

– *W&DRS DF ANTENNA PROJECT 1986* –

SWITCHING-BOX PARTS LIST (Try radio rallies for components. Maplin prices updated August '98)

- 1 Black ABS box 80 × 60 × 40mm — eg Maplin LH20W @ £1.99 ea
- 1 piece 0.1" matrix stripboard (Veroboard) 2.3 × 1.4" min — eg Maplin JP47B @ £1.79 ea
- 1 9v Battery, PP3 or equivalent
- 1 PP3 battery connector — eg Maplin HF28F @ 19p ea
- 3 coaxial TV sockets (surface mounting) — eg Maplin HH08J @ 46p ea
- 3 coaxial TV plugs — eg Maplin HH07H @ 59p ea
- 1 sub-miniature SPST toggle switch — eg Maplin FH00A @ £1.25 ea
- 1 red 2mm test socket — eg Maplin HF47B @ 39p ea
- 1 black 2mm test socket — eg Maplin HF44X @ 39p ea
- 1 14-pin DIL IC socket — eg Maplin BL18U @ 19p ea
- 1 4001UBCP or 4011UBCP CMOS IC† — eg Maplin QL03D @ 39p ea or QL04E @ 66p ea.
- 2 VHF 'PIN' switching diode — try dealers like Birketts at rallies, or ring them on 01522-520767
- 6 6BA × ½" or M3 × 10mm bolt — eg Maplin BF06G @ 55p /10 or JY23A @ 25p /10
- 6 6BA or M3 nut — eg Maplin BF18U @ 25p /10 or JD61R @ 19p /10
- 6 6BA or M3 plain washer — eg Maplin BF22Y @ 22p /10 or JD76H @ 16p /10
- 4 2BA or M5 solder tag (for dipoles) — eg Maplin BF27E @ 35p /10 or LR62S @ 50p /10
- 3 ferrite bead, Mullard FX1115 or similar — eg Maplin LB62S @ 70p /10
- 5 1000pF ceramic capacitors — eg Maplin JL03D @ 16p ea
- 1 0.1µF capacitor — eg WW21X @ 22p ea
- 1 3300pF capacitor — eg Maplin WX74R @ 12p ea
- 1 1MΩ miniature resistor — eg Maplin M1M @ 8p ea
- 1 120kΩ miniature resistor — eg Maplin M120K @ 8p ea
- 2 3.3kΩ miniature resistors — eg Maplin M3K3 @ 8p ea
- 2 double-ended circuit pins — eg Maplin FL23A @ £2.98 /100
- 2 single-ended circuit pins — eg Maplin FL24B @ £2.98 /100 (or just shorten a double-ended pin)
- thin enamelled copper wire (~26swg) for RF chokes — eg Maplin BL29G @ £1.26/50g reel
- insulated hook-up wire, black (or blue) and red.

† Note that the ICs must have UnBuffered outputs; ie a suffix containing UB, eg **CD4001UBE**. Types without a suffix containing the letters UB are generally *not* suitable. The prefix will vary depending on the manufacturer, eg D CD HCF HEF MM etc.. Alternatives to the Maplin types are Farnell part N°s 384-446 (HEF4001UBP) and 384-586 (HEF4011UBP).

1. File the edges of the veroboard down so that it will fit neatly into the middle pair of slots in the box. Carefully file notches in the two top corners of the board, so that the lid will fit snugly.
2. Build the drive circuit as shown on the diagrams. Note that a couple of the copper tracks underneath the IC are deliberately not cut. Note also that the supply connections to the board are via double-ended pins, whereas the two drive outputs, (**op1 & op2**), are via single-ended ones sticking out on the component side. Both types of pin must be carefully pushed through from the copper track side. You can use thick copper wire instead, if pins are unavailable. The copper tracks run left-right on the layout drawing.
3. Apply 9 volts to the two supply pins, (+ve at the top), and quickly measure the direct current drain. It should be zero, even when measured on a 10mA or less range. If any current, other than a tiny initial 'kick' is observed, then disconnect the battery and check.

