Build a 2M Halo

By Barry Miller, VK3TBM

A few months ago the Editor whined in print that he couldn't find a good, simple, sensible design for a Halo antenna for 2M SSB work. Quick as a flash, an E-mail mysteriously appeared from Barry. Look no more, he cried, for here it is. So... here it is! Thanks Barry. I'm building mine now...

About three years ago I became interested in using 2M SSB while mobile. I tried a couple of antenna types before settling on the one I am about to describe. The design is cheap and easy to reproduce, and I have been using it successfully since July 1997. I had noticed (in Melbourne, at least) a few new callsigns trying 2M SSB while mobile, but always into a vertical antenna. They were trying SSB because they had recently bought an Icom IC-706 (lucky souls). They needed halos!

If you think that there isn't much of a difference between using a vertical ¼λ (quarter-wavelength) or ⅝λ whip, and a horizontal ½λ halo while mobile, then have another think. *All* of the stations you are likely to work down at the bottom end of the band are horizontally polarised. And this is the beauty of a halo. It is a horizontally-polarised omnidirectional mobile antenna...

Until recently I had never tried working 2M SSB mobile using a vertical to a horizontally-polarised station. This year I did, over a relatively short path of about 60km. This same path with the halo resulted in S9 plus 40 signals; using a ⅝λ whip, signals were almost non-existent. Yes, it makes *that* much difference...

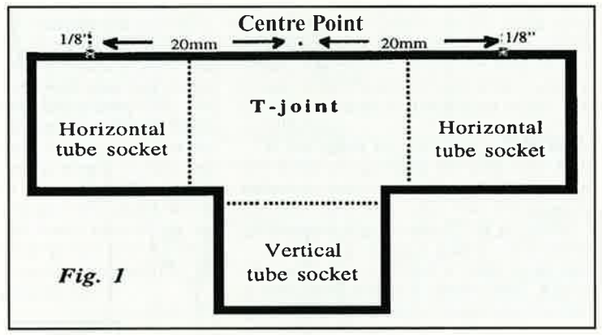


Fig. 1

Parts List

The following are the ingredients you'll need to make an exact copy of this antenna:
990mm of 6.35mm aluminium tubing
1.3m of 15mm Class18 UPVC tubing
two 6mm stainless steel hose clamps
two 25mm long 1/8-inch stainless steel bolts, with nuts
three 15mm UPVC T-joins
one 15mm UPVC end cap
two spade lugs
4m RG58 coax cable
A connector of your choice
1m of 16mm fibreglass rod or 15mm aluminium tubing
UPVC solvent

You'll also need the following tools:
1/8-inch drill bit
Drill
Hacksaw
Small bastard file
Measuring tape
Marker pen
G-clamp, large pliers or multigrips
Small screwdriver
Small needle-nose pliers
Knife (not too sharp!)
Cutters
Soldering iron
Electrical tape, or cable ties
Sealing compound (Silastic, or similar)
10 or 4 litre empty paint tin, or a metal bucket

There isn't a lot of information about halos in the theory books; the RSGB VHF/UHF Manual has a brief mention of the basics, and leaves the rest to you. This design is the result of mixing some of what is contained in that book, with a few suggestions from other amateurs. I have built four of these beasts so far, with all of them working first time.

A halo is a ½λ dipole in the shape of a circle. When this ring is held horizontally polarised, ie parallel to the ground, it has an almost perfect omnidirectional radiation pattern.

Don't become concerned about the paint tin — it's a tool, not a part of the completed antenna!

First, prepare the dipole. If your aluminium isn't already 990mm long, cut it so that it is. Clean up the ends with the file. Using the marker pen, mark the centre of the dipole (this point should be 445mm from one end... from the other end as well, come to think of it!). Also mark the two feeder connect points. These are 175mm either side of the centre point.

Next take the paint tin. We use this as a 'former' around which we will bend the aluminium. Using the G-clamp (or the large pliers or multigrips), clamp one end near the mouth of the tin. Now wrap the aluminium around the tin, to form a circle. Don't worry if there is some overlap; the tube has some natural springiness, and will initially resist being forced into a tight circle. Besides, the halo will 'stretch' into its correct shape when it is on the support frame.

