The Hentenna Antenna

David Butler G4ASR looks into the strange workings of the Hentenna from Japan, and provides dimensions for h.f. to v.h.f. versions.

The 144MHz Hentenna at the location of WA0ITP

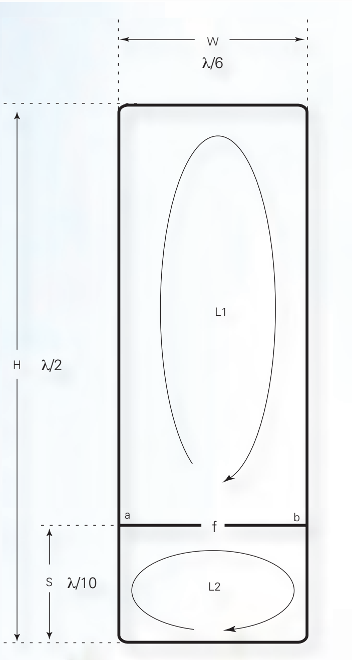

Fig. 1: The layout of the Hentenna consists of two loops, one radiating and one matching.

The antenna I'm describing this time around came from a chance conversation that I had with the station of **Francesco Messineo IZ8DWF**. Frank is very active on the 70MHz band and during one of our QSOs he told me that, when he's active from his holiday home in Sardinia (IS0), he uses a Hentenna antenna. Frank said that the Hentenna was very simple to make and gave some great results. Subsequently, during the summer of 2008, I went on to make five c.w. and s.s.b. contacts with the station of IS0/IZ8DWF.

The 70MHz signals from Sardinia, after travelling around 1700km, were always at very good strength. I found this surprising, as Frank was only running 8W output during many of these contacts. Later in the summer he increased his power to 20W into the antenna and was successful in exchanging signal reports with the station of OY3JE (Faroe Islands) over a 2760km path. So obviously the antenna works! Although I'd heard about the Hentenna previously* I really didn't know much about it and these QSOs prompted me into investigating the antenna a little further.

(* Antenna Workshop *by Peter Dodd G3LDO in June 2004's edition of* PW. Ed.)

Hentenna Characteristics

The Hentenna is quite an old design having been originally developed in the 1970s by a group of Japanese Radio Amateurs that included **JE1DEU**, **JH1FCZ** and **JH1YST**. They eventually got the antenna to work with some good characteristics but the team couldn't explain why it performed so well or indeed how it actually worked! So they called it a Hentenna, because 'Hen' means strange in Japanese (e.g. *Hen na hito*, a strange person).

No antenna does everything well but this design has a number of useful features:

- It possesses a modest but useful gain of about 3dBd, equivalent to a 2-element Yagi and has a wide v.s.w.r. bandwidth. It also produces a low-angle of radiation, quite useful if you want to build an h.f. version.
- It has wide front and rear lobes of around 88° beamwidth (between -3dB points), which are particularly useful for general v.h.f. operation.
- It is easily adjusted to provide a low v.s.w.r. and can connect directly to a 50Ω feed line.
- It is very lightweight especially if it is made from thin aluminium tubing and wire. A 50MHz version for example can weigh less than 500g and be supported on a lightweight mast.
- The v.h.f. versions for 50, 70 and 144MHz can easily be turned with a very small rotator. Indeed as it only needs to be turned through a maximum of 90°, a rotator may not really be necessary.
- No special parts are required and you can use any electrical conductor for making the main rectangle.
- It is a simple design that is inexpensive and easy to build with minimal tools and skills.

Design

Take a look at the layout of the Hentenna as shown in the diagram, **Fig. 1**. It consists of a radiating loop L1 and a matching section L2. The feeder cable is attached at point 'f'' and adjustment made at points 'a' and 'b' to minimise the v.s.w.r. measurement. Theoretically as point 'f' is balanced a 1:1 balun (balanced - unbalanced transformer) should be inserted at this point but in practice this is often unnecessary.

Coaxial cable of 50 or 75Ω impedance may be directly connected to point 'f'. When you look at that diagram you would think that the antenna is vertically polarised but it is in fact horizontally polarised. That is one of the reasons why this antenna is 'hen'!

The Dimensions

The Hentenna has three important dimensions and these are H: its height, W: its width and S: the matching point distance. The formulas for W, H and S are generally applicable on bands all the way from 3.5MHz right through to 430MHz and beyond.

W = 1/6th wavelength (λ/6)
H = 1/2 wavelength (λ/2)
S = 1/10th wavelength (λ/10)

As an example I'll describe how to work out the dimensions for a Hentenna centered on a frequency of 50.200MHz.

