Antenna Workshop

John Heys G3BDQ takes another look at the G5RV Antenna and says it can work well almost anywhere, "when treated right"!

The G5RV Revisited

The late **Louis Varney G5RV** designed his, now very well known, multi-band antenna in 1946. This was the year I was first licensed, a time of valved transmitter and receiver 'separates' - when few operators used or had even heard of s.w.r. meters. His antenna was originally designed to be a DX radiator on the 14MHz band, showing the characteristics of a three half-wave end fed wire, but instead centre fed via an open wire matching section and 72/75Ω twin feeder or coaxial cable.

No antenna tuning unit (a.t.u) was needed, for at that time, most transmitters used π-section output circuits, which could be adjusted to match into a wide range of local impedances. Soon, it was realised that the G5RV antenna would also radiate on the 3.5, 7 and 28MHz bands, despite the standing waves (high s.w.r.s) along the feedline. In 1946, all the Amateur bands were harmonically related as we didn't have the 10, 18, 21 and 24MHz bands at that time.

Furthermore, by strapping the feeder wires together the system could be tuned, against 'earth' to work as an effective top loaded 'T' on 1.8MHz. With such versatility, it's not surprising that the G5RV soon became so popular.

The Basic G5RV

The illustration, **Fig. 1,** shows an 'ideal' G5RV antenna with just one modern addition, a ferrite choke just beneath the junction of the coaxial cable and the vertical open wire matching section. (This item will be discussed later in the text).

There are certain design considerations when contemplating using a G5RV antenna. The matching section (shown in Fig. 1 as open wire line) must, if possible, descend vertically for at least 6.1m (20ft). This demands an antenna height of at least the full length of the vertical matching section, i.e. 10.36m (34ft).

If the antenna can be erected higher than 10.36m, it will be more effective on all bands. One way to achieve this is by using a non-metallic centre support mast and sloping down the top wires to make an inverted 'V'.

Open wire lines are affected little by weather conditions and should not be heavy if made with 18s.w.g. enamelled wire and lightweight plastic spacers every half metre of so. The commercially made slotted 300Ω impedance ribbon feeder may be used, but its velocity factor must be considered and this will reduce the matching section to 9.3m (30.6ft).

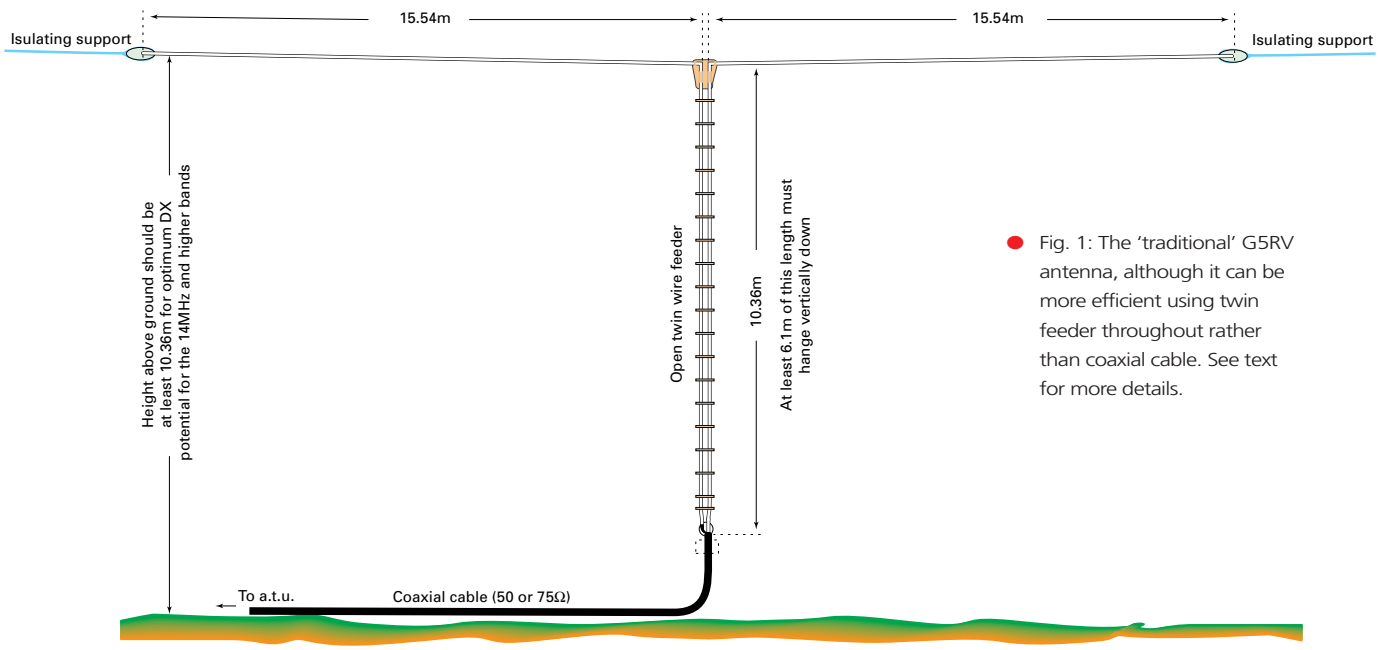

Fig. 1: The 'traditional' G5RV antenna, although it can be more efficient using twin feeder throughout rather than coaxial cable. See text for more details.

