DX DESTINATION

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ED TAYLOR G3SQX LOOKS AT A SELECTION OF HF ANTENNAS IDEAL FOR TRAVELLING.

This month I've some ideas for multi-band h.f wire antennas. However, as there's no straightforward answer to "What nine h.f. band antenna has good performance and is easy to put up?", I do so hesitantly! It's difficult, compounded by the fact that the impedance of the antenna system must be around 50Ω.

To help, I'm going to suggest three ways of achieving the objective. Most of the designs are actually a variation of one or the other.

Firstly, traps can be used to isolate parts of the antenna not required on the frequency currently in use. I'm thinking of a trap dipole here, although multi-band verticals generally use this principle.

Secondly, you can connect resonant wires to a single feeder, and treat the system as a single antenna. Thirdly, you can ignore antenna resonance, with a doublet that is tuned in the shack.

WHAT IS A TRAP?

A trap is a parallel tuned circuit, which has high impedance at its resonant frequency. This can be used in the middle of an antenna to isolate the end section of wire on a particular band. This makes the wire appear shorter, so an antenna appears to be a different length for each band used.

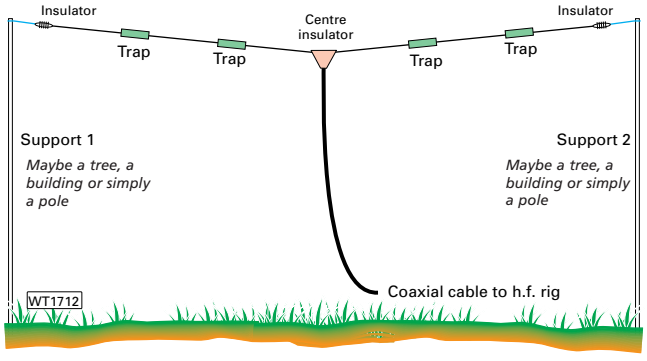


Fig. 1: A trap dipole can work on up to four bands.

You are probably familiar with the trap dipole in **Fig. 1**. Suppose the inner two traps are resonant at 28MHz and the outer two at 21MHz. The inner section of wire is designed to be a dipole on 28MHz and the next section will add length to make it a dipole at 21MHz. The overall antenna length will be such as to form a dipole at 14MHz and so the whole antenna acts as a dipole on three frequencies instead of one.

It's not difficult to calculate trap parameters and wire lengths, but most Amateurs will buy a commercial model. A balun, desirable with this type of antenna, is usually included.

Trap dipoles should offer a good match to 50Ω on up to four bands, depending on the design. A trap dipole can successfully be used as an inverted-vee, being supported at the highest point, in the centre.

However, this apparently attractive system has a few disadvantages, mostly mechanical. There are several points where wires attach to a connector and after flexing in the wind for a while these can break. Even though each trap (a coil and capacitor) will most likely be enclosed in a box to keep out rain, water could seep in, causing losses and detuning. If you are regularly assembling and dismantling this type of antenna, for use on a DX holiday, it can add to the problems. Trap dipoles are hard to fix even when you're at your home station.

MULTI-BAND VERTICAL

Vertical antennas often have a bit of mystery about them. Some Amateurs have a lot of success and some can never get them to work properly.

The general principle is that you imagine a dipole and make it vertical. Then take away the lower half and make a connection to the earth. The theory is well covered in text books, and most medium wave (a.m.) broadcasters use this type of system very effectively.

If you are planning multi-band use, the vertical part will have traps, loading coils and other devices which allow it to resonate on many frequencies. The commercial models can appear quite bizarre, with capacity hats and feeder stubs, but they can cover up to eight or nine bands with one antenna, which is quite an achievement. See **Fig. 2** to get an idea.

For portable operation, there are some worthwhile advantages in using a multi-band antenna. They are frequently self-supporting up to 8 metres or so, being mounted on a section of pole hammered into the ground. Because they use alloy tubing, they are generally fairly sturdy and the space taken by the antenna itself is quite small, although you would normally use radials, wires laid on the ground and connected to the outside of the coaxial feeder.