Now for the support frame. Take the UPVC tubing and cut two pieces, each 130mm long; these are the 'arms'. The remainder of the tube is the upright mast. Take the mast section and, using the solvent, glue it into the vertical tube socket of one of the T-joints. Also glue the two arms into the two horizontal tube sockets, in the same T-joint. See **Figure 1**.

With that done, take the two remaining T-joints. These need to be glued onto the end of the two arms, with the arms fitting into the vertical tube sockets of each joint. Note that the horizontal tube sockets need to be parallel to the ground, when the mast is held vertical. See **Figure 2**.

To add strength to the mast, slide the fibreglass rod or 15mm aluminium tube up into the mast tube. Seal it inside by gluing the UPVC end-cap in place. Drill a small hole in the end-cap, for drainage should water get into the mast. If you can get it, fibreglass is probably the better reinforcing

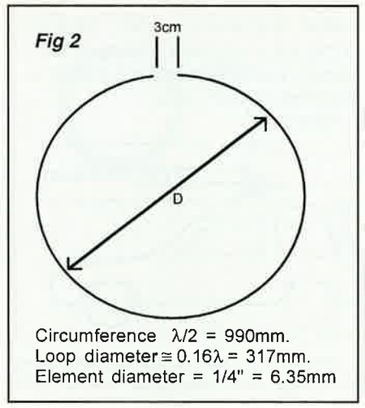


Fig 2

Circumference λ/2 = 990mm.
Loop diameter ≅ 0.16λ = 317mm.
Element diameter = 1/4" = 6.35mm

option. It won't affect nearby vertical antennas, and is far less likely to deform permanently if you hit a low branch while out in the bush. Once this is done, allow all glued joints to cure.

While waiting for the glue, you can make the connecting cable assembly. After trying other methods (the RSGB VHF/UHF Manual suggests a Gamma Match), none of which worked, I tried the Delta Match (See **Figure 3**). Bingo-deluxe!

Start by cutting a length of coax 1196mm long; this will be the 4:1 balun. Remove 265mm of the outer sheath from each end. Then remove 255mm of the braid from each end. With the knife, *carefully* remove a 10mm section of the inner dielectric, 5mm out from the braid, on one of the feeder arms. Try to avoid removing either of your thumbs at the same time; these will be needed later! Also remove 5mm of inner dielectric from both ends of the coax. Be careful not to nick the inner conductor. See **Figure 4a** for dimensions.

Take the remainder of the coax and attach the connector to one end. At the other end, remove 25mm of the outer sheath, then 15mm of braid. Finally remove 10mm of the inner dielectric.

Tin the braids of the feedline and the balun. Fold the balun so that the two braids rest next to each other, and solder them together. Also solder the braid of the feed line to the braids of the balun. See **Figure 4b**.

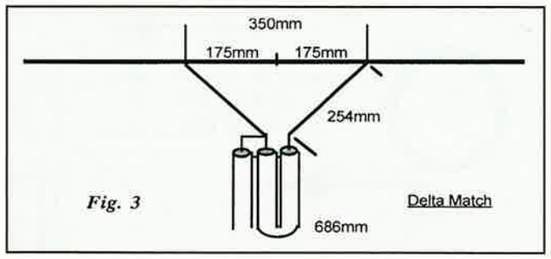


Fig. 3

Twist the inner conductor of the feed line with the conductor exposed near the braid of the balun. Again, see Figure 4b. Solder this joint. Solder the two spade lugs on the ends of the two feeder arms.

Next, prepare the holes for the dipole retaining bolts. Take the mast assembly. On one of the T-joints at the end of the arms find and mark the centre point of the top of the T. (See Figure 1 again.) Measure 20mm either side of the centre, and mark these two points. At these two points, drill ⅛-inch (3.175mm) holes.

Place the halo dipole on a flat surface. Measure and mark 5mm in from the two ends of the dipole. At these points, you need to drill ⅛-inch holes through the element. These holes need to pass through the element *parallel* to the flat surface that the dipole is resting on. See **Figure 5**.

