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KD9SV Reversible Beverage-On-Ground
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In the fall of 2013 I acquired a Shared Apex Loop array from Array Solutions to help with my contesting (and DXing) efforts on the low bands. I would have preferred to install four (or eight) long Beverages around the compass, but our property won't allow that. So I settled for the SAL-20 model (the model with a 20-foot horizontal length for each triangular loop) due to its small footprint (40-foot diameter). It was a compromise in RDF (Receiving Directivity Factor), but it fit our property and it opened up a new layer of QSOs for me. See the April 2014 **QST** for my review of the SAL-20

Recently Beverages laying on the ground (BOGs) have gained popularity with the low band crowd due to the ease of installation, very respectable performance and shorter length. The shorter length aroused my interest, as I may be able to install a pair of two-direction Beverages to cover NE-SW and NW-SE on our property. So when Gary Nichols KD9SV offered me his 200-foot long RBOG for evaluation, I jumped at the chance.

The KD9SV RBOG consists of a feed transformer, a reflection transformer, two-conductor wire and a control box. For two-direction performance, you need to provide two RG-6 coax feed lines that run from the feed transformer at the antenna to the control box in the shack. The control box (see Figure 1) includes a 160-Meter band pass filter, a 20 dB preamp and a termination for the coax on the unused direction. The preamp and filter are bypassed for operation on frequencies higher than 1.8 MHz. A 12 VDC source is also needed for the control box.

Figure 1 – Control Box

I originally planned to install the RBOG in our neighbor's field to the west of us. But we had so much snow last winter that the pond in the field was considerably expanded. Thus I had to go to Plan B – install it along the north property line that runs partially along and partially in the woods. I cleared a path with the lawn tractor, raked the debris down to dirt level, and laid the two-conductor wire along an ENE-WSW line. The installation, with everything at (literally) ground level, was easy and went smoothly.

Prior to the installation, I measured the preamp compression characteristics and the response of the 160-Meter band pass filter. Figure 2 shows these results. The preamp has an input 1 dB compression point of -20 dBm (with a gain of about 20 dB, the output P1dB is around 0 dBm). The 160-Meter band pass filter has a typical response for a parallel-resonant LC circuit.

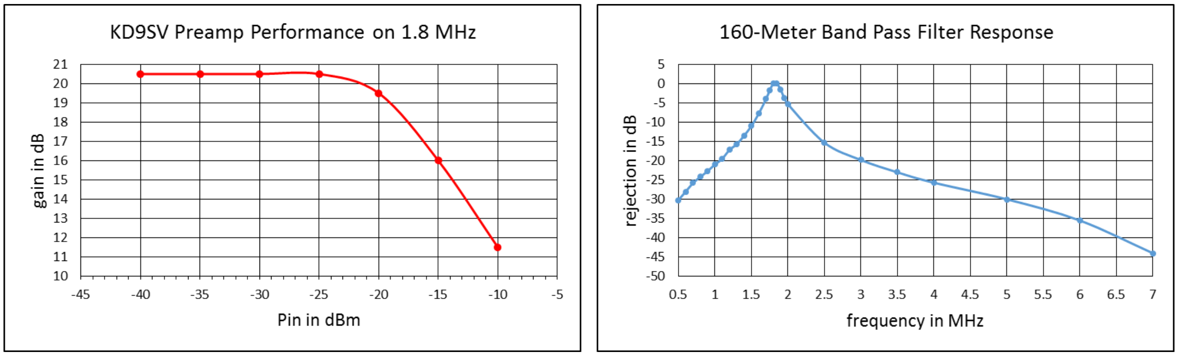

Figure 2 – Preamp and BPF Performance

The measured P1dB of the preamp is about 20 dB lower than the specification on the FET data sheet. It is lower because the FET in the RBOG preamp is lightly biased (lower quiescent current) compared to the data sheet condition. With 160-Meter aficionado John Goller K9UWA only 2.3 miles to the northeast of my QTH, I wondered if his transmit signal via ground wave could cause the preamp to go into compression. So we set up a test – when K9UWA keyed his radio at 1.0 kW, his signal on my inverted-L (maximum gain around 0 dBi in the main lobe) was around -23 dBm (that's about S9 + 50 dB). With the maximum gain of the BOG in the main lobe around -20 dBi, I don't expect any problems with the lower P1dB.

I had planned to do an extensive on-the-air evaluation of the RBOG system with European signals, but unfortunately 160-Meters has not been cooperative. My back-up plan was to listen to W1AW on 1802.5 KHz in the evenings (a path distance of around 1200 km). The signal-to-noise ratios (SNRs) of W1AW in Table 1 are representative for three different nights (with two nights at two different times) for my transmit inverted-L, the SAL-20 pointed NE and the 200-foot RBOG running ENE-WSW. I should point out that you *must* calibrate your S-meter to do these measurements.

Date	Time (UTC)	Transmit Inverted-L	SAL-20	RBOG
7 May 2015	0025	5 dB	11 dB	19 dB
7 May 2015	0040	24 dB	33 dB	35 dB
13 May 2015	0020	14 dB	10 dB	12 dB
13 May 2015	0030	9 dB	7 dB	11 dB
4 June 2015	0056	17 dB	21 dB	32 dB

Table 1 – SNR Results with W1AW on 160-Meters

Note the interesting results on 13 May – at the early time the SNR was actually higher on the inverted-L than on both the SAL-20 and RBOG. I don't believe I screwed up the measurements, as I've experienced the Inverted-L every once in a while beating the SAL-20. I believe this is due to how noise arrives at your location in terms of azimuth and elevation angle – the directional characteristics of noise can vary day-to-day and hour-to-hour, as do the arrival elevation angles of the desired signal. In fact, I believe two antennas with the same RDF could perform differently because RDF assumes noise arrives from all directions – but it doesn't.

