Antenna Workshop

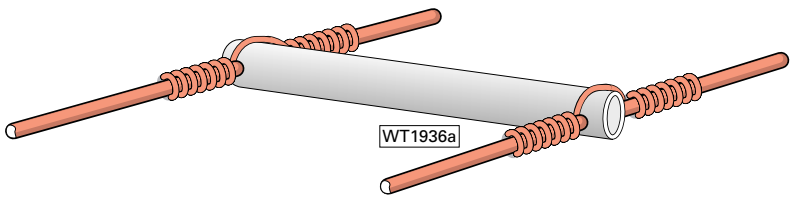
Simple Antennas for the HF bands

In this month's Antenna Workshop, Roger Cooke G3LDI describes some simple antennas for the lower h.f. bands.

I often wonder - why do people buy wire antennas? Surely there's no need to buy this type of antenna, or the tuning unit to match the antenna to the transmitter for that matter. So, to start if you have a long enough garden, try a 43.7m (135ft) long wire, as high as you can get it, fed at the end with tuned open wire feeder.

It's surprising what results can be achieved using wire antennas. The antenna can be almost any wire you have, but preferably hard drawn copper, but even insulated earth wire makes good antenna wire (and it can be bought quite cheaply from an electrical wholesalers). The tuned feeder can be made from multi-strand plastic covered wire, obtainable from the same source.

Don't just take the easy option and buy something just because it's advertised in a glossy advert! You can learn much more by doing it yourself gaining much more satisfaction too. The unit can provide a talking point when you get on the air, when buying everything, it's easy to end up with a limited amount of conversation after the weather and football have been discussed.



● Fig. 1: Open wire feeder is easy to make, a simple plastic spreader of around 125mm wide every 600-700mm along the run works well.

The spreaders for the feeder can be made from 10mm plastic tubing, which is quite cheap and easily obtained. Cut it into 120-150mm lengths, drill a hole in each end and feed the wire through. Space them every 600-700mm along the feeder, secured in place with a piece soft wire **Fig. 1**. Though it's a time-consuming job creating open wire feeder, its well worth it.

To make your own tuning unit, start by looking around at one of the rallies or shows and find some ceramic 2in formers and some wide spaced tuning capacitors (350-500pF). You can wind your own coils, and be able to alter the tuning unit at any time according to what type of antenna you wish to use.

Bedtime Reading

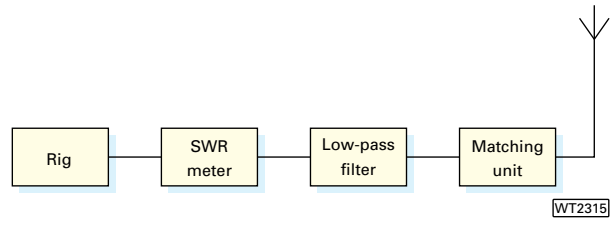
Some bedtime reading would be useful! A book such as the ARRL *Antenna Handbook* will provide you with a lot of very useful information. I personally use an SPC Transmatch that I made many years ago and is described in the book.

With a wire element 41.2m (135ft) long and high impedance (600Ω) feeder will allow the antenna to be used on several h.f. bands, with the help of an a.t.u. The actual layout will be determined by the physical location of the feed point relative to the shack.

Many commercial transceivers have an output designed to 'see' an unbalanced load of (50-70)Ω. For optimum transfer of power to the antenna, impedances throughout the system must be matched. If the antenna feed-point impedance is 50Ω, then a 50Ω feeder should be used to connect to the output of the transmitter. The output power from the transmitter is then transferred to the antenna, from which it is all radiated (barring losses).