If adjusted correctly, the antenna will match at 50Ω on many bands, allowing rapid band changing. The angle of radiation is low, so verticals are well suited to DX working.

However, there are some disadvantages. Vertical antennas can be expensive and are really too bulky to take on a plane.

Adjustment in situ can be laborious, and radials may be troublesome. Performance on lower bands (1.8 & 3.5MHz) is often fairly inefficient, because of the relatively short length.

Verticals tend to pick-up more noise from domestic appliances, thermostats, etc. However, when used in a field or large garden, a multi-band vertical can be a very convenient temporary antenna.

PARALLEL DIPOLES

If you want to operate on three bands, take separate dipoles for each band and attach each one to the same coaxial feeder, arrange the wires in a 'fan' like in **Fig. 3**. That's it, you've created a

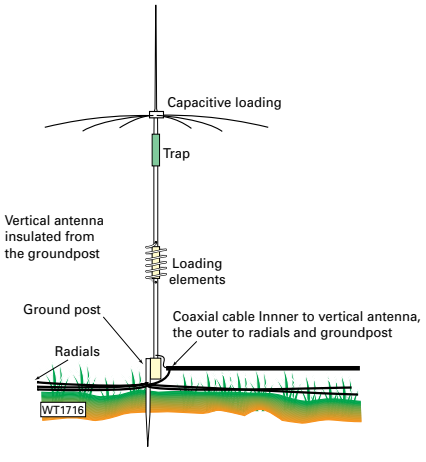
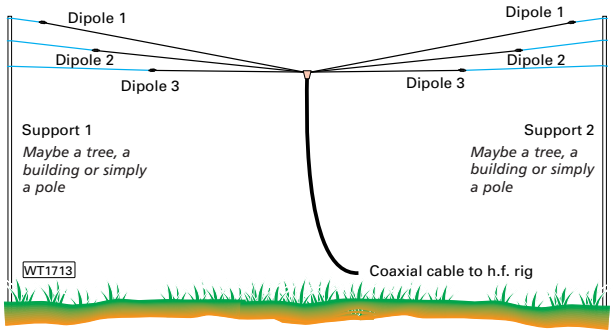


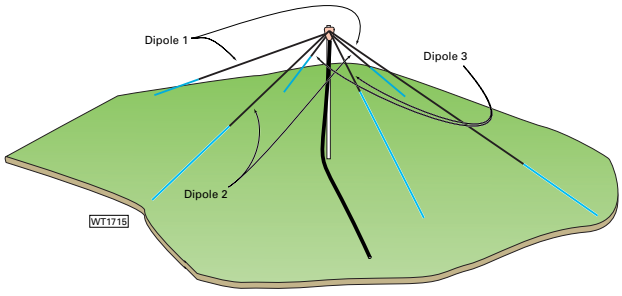
Fig. 2: Multi-band verticals all look different, here's one example.



● Fig. 3: Multiple dipoles - fan arrangement, with two supports (inverted-vee also works well).

multi-band system!

The theory is that each dipole will be accept power only at its resonant frequency, because the impedance of the others will be high enough not to affect its tuning. Is it true in practice? Well,



● Fig. 4: Multiple dipoles in a maypole arrangement.

each dipole affects each of the others, depending on the frequency and disposition of the wires. You can't always get a perfect match on each band and some combinations of bands are not recommended.

But the system works pretty well and I've found that up to three dipoles per feeder is very successful. You can feed the system directly from a 50Ω rig without trouble, with an s.w.r. below about 1.8:1.

However, it can take quite a while to set things up, as small variations in the separation of the dipoles can cause big changes of impedance. Usual procedure is to cut the wires longer than normal and trim the longest dipole first, moving on to the shorter ones.

The interaction can be minimised, if there is enough room, by using a 'maypole' inverted-vee arrangement, shown in **Fig. 4.** The wires are then separated as much as possible from each other. The benfits of parallel dipoles are that you can change bands quickly on air, can be made quite cheaply and is easily repaired in the field.