In addition to the SNR measurements of Table 1 and listening at other times, the RBOG is really impressive when using your ears and the signal is near the noise. Most of the time the RBOG beat the inverted-L and the SAL-20. Nothing against the SAL-20 – most of the time it beat the inverted-L. As stated earlier, the SAL-20 is a good choice for space-limited QTHs – it will offer QSOs that you may otherwise not be able to complete.

I'm really interested in seeing what happens to the performance of the RBOG this fall and winter. Since it's on the ground and near many trees, it will be covered up with leaves – both dry leaves and wet leaves after a rain or snow. If the wet leaves introduce more loss, then the performance could suffer. The solution, as mentioned by several on the topband reflector, would be to keep the two-conductor wire clear of leaves (and other debris). Also, two other evaluators (K3UL and K2CUB) of the KD9SV RBOG report that snow last winter didn't appear to affect the performance – that's not too surprising as the density of snow can be low, and the conductivity and relative permittivity of not-too-dense snow at 1.8 MHz is not prohibitive.

I'm always interested in antenna modeling, so Jim Wolf KR9U and I modeled a BOG close to ground using NEC 4.1, which uses the GN2 ground code. This effort was spurred on by the work last spring (to eventually be published in QEX) of Rudy Severns N6LF. He used NEC 4.2, which uses a more complex ground code – GN3 – and compared simulated results to measured results of four antennas: a 300-foot center fed dipole that was moved from 4 feet above ground to 1 inch above ground in several steps, a 40-foot dipole buried 1 inch below ground, a tall vertical wire with one ground rod and his 450-foot long BOG. With all four antennas, his simulated results agreed very well with measured results as long as he paid attention to the modeling rules in NEC, paid attention to the insulation on the wire and used measured values of his ground conductivity and permittivity (as opposed to the canned 'poor', 'average' and 'good' values).

Our first modeling exercise was to compare the NEC 4.1 results to N6LF's NEC 4.2 results on the 300-foot dipole (remember, it was always above ground). The modeled results from 4 feet above ground to 1 inch above ground were extremely similar to Rudy's results, giving us confidence to model a BOG at 0.25 inches above ground using NEC 4.1.

Some interesting trends we saw with our modeling efforts with BOGs:

1) Just like normal Beverages several feet above ground, BOGs appear to have preferential lengths for best F/B
2) BOGs can be too long – on 160-Meters, a good length appears to be 200 feet
3) The decreased BOG gain will benefit from the use of a preamp

In spite of the limitations of the model (for example, how well does NEC model the transition from air to ground?), broad trends were discerned. Figure 3 shows the modeled results for a 200-foot long BOG at 0.25 inches above average ground (we used average ground as at the time of this writing we don't know our ground characteristics) with a 240 ohm termination. These results should be regarded as *PRELIMINARY*. The RDF is decent (9.3 dB) for a "short" antenna, but the F/B at expected elevation angles (about 11 dB) isn't spectacular.

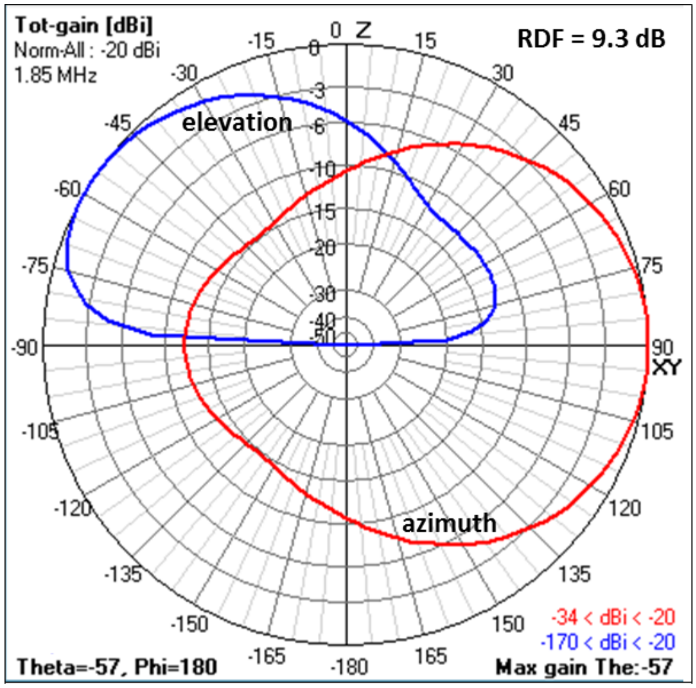

Figure 3 – Preliminary Simulated Results

In summary, the KD9SV RBOG performed well under my limited evaluations, and most of the time it should give very respectable results. But the RBOG takes up more space and you need at least one more two-direction system to have the minimum "around-the-compass" coverage. Having said that, I have no plans to take down the SAL-20, as I believe in the old adage "you can't have too many antennas on 160-Meters".

The KD9SV RBOG is sold through DX Engineering, and details about it can be found at http://www.dxengineering.com. When you visit the DX Engineering web site, do a search on KD9SV Products.