Antenna Workshop

The SLINKY-HULA

John Heys G3BDQ creeps out of his local toy shop, feeling a right 'charlie', as he describes his latest compact experimental indoor antenna made up from two toys!

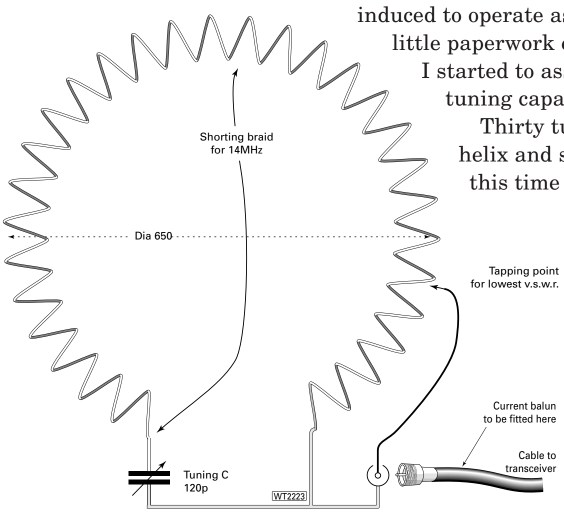
The November 2001 issue of *PW* had an article showing how to use the metal Slinky toys as antenna elements ... so allowing standard designs such as dipoles or ground planes to be greatly reduced in size. The Slinky is a helix made from a rust-free metal which has 87 complete turns each with a diameter of 69.5mm. Each turn therefore is about 218mm long if straightened.

Being blessed with more than a little natural curiosity I wondered if a loop of manageable diameter and made with Slinky turns could be induced to operate as a magnetic antenna. A little paperwork exercise followed and then I started to assemble the loop and its tuning capacitor.

Thirty turns were cut from the helix and slipped over the other toy, this time a plastic Hula Hoop. The turns were held in position with several nylon cable ties. I can now admit that I did feel a bit of a 'charlie' as I carried the bright green hoop from the town centre store to the car park, but it was all in the cause of science!

The hoop itself, was cut and its end pulled together to overlap, so making a 650mm (25.5in) diameter circle which could then be screwed down to a timber base (see photos). A vertical wooden strut was added to give the structure rigidity.

● Fig 1: The Slinky-Hula is a tuned, air/plastic cored, toroidal antenna with a remarkably wide band when tuned and matched.



Assembled Loop

The assembled loop had a measured inductance of 7µH which would resonate on 7MHz when tuned with about 75pF. I selected a suitable variable capacitor having a maximum capacitance of around 120pF with wide vane spacing, which came from a Second World War surplus item (an American tuner unit).

I later discovered that a capacitor, with such wide spacing was not needed, for unlike magnetic loops the antenna does not have a very high *Q*. Some ideal variables are those which were used in the ex RAF 1153 aircraft transmitters which still appear in junk sales and on the surplus market.

The circuit for the antenna is shown in **Fig. 1**. All the wiring was made with flattened copper screening from odd lengths of coaxial cable found in the 'odd bits' box. An output socket connects to a short length of 50Ω coaxial cable which terminates in a crocodile (croc) clip. This wire was a temporary expedient to be replaced later, with a soldered connection, when the correct tapping point has been found.

In Fig. 1 the coaxial cable which leads via an s.w.r. meter to the transceiver is shown with a current balun close to the antenna. I personally like using the 'clamp-on' ferrite stoppers as they are so easy to place and remove. (Other current baluns which prevent r.f. currents running back to the transceiver on the outer surface of the coaxial cable shield can be used instead of the 'clamp ons').

High Resistance

The metal used for the manufacture of the Slinky toys has a higher ohmic resistance than copper, but the 30 turns used for this antenna, which have a collective length of approximately 6.4m, show a d.c. resistance of 1.2Ω.

Being blessed with more than a little natural curiosity I wondered if a loop of manageable diameter and made with Slinky turns could be induced to operate as a magnetic antenna

Antenna

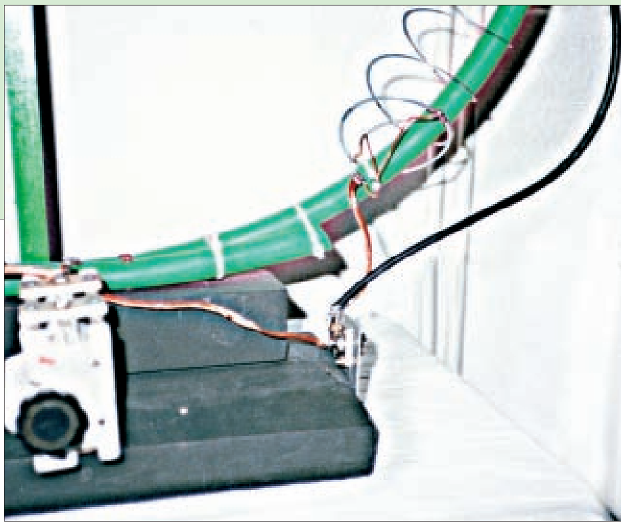


Fig. 2: A close-up shot of the connection point, no earthing is needed for this antenna (see text for details).