Take the dipole and feed one end of it through the spreader arm/T-joint without the retaining bolt holes. Roughly line up the centre mark on the dipole with the centre of that T-joint. Once in place, slip the two 6mm hose clamps over the ends of the dipole (one each side), and temporarily tighten them at the marked feed connection points.

Place the two dipole ends inside the drilled T-joint. Push a ⅛-inch bolt through each T-joint hole, then through each dipole hole, and then on with the nuts. I suggest using two ⅛-inch flat washers; one between the bolt head and the T-joint, and one between the dipole and the nut. Tighten up the nuts. If available use *Loctite* or some similar thread adhesive to stop the nuts working loose. You may need to cut the bolts in half so that they fit inside the T-joint. An alternative is to drill the hole in the T-joint through both sides, so that the bolt passes through the opposite T-joint wall. Or you could go to the trouble of hunting down ⅛-inch by 12mm bolts...

Loosen the hose clamps enough to allow you to slide the spade lugs between the clamps and the dipole. If available, smear conductivity paste between the lug and the element. Retighten the clamps with the lugs at the marked connection points.

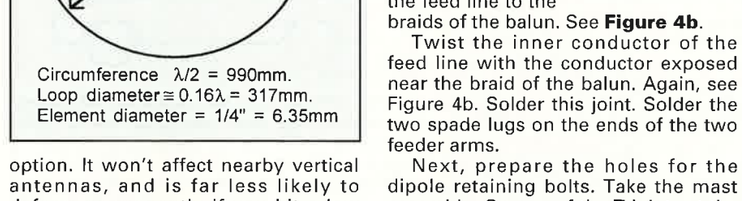


Fig. 4a Balun and Feeder Arms

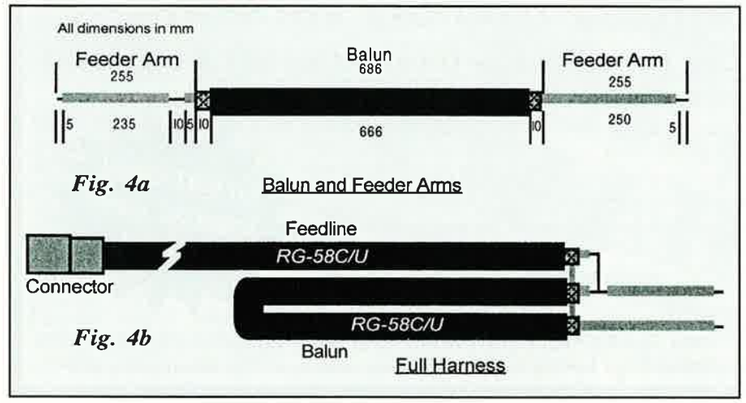


Fig. 4b Full Harness

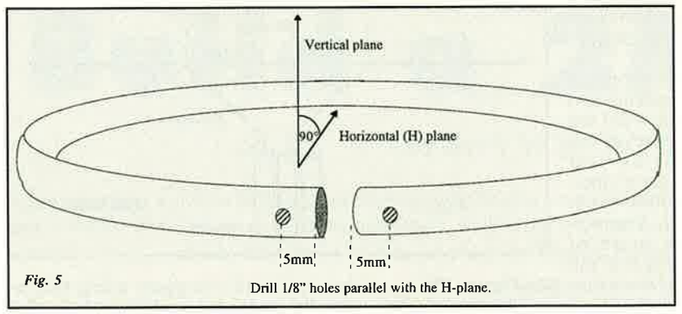


Fig. 5 Drill 1/8" holes parallel with the H-plane.