- First calculate the wavelength by dividing 300 by the Frequency (in MHz). 300/50.2 = 5.976m (One full freespace wavelength).
- The width (W) is calculated by dividing the wavelength by six: 5.976/6 = 0.946m (946mm).
- The height (H) is calculated by dividing the wavelength by two: 5.976/2 = 2.988m (2988mm).
- Point (S) is calculated by dividing the wavelength by ten: 5.976/10 = 0.597m (597mm).

These calculations will put you very much in the ball park but if you want more accuracy an on-line calculator for the Hentenna (and the Moxon loop antenna) can be found at **http://www.i1wqrlinkradio.com/antype/ch13/chiave1846.htm**

The calculations, correlated well with the computer model created with *NEC* antenna modelling software, a program that allows you to enter the size of material you are using for the antenna and to see its effect. Simply enter the design frequency (MHz) and the wire diameter, in millimetres, and the program will then display the required dimensions.

I've provided dimensions for wire loop Hentennas on a variety of h.f. and v.h.f. bands in **Table 1**, but it may be better to use the on-line calculator especially if you are considering constructing versions for the 50, 70 and 144MHz bands.

The Construction

As the Hentenna may be constructed for any frequency from h.f. through to u.h.f. the choice of materials is largely dependent on the band that you are building it for. If you're going to construct a large h.f. version you should use heavy-gauge wire to form the loops. The four corners will need to be supported by two suitably placed masts or even trees. If you use the latter it may be prudent to use elasticated bungee cords for the corner supports to minimise flexing in the wind.

Versions of the antenna for bands between 14 to 28MHz are not very wide and you could use bean poles or other insulating material to support the horizontal parts of the wire loop. Alligator clips or electrical 'choc-blocks' may be arranged, as shown in the photograph **Fig. 2**, to provide a moveable connection whilst carrying out v.s.w.r. adjustment.

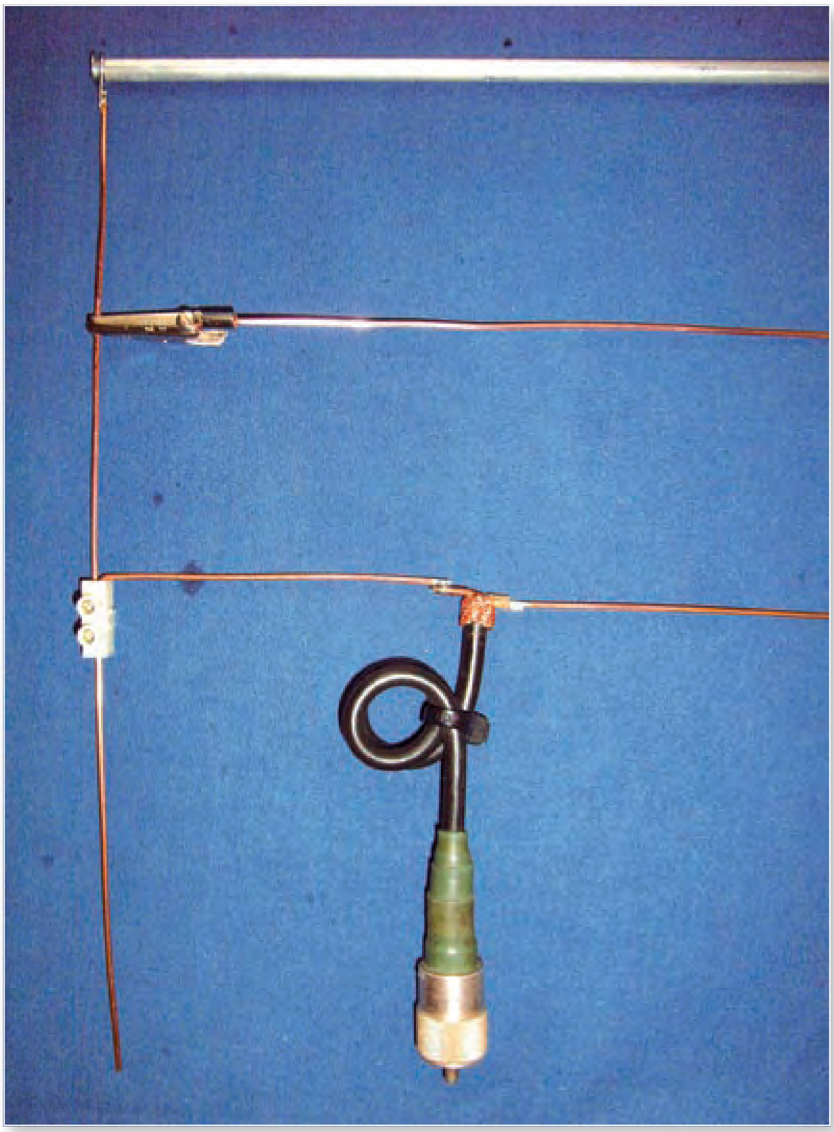

Fig. 2: Electrical connectors, known as 'choc-block' or crocodile clips are a good way of making temporarily adjustable connections.