4. If all is well, then disconnect the battery, and plug in **IC1** with pin 1 towards the top. (The pin 1 end is usually denoted by a small slot, notch, or indentation at or near the end.) You may need to bend the pins together slightly first, by resting one row of pins at a time on the table, and gently bending the body over.
5. Apply 9 volts to the two supply pins, and quickly measure the current drain. It should be about 3 to 4 mA DC; if it is substantially more or less than that, then disconnect the battery and check.
6. If all is well, then measure the direct voltage on each of the two outputs **op1** & **op2** in turn, with the negative meter probe connected to the battery -ve. The reading should be about 4 to 5 volts on each. If the readings are outside this range, or if they differ from each other by more than 0.5 volts, then check. If you have a 'scope, then check that the outputs are squarewaves of about 9 volts p-p.
7. If all is well, then measure the direct voltage (dc volts range) between the two output pins. It should be less than 0.5 volts. Now measure the alternating voltage (ac volts range) between the two output pins. The reading will depend on the type of meter, but it should be roughly 9 volts.
8. If you have a 'scope or frequency meter, then check that the circuit is oscillating at roughly 900Hz. Alternatively, you can connect a crystal earpiece, crystal microphone, or old-fashioned high-impedance headphones, between the battery -ve and each output in turn. You should be able to faintly hear the 900Hz tone.
9. You can now drill out the box as per drawing, and mount the sockets and switches etc.. Wire everything up as per diagram, and note that the mechanical layout drawing is only a rough guide to component positioning, and is not explicit about the wiring. The earthy sides of the 3 coaxial sockets are strapped together with wire, and then linked to the battery -ve terminal pin on the board. Leave wires to the board long enough for the board to be removed from the slot without any unsoldering, (but keep the RF component leads short). This will be very useful should any fault finding or modifications need doing.

PROBLEMS

One or two people have had problems with these 'singing' aerials giving multiple 'nulls', making it virtually impossible to get a decent bearing. If you have problems with your antenna, then here's what to do. First, try out the switching 'black box' on someone else's (working) aerial. If that works OK, then turn your attention to the dipole elements and the coaxial leads.

Keep the coax to the dipole centres as short as possible, and make sure that the two sides are of equal length. Check that the connections inside the coax plugs are sound. For the feed connections to the dipoles, use only BRIGHT ZINC-PLATED screws; self-tapping or *Supadriv* or *Pozidriv* general-purpose types are suitable. Screws with a dullish look to them WILL NOT DO, no matter how much you try and clean them up, and for goodness sake *don't* use brass screws with Aluminium elements! I found that with dull-finish screws, even when a good DC connection was obtained, the antenna still wouldn't work properly. I can only assume that the 'rusty bolt effect' was responsible; ie the joints were acting as crude rectifiers at RF. Finally, do make sure the screws are done up very tight.

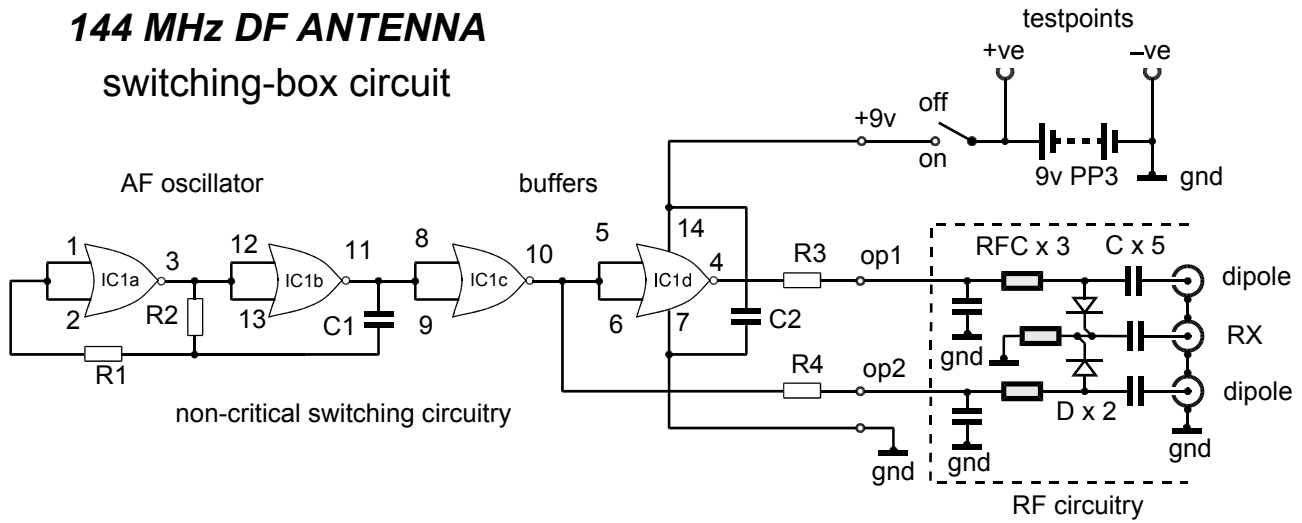
If you have problems or queries, I will be pleased to help you, especially if bribed with a pint!