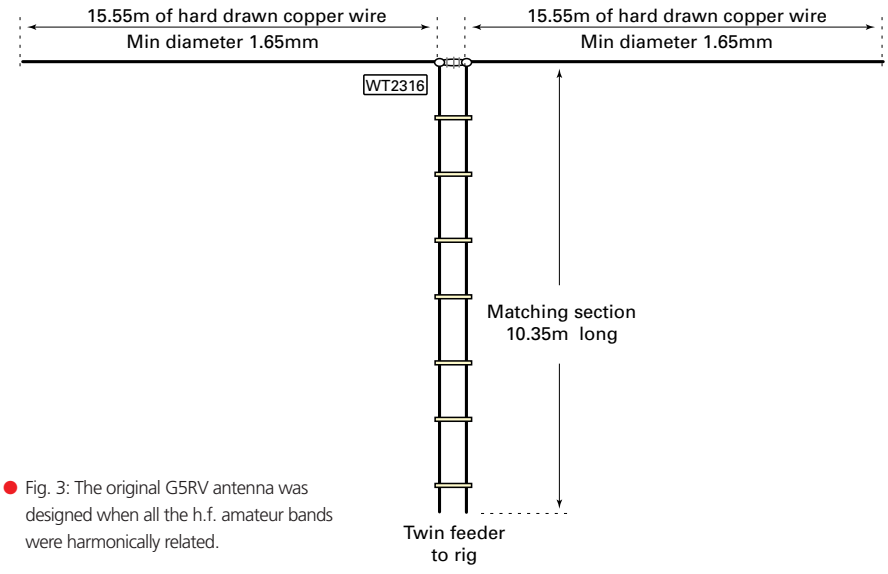
Obviously a multi-band antenna will exhibit varying degrees of match to 50Ω, not even remaining constant within one band, let alone from band to band. As the mismatch increases, the reflected (reverse) power rises and the s.w.r. increases. Thus s.w.r. is a measure of the loss or the effectiveness of the whole system.

Matching the feeder impedance to the antenna itself may not be a straightforward task, particularly in the case of multi-band antennas, which are themselves compromises. The solution to this problem, which has become virtually standard practice, is to match the transmitter to the feeder plus antenna as shown in **Fig. 2**.

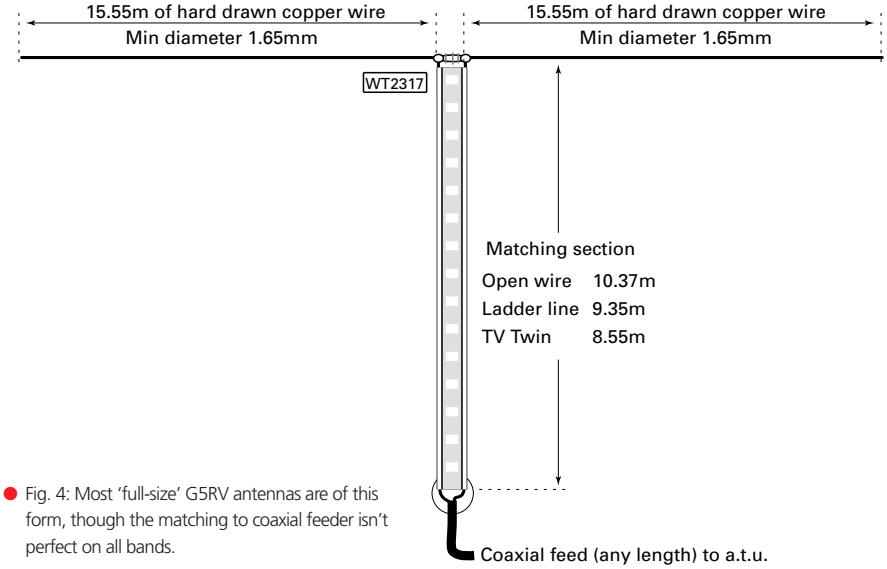


● Fig. 2: Preferred arrangement of transmitter-to-antenna link up.

Matching of the feeder to the rig is normally by means of the antenna-tuning unit (a.t.u.), though this doesn't tune the antenna. The a.t.u. matches the impedance at the bottom of the feeder to the transmitter output - it should really be called an antenna matching unit. But it's been 'a.t.u.' through many years common usage, though there are now other names in use,



● Fig. 3: The original G5RV antenna was designed when all the h.f. amateur bands were harmonically related.



