Antennas

More on G3LDO's small loop testing methods

PHOTO 1: ZL1VL's 400 sq ft (37m^2) of galvanised chicken wire counterpoise system, which gave a definite all round improvement to the performance of the Hustler 6BTV.

ANTENNA COMPARISON TESTING AND *WSPR*. In the January Antennas I described the experimental work of Walter Blanchard, G3JKV, who was testing a Hustler 6BTV on behalf of the Dorking Amateur Radio Club. Most of this work involved trying different radials and ground systems and conducting comparative performance tests.

This description brought a surprising amount of e-mail and an example was published in March Antennas; the experiences of Duncan Tribute, G1OEQ and his Hustler 6BTV, which he uses from a restricted site in Truro.

LETTER FROM NEW ZEALAND. Additionally Vince Lear, ZL1VL (ex G3TKN), sent me details of experimental work comparing a ground mount Hustler 6BTV vertical against full sized inverted V's for 20, 30 and 40m at apex heights of 29ft (9m). He goes on to say "I live in a typical suburban environment in Auckland and the aerial is not out in the clear, so my results are probably fairly typical of what the average ham can expect living in these sort of surroundings. The low height of 29ft is also probably typical for most hams with restricted space.

"When rapid switching of different antennas takes place (especially when one is a vertical and the other a horizontal) there will always be times when one antenna may have an advantage over the other depending on time of day, propagation conditions and of course distance. Sometimes the advantage can swing back and forth by the minute. The results below are a broad summary to give an overall idea of what I found was happening most of the time.

"20m: I found the inverted V dipole to be consistently better on just about every station; sometimes 2 S-units and sometimes more. On one short path QSO to G the Hustler got a 4/2 while the inverted V was 5/6 although the inverted V had a greater signal to noise ratio. GM3PPE in Kelso who also runs a Hustler did similar tests a while back and found his 20m inverted V at 30ft (9.1m) to be around 10dB better on average in the broadside direction compared to his Hustler at all ranges. His Hustler was mounted clear of obstructions.

"30m: There were times when the inverted V was slightly better (especially up to JA) but overall the two antennas seemed about equal on Europe and Stateside.

"40m: The Hustler was the clear winner at DX as obviously an inverted V at 29ft (9m) is just too low. In the late afternoon on the long path to Europe there were some weak EUs that could be copied on the vertical that were virtually inaudible on the inverted V.

"80m: I have not compared the Hustler with any other antenna at this QTH, but it has proved itself on DX at distances up to 5000 miles (JA) running just 100W.

"I feel if one is living in a suburban environment, ground mounted verticals are to be avoided on 14MHz and higher frequencies. However, they can work well on frequencies below 10MHz given a good ground. My original ground system comprised some 20 radials around 20ft (6m) long. This radial system was replaced with 400 sq ft (37m^2) of galvanised chicken wire mesh, see **Photo 1**. At that point, I felt there was a definite all round improvement in the performance of the Hustler 6BTV. There was a reduction in the base impedance of the vertical showing lower earth losses with the wire mesh.

"Finally, I thought I would experiment with a 20m ground plane (spaced well away from the Hustler) using 2 quarter wave radials and with its base elevated 13ft (4m). The elevated GP was noticeably better than the Hustler by 1 and sometimes 2 S-units but I still felt the 20m inverted V at 29ft (9m) was better than the GP. I had taken the 20m inverted V down, so I was not able to do direct comparisons between the GP and the inverted V."

ANTENNA PERFORMANCE COMPARISONS. Some of you may be aware that a method I used to make comparison tests on antennas has been the subject of discussion, so in this column I will explain antenna testing in general and my QTH in particular.

The general layout of one half of my back garden is shown in **Photo 2**. The loop antenna in the foreground is being compared with the multiband rotary dipole on the roof.

The loop was mounted 2m above the ground well away from the house via a feeder comprising 43m of RG213 and 10m of RG58. The comparison antenna was an 11m high multiband rotary dipole on top of the house fed via 15m of RG213. This gave the dipole an obvious advantage but, in spite of this, the loop did very well on short skip contacts. Sometimes the loop gave the best results, other times the dipole did best although DX signals on the dipole were 2 to 3 S-points ahead of the loop.