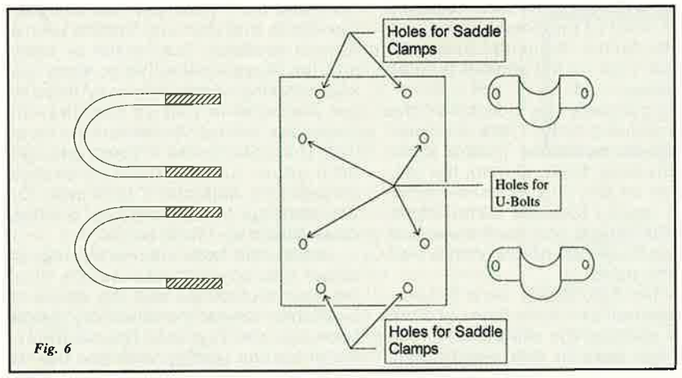
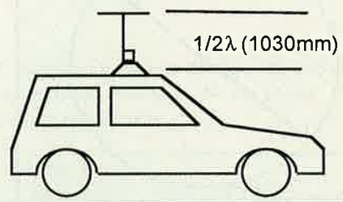


Fig. 6

Antenna is centrally mounted 1030mm above the car roof, on a roof rack bar. Connection to radio is via a 3 metre length of RG-58C/U coax.



The halo is now basically finished. All that remains is to test it (and make any necessary adjustments). To do this the halo should be mounted over the car. I have mine mounted as high and as central as I can, using a roof rack bar. A basic bracket can be made from 4mm aluminium plate, 20mm plumbers saddle clamps, and two suitably sized U-bolts. This is up to you, but **Figure 6** is a suggestion.

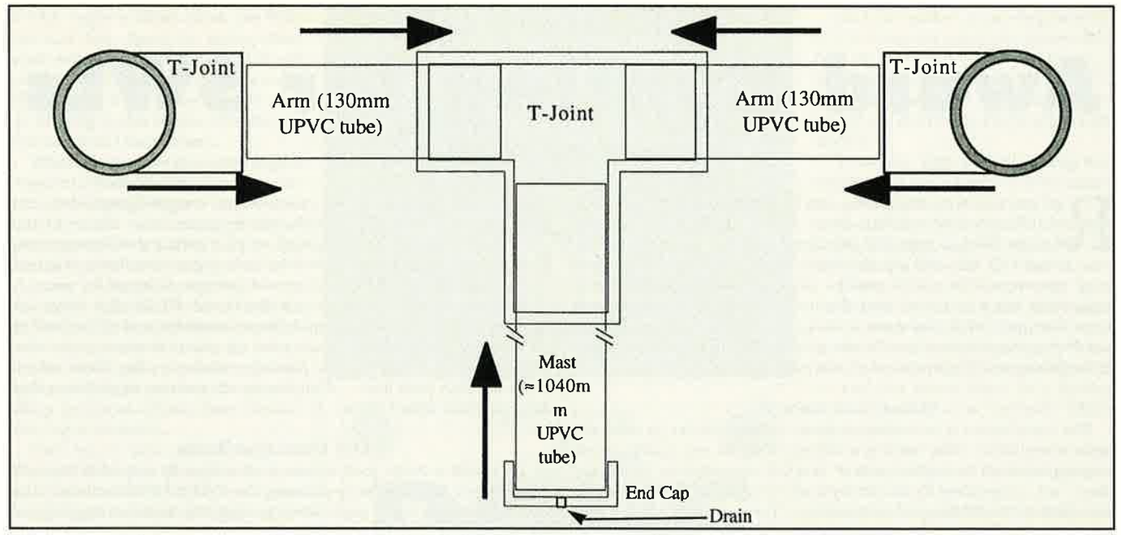
With the halo mounted on the vehicle, connect it via a VSWR meter to your 2m radio. The reading should be better than 1.5:1. Shifting the feeder connection points towards or away from the dipole centre-point will allow you to improve the match if you feel it necessary. Make sure the changes to one side of the dipole are exactly mirrored on the other side. For example, don't make one side 175mm from the centre, and the other side 185mm. And, when tuning up, use an SWR Analyser or a CW carrier, away from the calling frequencies. *Please, no FM on 144.1MHz!!*

When you are happy that all is working correctly, tape or cable-tie the coax and balun to the halo mast or run it down inside the mast itself. Waterproof all the exposed coax joints with silicone, or you could try something I found in a marine shop. It's an American product called *MDR-740 Liquid Lectric Tape*. It is a water-based vinyl sealant which is painted on and allowed to dry. Several layers can be built up for extra durability. It is designed for use in waterproofing electrical connections on boats.