A version of the Hentenna for the 50MHz band, at 3m high, is quite tall and here you could use a combination of horizontal aluminium tubing and vertical wire conductors. One method of connecting the wire to the tubing would be to use a self-tapping screws to clamp the cable into the ends of the aluminium tubing. **But be sure to waterproof the various joints afterwards.**

For 70MHz, the Hentenna can be made from 10mm (or thereabouts) aluminium tubing, as shown in the photograph **Fig. 3**. This is the antenna constructed by Frank IZ8DWF for use with great effect from his Sardinian holiday home. It is made from lengths of tubing simply bolted together and supported on an insulated mast section made from plastic water pipe. Simple but very effective!

Versions for the 144 and 430MHz bands may conveniently be made from 12mm (1/2") diameter copper water central heating pipe as this will make the Hentenna far more rugged. But be careful to mount the Hentenna on an insulated mast.

You could construct two Hentannas on the same

Fig. 3: The Hentenna, constructed by Frank IZ8DWF

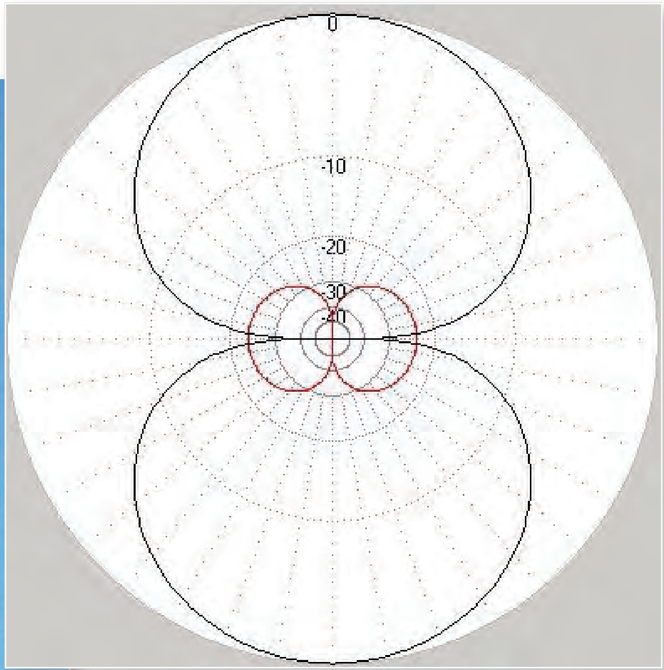

Fig. 4: The polar plot in the horizontal plane shows good wide lobes, needing little in the way of a rotator

supporting structure but mounted at 90° to each other. After individually setting the v.s.w.r. you then phase them together with a quarter-wavelength of 75Ω cable to produce an omni-direction, horizontally polarised antenna with 3dBd gain in all directions.

Finally, don't forget the strange property of the Hentenna – that a vertically shaped Hentenna produces horizontal polarisation! If you require vertical polarisation then simply mount the Hentenna so that the longest dimension is horizontal.

Adjustment

Let's now look at adjustment of the Hentenna. Temporarily connect a v.s.w.r. meter to the feed-point connector and then attach your 50Ω feed-line to the other side of the v.s.w.r. meter back to the transceiver. The dimensions given should produce a v.s.w.r. of 1.5:1 or less but you will have to adjust the tapping point S, if the v.s.w.r. is unacceptable.

Moving the tapping points to a value longer than S moves the matching frequency up and conversely, a shorter tapping point than S, moves the matching frequency down. If you are using alligator clips for adjustment you should make a permanent connection afterwards by soldering them to the loop.

That's all there is to it. Now get building! ●

Table 1: Some Hentenna dimensions for h.f. to v.h.f.

Band (m)	**80m**	**40m**	**30m**	**20m**	**17m**	**15m**	**12m**	**10m**	**6m**	**4m**	**2m**
Freq. (MHz)	**3.550**	**7.050**	**10.10**	**14.20**	**18.15**	**21.25**	**24.95**	**28.50**	**50.20**	**70.20**	**144.2**
Wavelength (m)	84.51	42.55	29.70	21.13	16.53	14.12	12.02	10.53	5.976	4.269	2.083
Height: H (mm)	44250	21280	14850	10560	8260	7060	6010	5260	2988	2070	1040
Width : W (mm)	14080	7090	4950	3520	2750	2350	2000	1750	950	700	350
Position of Loop separator : S (mm)	8450	4260	2970	2110	1650	1410	1200	1050	597	395	210