As reported in September, VK5KLT **[1]** had some interesting findings and comments regarding the best location for a transmitting

TABLE 1: Part of the edited G3LDO transmission data from the *WSPR* web

Time	Frequency	SNR	Call	Locator	km	miles
QUAD						
14:52	14.097161	-15	NB3N	FM19ki	5875	3651
14:48	14.097149	-9	W3GXT	FM19ol	5844	3631
14:48	14.097199	-14	W0OGH	DM43ci	8502	5283
14:48	14.097163	-5	NB3N	FM19ki	5875	3651
14:40	14.097148	-15	W3GXT	FM19ol	5844	3631
14:40	14.097200	-11	W0OGH	DM43ci	8502	5283
DIPOLE						
14:32	14.097161	-18	NB3N	FM19ki	5875	3651
14:32	14.097156	-19	WA8KNE	EM90gg	6846	4254
14:26	14.097153	-18	KF1Z	FN33na	5282	3282
14:26	14.097128	-21	WA3DNM	FM29fw	5728	3559
14:26	14.097156	-20	WA8KNE	EM90gg	6846	4254
14:18	14.097197	-23	W0OGH	DM43ci	8502	5283

loop antenna and that the bottom of the loop does not need to be more than a loop diameter above ground. He also noted that there is no significant improvement in performance when a small loop is raised to great heights; all that matters is the loop is substantially clear of objects in the desired direction of radiation and that mounting on an elevated roof ground-plane yields excellent results.

The important point is that "the loop should be substantially clear of objects in the desired direction of radiation". As you can see from **Photo 2** this isn't the case. I hope to repeat the comparison with the loop mounted on the flat roof of the house extension and fed with a short length of RG213.

WSPR**.** There is another interesting way that you can use to check the comparative DX performance of antennas. G3JKV mentioned the use of *WSPR* in the January Antennas. For those of you who have never heard of this before, *WSPR* (Weak Signal Propagation Reporter) **[2]** is a free software application that can enable your station to send and receive signals from similarly equipped stations worldwide.

The *WSPR* transmission contains the transmitter's callsign, locator and power (in dBm). Once set up, operation of *WSPR* is completely automated. The software logs every transmission you make, as well as all the decoded signals received.

Because participating stations usually upload signals that they receive in real time to a web server, you can find out within seconds of the end of each transmission exactly where and how strongly it was received. It is these reports that are of interest. My *WSPR* signals are shown in **Figure 1**. The station reporting the signals, together with location and distance from my QTH, are shown in each row. The most important information, the received signals, are reported as SNR (signal to noise ratio), rather than a specific signal level. Remember that these signals are very weak, often way below what is audible in the CW mode.

ANTENNA TESTS USING *WSPR*. I decided to use *WSPR* to compare the multiband trapped dipole on the roof with my multiband quad (located behind the camera that took Photo 1). These antennas have been in use for some time so I had a fair idea of their relative performances and the tests were more to assess how well *WSPR* performed as an antenna performance-measuring tool. *WSPR* can collect a considerable about of data in a short space of time so some method of selecting and processing the data is necessary.

G8JNJ has used this method, which he describes as follows: "What I do is transmit on one band with one antenna on a specific frequency, then swap antenna and frequency on the same band. I then download all the stations that have spotted me over a few hours from the *WSPR* website database.