All that remains now is for you to get out there, go mobile, and *use* the thing! Don't worry about the curious stares you might receive. From experience, only about half of people notice the antenna when I'm driving. Sure, so 25 per cent of them run off the road immediately afterwards (actually, that's a complete lie); but some onlookers actually enquire what it is. Good grief, you may even arouse some interest in this hobby of ours! Have fun!

References

1) The RSGB VHF/UHF Manual, by G R Jessop, G6JP. 4th Edition, 1990.
2) Beam Antenna Handbook, by Bill Orr, W6SAI, and Stuart Cowan, W2LX. 2nd Edition, 1990.
3) All About VHF Radio, by Bill Orr, W6SAI. 1st Edition, 1988.



Tables

Freq. (MHz)	144.0	144.15	145	146	148
V.S.W.R.	1.1:1	1.1:1	1.1:1	1.2:1	1.4:1

Mk1 (1/4 λ above car roof)

Date	Time	Call	Pwr	RS	QTH 1	QTH 2	Path
13/6/97	1900	VK3TMP	2.5w	5x1-9	Box Hill>Shelford	Somerville	107km
13/6/97	2030	VK3XPD	2.5w	5x1	Shelford	Burwood	100km
15/6/97	1630	VK3ZQB	2.5w	5x40+	Hawkesdale>W'bool	Port Fairy	32km
28/6/97	1700	VK3TMP	20w	5x3	Newborough	Somerville	97km
20/7/97	0904	VK3AFW	20w	40+-1	B' Marsh-Bungaree	Oakleigh	105km
22/7/97	0802	VK3AFW	20w	5x3	Yallourn	Oakleigh	105km
22/7/97	1745	VK3TMP	20w	5x9+	Bunyip	Somerville	50km
25/7/97	2045	VK3TMP	20w	5x9+	Wandong	Somerville	95

Mk2 (1/2 λ above car roof)

Date	Time	Call	Pwr	RS	QTH 1	QTH 2	Path
30/7/97	0820	VK3AFW	20w	5x9	Glenroy>Kalkallo	Oakleigh	42km
30/7/97	0820	VK3AUU	20w	5x3	Glenroy>Broadford	Drouin	125km
30/7/97	0820	VK3TMP	20w	5x9	Craigieburn	Somerville	70km
30/7/97	1220	VK3AUU	20w	5x3	10km north of Seymour.	Drouin	145km
31/7/97	0820	VK3TMP	20w	5x6	Myrniong	Somerville	100km
31/7/97	0823	VK3AFW	20w	5x9	Myrniong>8km SE of Creswick	Oakleigh	110km
31/7/97	0907	VK3AUU	20w	5x1	2km S Clunes.	Drouin	200km
31/7/97	1030	VK3AUU	20w	5x3	Maryborough RT	Drouin	220km

Mk2 (1/2 λ above car roof)

Date	Time	Call	Pwr	RS	QTH 1	QTH 2	Path
22/2/98	2140	VK3CY	20w	5x2	Heidelberg	Wedderburn	200km
22/2/98	2140	VK3TMP	20w	5x9	Heidelberg	Somerville	55km
22/2/98	2210	VK3DEM	20w	5x3	Yan Yean (30km N of Melbourne)	Bairnsdale	225km
22/2/98	2210	VK5NY	20w	5x5-9+	Yan Yean (30km N of Melbourne)	McLarenvale, SA	650km
22/2/98	2300	VK5NY	20w	5x1	Seymour	McLarenvale, SA	650ish km
22/2/98	2330	VK5NY	20w	5x1	10km south of Shepparton	McLarenvale, SA	650ish km
22/2/98	2358	VK5AKK	20w	5x1-2	Shepparton	Adelaide, SA	620km
23/2/98	0152	VK2TWR	20w	4x1-5x3	Mt Gwynne, NSW QF24we	Nimmitabel, NSW	310km
23/2/98	0152	VK3AJN	20w	5x9	Mt Gwynne, NSW QF24we	Wangaratta	50ish km
23/2/98	0152	VK3BMY	20w	5x60/9	Mt Gwynne, NSW QF24we	Numurkah	48km