Band	Operating mode
28MHz	Two long wires each three half-waves in length and fed in phase. It becomes a multilobe wire radiating in many directions.
24MHz	A centre-fed long wire a little over five half-waves long.
21MHz	A centre-fed long wire five half-waves long.
18MHz	Two full-wave long antennas fed in phase.
14MHz	A centre-fed long wire of three half-waves fed out of phase.
10MHz	A collinear array with two half-wave elements in phase. However, the s.w.r. on the coaxial cable feeder may be as high as 40:1.
7MHz	A collinear array with two half-waves in phase.
3.5MHz	A half-wave dipole partially folded in the centre.
1.8MHz	May be used as a top loaded vertical. Some series inductance may be needed at the a.t.u. end of the feeder when the this is short.

Table 1: The G5RV exhibits differing operating modes on the different h.f. bands. See text for more details.

The connection of an unbalanced feeder (coaxial cable) to the balanced matching section will result in r.f. currents running back along the outer surface of the coaxial cable braid. These will produce standing waves along the coaxial cable, radiation and might give rise to unwanted TVI/BCI problems. Three or four 'clip on' ferrite filters will make up a coaxial choke and should be positioned on the coaxial cable just below its junction with the matching section and will prevent or minimise the standing wave problem.

The r.f. energy at v.h.f. and h.f. will run along the surface of a conductor and the suggested ferrite choke will be effective on 7MHz and the higher frequency bands and yet allow r.f. to be conducted normally on the inner side of the coaxial braiding. I have not heard of a source of large 'clip on' ferrites that will fit the heavier UR67 coaxial, so instead a coil choke can be made by winding the upper part of the feeder into a four turn 150mm (6in) diameter coil held together with tape.

The addition of a choke or ferrite balun often makes the vertical feedline quite heavy and a small vertical support might be needed. If this is not done, the antenna centre will be pulled down and the antenna performance reduced. **Dave Ingram K4TWJ** does not use a choke balun, but instead suggests a long coaxial cable feed of at least 22m (70ft). This tactic will make the station a.t.u. tuning easier, but in my opinion will not prevent the standing waves and unwanted feeder radiation.

Radiated Energy

The full sized G5RV as illustrated in Fig. 1, has quite different radiated energy patterns on the various Amateur bands. The radiation characteristics of a typical G5RV on the various h.f. bands from 1.8 to 28MHz, giving the effective electrical lengths of the top are shown in **Table 1**.

A 10m (33ft) high G5RV is very close to the ground in terms of wavelength when it is used on the 3.5 and 7MHz bands so much of its radiation will be at high angles including the vertical. This will often enhance signals to and from stations located in the UK and over much of western Europe. It will however be a poor DX antenna on these bands.

On the higher Amateur bands, the G5RV's DX potential is good. Its quite low radiation angles together with its multi-lobed radiation patterns will allow world-wide communication when conditions are suitable.

Other Versions

The full sized G5RV may be rather big for many urban locations, but by putting bends in its 'top' sections it can often be fitted into small gardens. It's best if balance is maintained and that the bends are similar along each leg. Mention was made earlier of the use of a single but high centre support to make the antenna into an inverted 'V'. If this is done, it is suggested that the dipole ends come down to no lower than 4m (12-15ft). Another way to fit the antenna into a smaller property is to drop down each end vertically for no more than 3m (10ft).

Over 'the pond' **K4TWJ** has described a half sized G5RV operating on the bands 28 to 7MHz. He suggests the top should have two legs of 8.2m (27ft) and a matching section of slotted 300Ω line 5.2m (17ft) long. He also states that although the gain on 14MHz will be a little down on the full sized G5RV it will still be better than that of a conventional half-wave dipole.

Dave also describes an even smaller or 'micro' version of the G5RV which has its dimensions half as small again. This model will cover the bands from 28 to 14MHz and will need a total top length of 8.2m (27ft) and a matching section 2.6m (8.5ft) long. With these dimensions, the 'micro' version can be fitted into quite small areas.

Meeting G5RV

I was fortunate to meet the late Louis Varney G5RV about 20 years ago at an Amateur gathering in Bromley, Kent and he told me that a more efficient version of his antenna would have the same top dimensions but would use open wire transmission line all the way from its centre to the station a.t.u. This a.t.u. should be of a balanced design such as the 'Z-Match', the KW 'E-Zee Match' or a home-brew parallel tuned circuit with perhaps plug-in coils for each band. An a.t.u. of the unbalanced design as used in autotuning systems and many commercial products will not do and should never be used to tune balanced feeders via a 4:1 balun. In my experience, such baluns waste power and on some bands the lost power is dissipated as heat. The toroids of such baluns can become alarmingly hot. An antenna built on these lines should ideally have a feeder length of 26m (85ft) and will then work all bands and not give rise to matching problems at the a.t.u.

Some folk speak rather unkindly of the G5RV antenna design, but many Amateurs world-wide have found it to be very effective. I remember one 'W2' station on 'Top Band' who was coming through at a genuine S8 when using 100W to a G5RV in his small inner city New York lot. He said that the QSO really made his day!

Remember, some QRP stations employ G5RVs and still manage to work quite exotic DX!

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