						Power		Reported		Distance	
Date	Call	Frequency	SNR	Drift	Grid	dBm	W	by	loc	km	mi
2010-09-02 13:58	G3LDO	14.097160	-19	-3	IO90at	+37	5.012	NB3N	FM19ki	5875	3651
2010-09-02 13:58	G3LDO	14.097158	-21	-3	IO90at	+37	5.012	DF2LV	JO44rs	798	496
2010-09-02 13:52	G3LDO	14.097155	-21	-4	IO90at	+37	5.012	WA8RNE	EM90gg	6846	4254
2010-09-02 13:52	G3LDO	14.097152	-13	-3	IO90at	+37	5.012	4X1RF	KM72ls	3504	2177
2010-09-02 13:52	G3LDO	14.097164	-26	-3	IO90at	+37	5.012	W0BLD	EM37jc	7081	4400
2010-09-02 13:52	G3LDO	14.097164	-14	-3	IO90at	+37	5.012	IZ6QIB	JN62qi	1411	877
2010-09-02 13:52	G3LDO	14.097197	-21	-3	IO90at	+37	5.012	W0OGH	DM43ci	8502	5283
2010-09-02 13:52	G3LDO	14.097146	-22	-3	IO90at	+37	5.012	W3GXT	FM19ol	5844	3631
2010-09-02 13:52	G3LDO	14.097150	-15	-3	IO90at	+37	5.012	M0ORE	IO90er	83	52
2010-09-02 13:52	G3LDO	14.097181	-16	-3	IO90at	+37	5.012	N6QW	CM88ob	7725	4800
2010-09-02 13:52	G3LDO	14.097164	+4	-4	IO90at	+37	5.012	S51CM	JN65tm	1196	743
2010-09-02 13:52	G3LDO	14.097126	-21	-3	IO90at	+37	5.012	WA3DNM	FM29fw	5728	3559
2010-09-02 13:46	G3LDO	14.097156	-2	-3	IO90at	+37	5.012	DF2LV	JO44rs	798	496
2010-09-02 13:46	G3LDO	14.097150	-16	-3	IO90at	+37	5.012	M0ORE	IO90er	83	52
2010-09-02 13:46	G3LDO	14.097156	-12	-3	IO90at	+37	5.012	WA8RNE	EM90gg	6846	4254
2010-09-02 13:46	G3LDO	14.097164	-18	-3	IO90at	+37	5.012	W0BLD	EM37jc	7081	4400
2010-09-02 13:46	G3LDO	14.097180	-21	-3	IO90at	+37	5.012	N6QW	CM88ob	7725	4800

FIGURE 1: Screen dump of G3LDO signal reports by *WSPR*.

PHOTO 2: The antenna arrangement at the QTH of G3LDO.

"I then dump them into an *Excel* spreadsheet and sort by frequency and distance. That way I can separate out the transmissions that were on each antenna and plot different graphs against the reporting stations, which will be at the same distance for individual spots (for directional antennas you can also sort by bearing if required)."

I felt that the G8JNJ method required modification for my tests. First of all, I rotated both antennas so that their maximum gain patterns were headed northwest. With *WSPR* running, I connected each antenna in turn to the radio for a period of 15 minutes over a total period of one and a half hours. Not having the know how to download the *WSPR* data into *Excel* I downloaded the data as an image file (partly shown in Figure 1) and scanned it into a *Word* file using a character recognition application. Once the data was in *Word* I deleted all data except transatlantic reports and unwanted column data.

The data was then sorted into time slots that coincided with the time the appropriate antenna was used. An example is shown in **Table 1**. The most important data is the SNR; the smaller the SNR negative number the stronger the signal (-10 is better than -15). Table 1 only shows part of the picture. Altogether there were 59 signal reports, 33 for the dipole and 26 for the quad. The average signal reports for the dipole were –22.33 while the reports for the quad gave –15.38. This gave the quad a gain of just under 7dB over the dipole.

There are feeder losses to consider. The quad was fed via 53m of RG213 while the dipole was fed with only 15m of RG213. With an SWR of 1.3:1 the feeder losses of the quad and dipole were 1.4dB and 0.4dB respectively. This gives the quad an 8dB advantage over the dipole using this antenna testing method, about what you might expect.

REFERENCES

[1] www.qsl.net/vk5bar; go to 'Papers' and select 'Small (loop) antennas'.

[2] *WSPR*, written by Joe Taylor, K1JT. Obtainable at www.physics.princeton.edu/pulsar/K1JT