An s.w.r. meter set to its lowest power range and the station transceiver adjusted to low power and switched to 7MHz are the first steps in setting up. The output coaxial cable which connects to the helix (initially by croc clip) should be connected about six turns from the end of the helix winding.

The antenna should be positioned on a non-metallic surface within reach, **Fig. 2**, so that it can be tuned, Fig. 2, whilst keying the carrier and simultaneously watching the s.w.r. meter. A 'Slinky-Hula' made as described will work on the 7MHz band and adjusting the tuning capacitor 'C' will show, at resonance, a fall in the s.w.r. reading.

If unity s.w.r. is not found, the tap of the helix can be moved to discover the ideal setting. I connect a tiny neon lamp as is used in power sockets and plug to a position close to 'hot' end of the helix by the tuning capacitor.

When using between 50 and 100W of power, this lamp gives a good indication of correct tuning (especially when the antenna is located well away from the operating position).

The Slinky-Hula design is unusual in that unlike magnetic loops which use a very thick tube as the single turn coil, it does not have very high r.f. voltages across its tuning capacitor. Even more surprising is the really enormous bandwidth of the antenna. Magnetic loops must be re-tuned every time you change your frequency of operation, even with just a few kilohertz of frequency change.

Broadband Characteristic

The Slinky-Hula on the other hand exhibits a very broadband characteristic. When tuned up for the minimum s.w.r. on 7.05MHz there is no need to retune on any frequency over the band. My version gives an s.w.r. between unity and 1.2:1 right across the 7MHz band.

When using the dimensions described the antenna will also tune 10MHz and when set-up at mid-band, will allow operation over the whole band without re-tuning. On 10MHz the tap point for the output coaxial cable may require some slight adjustment.

To allow working on 14MHz I made up a shorting wire from coaxial cable braid with croc clips at each end. This, when connected from the 'hot' end of the helix and the tap centre point of the loop allowed operation on 'twenty'.

On the 14MHz band the bandwidth (with an s.w.r. of 1.2:1 or better) is an amazing 250kHz. Should a Slinky-Hula be planned for the 18 and 21MHz and higher bands, I'd suggest that a loop using fewer coil turns but having the same loop diameter be used. It will be noticed in Fig. 1 that the antenna has no earth connection.

The fact that the antenna is not earthed is important, for earthing was tried, but then I found the antenna became almost impossible to tune up. The only earth connection should be at the transceiver. I then discovered that once the correct tap point on the helix is found, it remained as best on the other bands.

I tried positioning the antenna either on the upstairs landing close to a window which looked southeast or instead in the 'spare' room which has a large double glazed 'picture' window looking northwest. This window was found to be best for working up country on 7MHz to UK stations (my QTH is on the southeast coast near Hastings).

Many European

When the antenna was on a small table on the landing many European and more distant stations were easily worked on 14MHz. Magnetic loops are quite directional and have deep nulls in two directions, but the Slinky-Hula may be rotated or even laid horizontally with little or no effect upon signal strengths.

Much of the radiation does seem to be mainly mid and high angle, but even so, some stations outside Europe have been contacted. To date, my best DX has been a QSO with **VU3BKY** in Bombay on 14MHz c.w. one afternoon.

Working all over Europe has been possible on 14MHz on s.s.b. and c.w. and with 100W power reports usually lie between S6 and S9. On 7MHz (40m) I have had many c.w. and a few s.s.b. contacts with stations over the UK and into Europe. I have also had no problems in working stations when using 10MHz.

In the autumn of 2002 I, along with others, obtained an Notice of Variation (NOV), which allowed operation on five spot frequencies around 5MHz. I found that my adding an extra 50pF capacity (from an outboard variable) I could tune the antenna to that band with **G3YFN** giving me a '5/7-5/8' report from Newcastle.

Certainly Versatile

The Slinky-Hula is certainly versatile. But **I really have to admit I do not know why** such a single design allows operation without re-tuning over a wide range of frequencies! Additionally, why is it not directional, or why it is so efficient I'm not entirely sure. I have always maintained that antennas with enormous r.f. voltages on them may not be radiating all the energy fed to them.

My Slinky-Hula antenna is most certainly not a magnetic loop and perhaps might best be described as a pvc-air cored toroid. If the variable capacitor could be enclosed and the antenna thoroughly waterproofed, it would be very effective, with remote tuning, when used high up out-of-doors.

Why not nip out to your local toy shop, and grab a couple of toys to make a Slinky-Hula for yourself? See you there!

PW