*Richard Sterry G4BLT March 1986
(last revised 01/07/99)*

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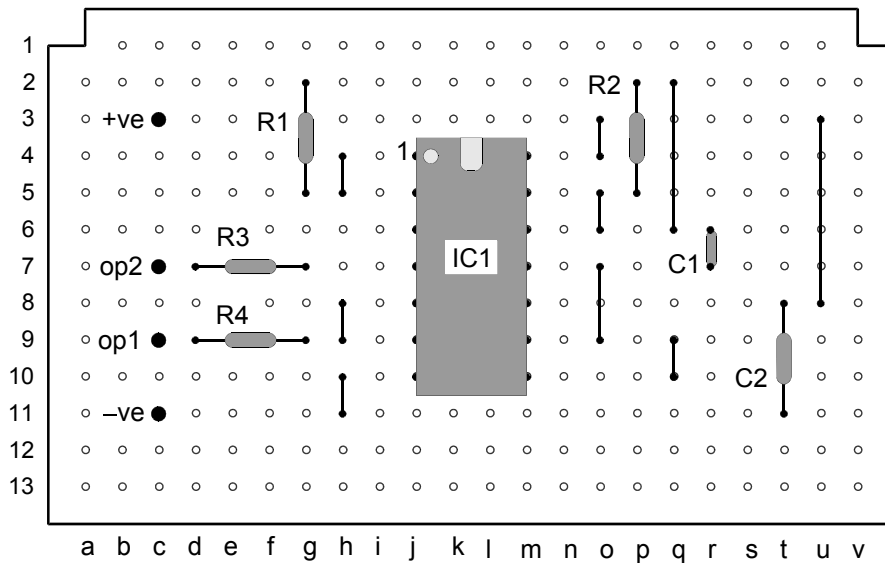
144 MHz DF ANTENNA

switching-box circuit



WARNING – DO NOT TRANSMIT INTO THIS CIRCUIT!

VEROBOARD LAYOUT (component side)



track cuts at:- e7, e9, k4, k5, k7, k9, k10, p6, p8
(tracks run horizontally on underside)

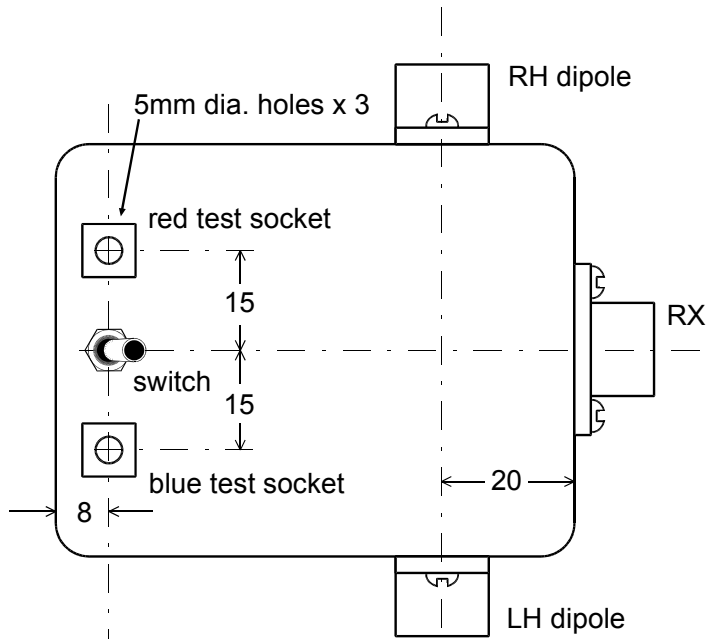
- IC1 4001UB or 4011UB
- RFC 2 turns on Ferrite Bead
- R1 1M Ω R2 120k
- R3 3k3 R4 3k3
- C1 3300pF C2 0.1 μ F
- C x 5 1000pF disc ceramic
- D x 2 VHF PIN diode