● Fig. 4: Most 'full-size' G5RV antennas are of this form, though the matching to coaxial feeder isn't perfect on all bands.

such as antenna system tuning unit or matching network.

Perfectly Matched

A perfectly matched system will have an s.w.r. of 1:1 and many modern rigs may switch off or reduce power when the s.w.r. rises above 2.5:1. The question therefore arises: what's an acceptable maximum s.w.r.? There are many possible errors with s.w.r. measurement and a figure of 1:1 might be regarded with a certain amount of suspicion. Conversely, a system which appears to have an s.w.r. greater than 5:1 should certainly be investigated, although overall power lost is only just less than 3dB.

It's probably more important to reduce s.w.r. to safeguard solid-state transmitter output stages than for any other reason. In practice, the consequences of a high s.w.r. is greater loss in the feeder and with very high power and an excessive s.w.r. there may be breakdown of the feeder or such units as filters or switches.

The actual feeder losses depend on both feeder type and frequency. In general with twin feeder losses are inconsequential on h.f. (up to 30MHz). Breakdowns may be due to flashover (high voltage) or perhaps, conductors or dielectric melting due to high current points. **Note**: High s.w.r., in itself, does not cause a feeder to radiate, or produce TVI or other interference.

The G5RV

Let's now turn to a good general wire antenna, the G5RV, originated by the late **Louis Varney G5RV**. The original dimensions are shown in **Fig. 3**. The top should be horizontal and run in a straight line (if possible) and should be erected as high as possible above ground. It's better to erect the antenna at an average height of about 10.35m (34ft), which happens to be the optimum radiation efficiency on 1.8, 3.5 and 7MHz bands for any horizontal antenna. Few stations have the space, for the optimum height (λ/2) on the lower h.f. bands.

If, due to limited space available, or to the shape of the garden, it's not possible to accommodate the top in a straight line, then as much as 3m (10ft) at each end may be allowed to hang vertically. Or in practice, they may be bent in a horizontal plane, with little practical effect upon performance.

Incidentally, you may bend the ends of any resonant dipole antenna, as the most radiation takes place from the area where the current is greatest. Near each end of an antenna, the current is close to zero, so the effective radiation from these parts of the antenna is minimal.

The G5RV antenna may also be used in the form of an inverted-V. However, it should be borne in mind that, for such a configuration to radiate at maximum efficiency, the included angle at the apex of the V should not be less than about 120°.

There are at least three basic ways to make the matching section of the G5RV, by using an open wire, a ladder line (standard), or by using 300Ω TV twin lead, as shown in **Fig. 4**. The bottom end of the matching section, is connected to an ordinary coaxial cable linked to the transceiver. The full-size G5RV works on the 1.8MHz band too, where at the station end of the feeder (any form) the two sides are strapped and fed by a suitable antenna tuner using a good earth connection or a counterpoise wire.

Convenient Length

A particularly convenient length of open-wire feeder, for the G5RV, is 25.6m (84ft), because such a length permits parallel tuning of the antenna tuner circuit on all bands from 1.8-28MHz with conveniently located coil taps in the antenna tuner coils for each band. There are several designs to give the optimum loading condition for each band.

The feeder length of 25.6m is not a fixed requirement, as almost any length that's mechanically convenient may be used. As the feeder will always carry a standing wave, its characteristic impedance is less important. Relatively sharp bends may be used without detriment to its efficiency. Only when open wire feeder is correctly terminated by a resistive load equal to its characteristic impedance should such bends be avoided.

So, get out the wire-cutters, pliers and soldering iron. Go and buy some cheap wire and some plastic tubing and make a few antennas. Lots of fun can be had testing out a new antenna; Okay ... it might not match up to the latest *XYZ34* ten-element beam at 50m up, but so what, you made it yourself for little outlay and got results!

Self-education is all part of our hobby and should be encouraged. Following this path will give you more knowledge, experience, conversation, And turn you into a good operator. We could use any number of those!

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