, as there is less man made interference then. I tried this on my quad, and also changed to vertical [takes about 3 minutes when the quad is down] and it certainly made a difference.



## Testing the Quad Antenna

I think the best way to test the Quad antenna is to swing it onto a known signal. I used the Didcot beacon on 28.215 CW. There is a sharp null in signal around 25° either side. When you swing back onto it again the signal will rise quite rapidly. By facing the reflector element at the Didcot beacon, I was able to almost lose the signal completely. This proved the front to back gain was working as it should. If you observe not much difference in signal when performing this operation, you almost certainly have interaction with the main feed-line, which is most undesirable.

A VSWR test should show around 1.2:1 or so around the desired frequency of operation. Should any alterations need to be made, note the frequency where the VSWR is lowest, and then divide your desired frequency of operation by the frequency that had the lowest VSWR, and you have a **scaling factor**. Multiply **ALL** your antenna dimensions by this scaling factor and hey presto your VSWR should be spot on!!

## Using the Quad Antenna

On a warm early summers day the 4 element Quad was installed around 60 feet high and was fed vertically with the choke balun method.

The temperature was around 20° and so was quite pleasant to work on.

A few fruitless CQ's later, we checked the Didcot beacon for signal strength, and were re-assured to find it loud and clear.

I tuned around the beacon section of the band to find a signal of fairly clear strength, around 5/5. I noted the morse ident several times before tuning away to find another one.

I remember getting home and typing the beacon I had heard into the web browser, and was astonished to find it belonged to a 2 watt omni beacon on the Island of Haiti!!

Needless to say the next day we went back with MP3 recorder at the ready and we were not going to be disappointed!! We checked the beacons again, and were happy to hear a few coming up from South America. On tuning around the phone section, we heard a very strong station calling CQ.

I called ZD7FT **ONLY ONCE** and was amazed when he came straight back to me.

He gave us a 5 and 9 report, and I remember asking him

“Is that a genuine 5 and 9 or a contest 5 and 9?”

“It's the real thing” he said. So I called him using 50 watts into a full 106” stainless ¼ wave for 28MHz, he didn't come back. He called CQ so I called him again on the vertical, again no reply. So I called again on the Quad, and asked if his details were on QRZ.COM. He came straight back and told me they were. I was astonished how clear he was on the Quad compared to the vertical. There was nearly 3 S points difference in favour of the Quad.

Some time later, Will [2E0GYZ] had a call. He had only that morning got his licence through, so was itching to have a go on 10 metres!!

Within the space of 10 minutes, he had worked 3 South African stations, the WEAKEST report we received was a 5 and 7!!!

I also worked an Algerian station 7X2BK with again a 5 and 9+ report. Then gradually the voices got quieter until the band once again became silent.

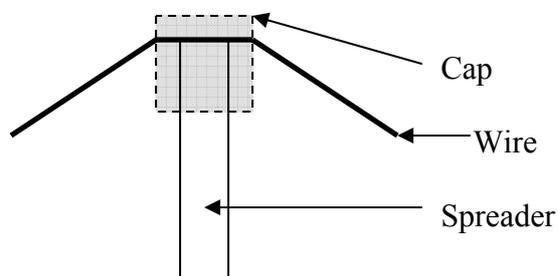
4 Element Quad antenna  
Design Frequency 28.500 MHz  
Ver.1.03

**VSWR 1.3:1 @ 28.500**  
**VSWR 1:1 @ 28.700**

Element	Tot. Length	Wire 1 side	Spreader $\frac{1}{2}$	Spreader Full	Spacing
Reflector	10.64M	2.66 M	1.88M	3.76 M	
Driven	10.34M	2.59 M	1.81M	3.62 M	1.22 M
Dir # 1	10.09M	2.52 M	1.77M	3.54 M	1.22 M
Dir #2	9.80M	2.45M	1.72M	3.44 M	1.22 M

**NOTES**

**A.** The wire passes through the tube, and sits nicely on the tip of the spreaders. Because the wire passes through the tube, it cannot slide down any further than the tip of the spreader.



**B. The Quad exhibits the same SWR in the air, as lowered over on the ground.**  
Very strange...but saves quite a lot of raising and lowering of the tower.!!

**C. VSWR is lower if horizontally polarized.**

I can't explain this except perhaps the proximity of the cable feed-point being nearer the mast in the horizontally fed position helps the tuning in some way.

## Summary

I will never forget the few days in the early part of the Summer of 2005 we had assembling, testing, tuning and finally using the Quad.

We all learned a great deal during the time we spent in the heart of the Wiltshire Downs. It was magical to see a home designed and built antenna perform so remarkably well.

As well as the radio side, it was also nice to spend some time out in the fresh air and enjoy the countryside which we so often take for granted.

The antenna is a real piece of mechanical engineering, and took many hours of drawing, measuring, cutting, filing, lathe work and assembly. It therefore perhaps is not for the beginner. That said, with help from others, and a bit of patience, and a little bit of good fortune, it is well worth the efforts in the long run.

According to **William Orr**, who in my humblest of opinions is a real authority on this type of antenna, the gain figures are 12.5 dBd forward gain and 25dBd F/B gain.

As I do not possess any type of accurate calibrated measuring equipment, I cannot really prove or disprove these figures.

I will say however, that in the presence of several reliable witnesses, under “flat” band conditions we worked a station in Georgia [East Europe] 5 and 5. He was counting in degrees as he turned his beam towards us, and as he stopped counting, we called him and he turned his beam back onto us. He was using 8 elements over 8 elements and said we were the only station he could hear at the time.

The Quad antenna is a beautiful sight to behold and all the work is well worth it when you see it up in the air against a pale blue sky. It perhaps is not quite as good as say a 8 element yagi, although I must draw your attention to the fact that the Quad antenna is very quiet electrically, and there is very little or no static interference to spoil the quality of reception.

I hope this may inspire you to build one of these truly superb antennae, and we look forward to possibly working you on 10 one day!!!

**Please Note: This Quad cost me £40 to build, and I learnt a lot along the way. What could you buy in the same price range to give you over 12dBd of gain!!**

**At this point I would like to thank the following people, without whom this project would not have been possible.**

**Mr Simon Rawlins** [for the use of his workshop]

**Andy** [Landowner]

**M3GSF** [Development/Security manager!]

**M3IIY** [Development/Use of the leatherman!!]

**2E0GYZ** [Catering/Wildlife awareness!!!!]

**M0XUK** [Development/Field testing]

**M1DST** [Development/IT Guru!!]

**Mrs Nicky Bastin** [VERY understanding XYL!! /Waste disposal supervisor!!]