- = wire link
- = terminal pin

Drawn by G4BLT	17.01.86
Redrawn	08.06.94
Using Draw on an Acorn A440/1	
Last revised	01.07.99

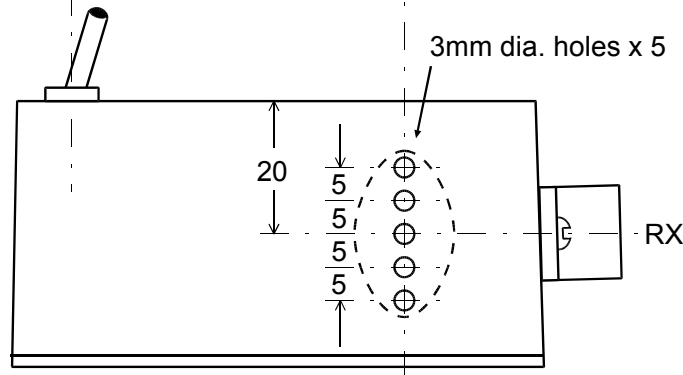
DF ANTENNA SWITCHING BOX

PLAN VIEW

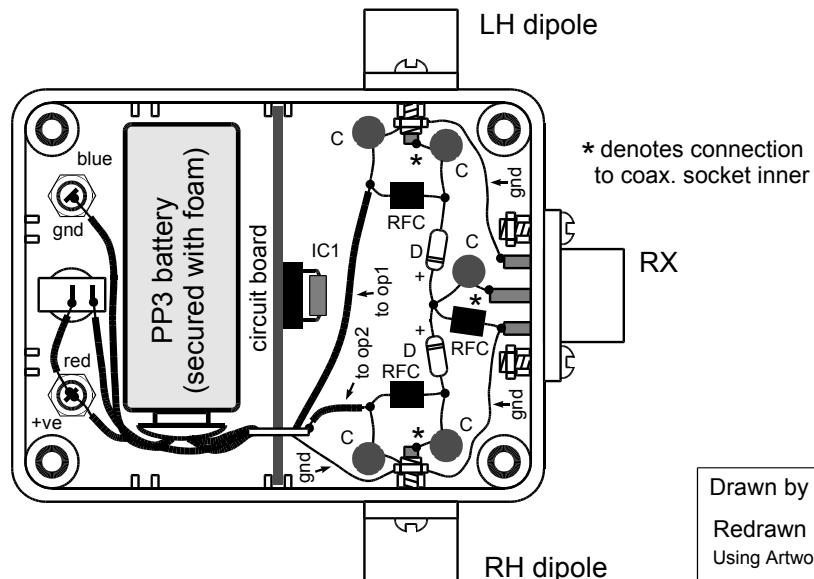


all dimensions are in millimetres

SIDE VIEW

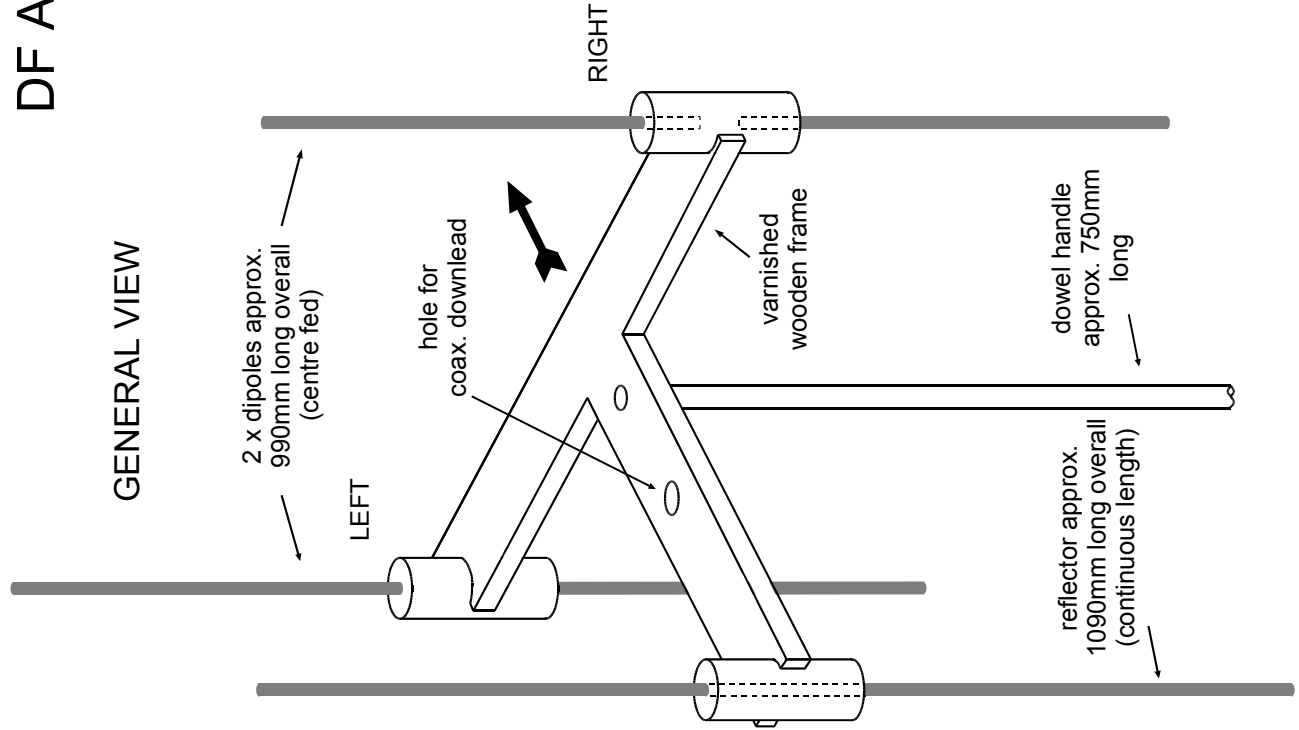
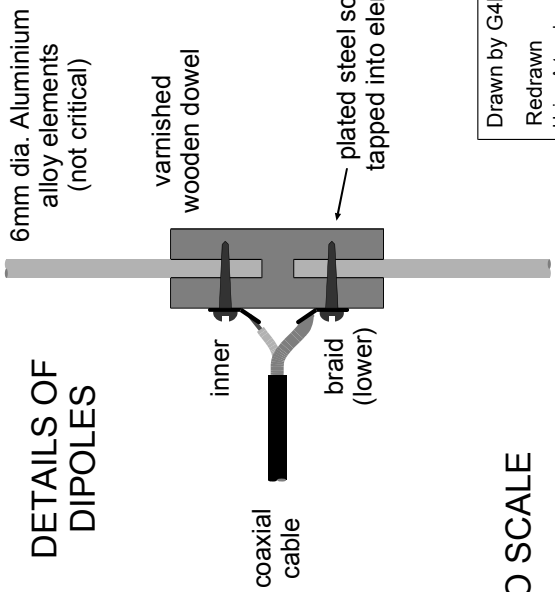
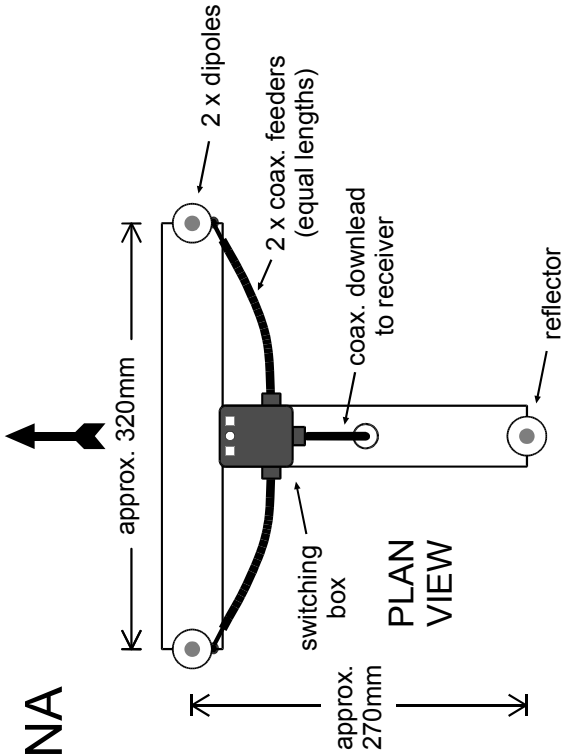


INSIDE VIEW



Drawn by G4BLT 29.01.86
 Redrawn 11.09.95
 Using Artworks on an Acorn A5000

DF ANTENNA



Drawn by G4BLT 14.03.86
 Redrawn 11.09.95
 Using Artworks on an Acorn A5000

NOT TO SCALE

PRACTICAL USE OF THE DF ANTENNA

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PRINCIPLE OF OPERATION

The principle of operation is simple. The switching box switches each dipole to the receiver alternately, at a frequency of roughly 1kHz. If there is no amplitude or phase difference between the signals received from the two dipoles, then the signal will be received normally and the audio modulation (eg voice) will be audible. This will happen when the antenna is 'pointing' directly at the transmitter, (the reflector marks the back end), and also when it is pointing directly away from the transmitter. As the antenna is rotated away from either of these directions, the 1kHz tone will increasingly intrude into the signal modulation, so basically you null out the tone to find the bearing.

The antenna will function perfectly well without the reflector, but it would be impossible to distinguish between the true bearing and one 180 degrees away, without triangulation. The reflector solves this in two ways...

1. The reflector causes the rear null to be noisier than the front; the signal sounds 'scratchier'.

2. The reflector causes the rear null to be shallower and sharper than the front null. Ie, you can't quite null out the tone as well at the back as you can at the front, and when you do null it then the slightest movement causes the tone to be heard faintly. With the front null, you should be able to eliminate the tone entirely, and very slight movements do not cause it to return so noticeably. If you alter the dimensions of the elements, or make other changes, this difference between the front and rear may be less noticeable, or perhaps it might even make it MORE noticeable.

HOW TO TEST IT

Find some nice open uncluttered ground such as a park, field or playing field, and get a friend to use a handheld rig (vertical polarization) a couple of hundred yards away. Keep away from buildings, vehicles (especially ones with antennas on), power lines etc., so you can test the antenna under ideal conditions. When the transmitter is operating, and the DF antenna is switched on, you should hear a loud audio tone on the receiver. Hold the antenna upright away from your body, and as high as you can comfortably. A handheld rig strapped to the broomstick handle is ideal, but it is possible to use a longer feeder connected to a mobile rig.

Slowly rotate the antenna, and you should clearly find the front and rear nulls. Note that when the antenna is nulled, you can hear the transmitted audio, but not otherwise - the tone drowns it out. Walk around a bit, and get your friend to walk around a bit, and check you can find the nulls easily each time. You can 'sight' between the bottom of the reflector and the handle. If it doesn't line up with the transmitter perfectly, you can bend the lower half of the reflector slightly until it does.

Assuming the antenna works ok under ideal conditions, try it at greater range, amongst buildings, near power lines, etc.. You will find that you cannot always get a clear bearing. When this happens, move a few yards and try again until you do get a clear bearing. Sight to some obvious landmark as far away as possible, such as a distant tree, pylon, church tower, whatever. You can then take a

compass bearing on that landmark afterwards. If you get a slightly different bearing each time, depending on where you stand, take the mental 'average' direction of several sightings - this works well. However, if the signal path is very obstructed then the bearing may not be clear, or else it could be inaccurate. This is not the antenna's fault, so choose good open places to take bearings, and if the bearing points over a hill then bear in mind that you might be wise to try again at the top of the hill, or just over the other side.

ACCURACY

If you have built it well, and practice a little to get the hang of it, and you can use a compass properly (don't forget to compensate for magnetic North), this antenna is capable of taking bearings consistently to an accuracy of 5 degrees or better, but subject to the above caveats. The accuracy does not diminish as you get closer to the transmitter, and good bearings can be taken tens of yards away, but if the 'fox' is amongst buildings etc. then reflections can make the bearings confusing; again, this isn't the fault of the antenna.

TIPS

Ideally, two triangulation bearings should cross at right angles. If the bearings cross at a very shallow angle, then only a few degrees error in each bearing will move the intersection point a long way; several miles possibly. Therefore, when this happens, move closer into the right general area, and then start taking bearings afresh. The closer you are to the fox, and the nearer the intersection angle is to 90 degrees, the more accurate you will be.

In my experience of 2m foxhunting, participants (the 'hounds') usually make one or both of two basic mistakes:

1. They try and use a vague or ambiguous bearing, instead of moving a few yards and trying again. A bad bearing can be worse than no bearing at all.
2. They ignore what the antenna is telling them, and start to use 'psyschology', ie making assumptions about where the 'fox' would go. The time to do this is when you are really close; when you can really 'smell' the fox!

Enjoy!

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