THE VERSATILE DOUBLET

If you're wondering why I haven't covered the G5RV yet it's because I like to consider it to be a type of doublet, with pre-determined dimensions. A doublet can actually be any length, becoming a versatile multi-band antenna.

Any antenna can be made to radiate at any frequency, providing you can find a way of getting power into it. In many cases, it's easier and more convenient to use resonant lengths, with a half-wave dipole, but a non-resonant antenna will still radiate.

The only real constraint is that as antennas are reduced in length below about 20% of a wavelength, it becomes more difficult to make them accept power. Still, it can be done, albeit at low efficiency, as experimenters on 136kHz are demonstrating.

As a rule doublets are constructed around a half-wave in length at the lowest frequency used. Then the power is fed in at this and higher frequencies and it will work fine. The radiation pattern will not be as predictable as with a dipole, but doublets tend to become more omni-directional if configured as inverted-vee.

Doublets need to be fed with a very low-loss feeder. Coaxial cable will not be successful, because the feeder has to deal with impedances very different from 50Ω In fact, most people are surprised to learn that the feeder is **not** matched to the antenna! There will be a very high s.w.r. on some bands, but the feeder is designed to deal with it.

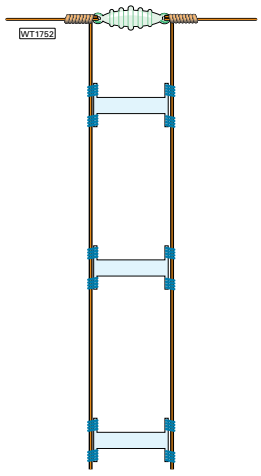
The feeder that does all these things is open-wire or ladder-line and most Amateurs construct their own. It consists of two wires parallel to each other, held about 5-12cm apart, with separators every 30-60cm along its length. The separators can be bought or made from material such as discarded ballpoint pen cases. See **Fig. 5** for an example of this type of feeder, attached to the antenna.

It's possible to buy slotted feeder, moulded from plastic material, with a separation of 3-6cm. This works pretty well, but is not as good as true open-wire and it can be badly affected by rain.

Open-wire has a loss of one or two dB per mile, even when operating with a high s.w.r. Because the dielectric (material between the wires) is mostly air, the losses are very low. This is why some m.w. and s.w. broadcasters use open-wire feeder to move signals from place to place with minimum attenuation.

Of course, you haven't really solved the problem of how to match the antenna to the rig, you've just moved the matching requirement somewhere else. You still have a transceiver which expects to see an impedance of 50Ω and you have a feeder coming in with an unknown impedance. **See Fig. 6**.

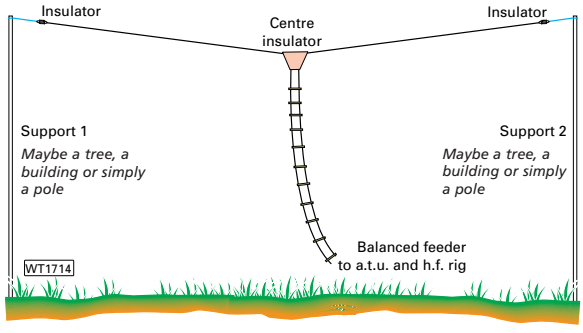
To put power into the feeder and the antenna, you need an antenna tuning unit (a.t.u.) between the transceiver and feeder. I know we are not really tuning the antenna, but the whole system (antenna, feeder and a.t.u.) so that it looks like a 50Ω load.



● Fig. 5: Open-wire (ladder-line) feeder, at its junction with the antenna.

Some rigs have an a.t.u. built in, but this is unlikely to be adequate for the high s.w.r.s that will be seen. In addition to tuning, the a.t.u. must take the balanced feeder and convert it to unbalanced form at 50Ω to connect it to the rig. This usually means it will contain a balun on the antenna side.

For use in the field, the doublet can be carried and put up fairly easily. You are committed to taking an a.t.u., and you may have to play around with feeder lengths to get an impedance that the a.t.u. will cope with on every band. Band changing can be slow, since you have to adjust the a.t.u. each time. Nonetheless, the doublet is simple and effective and many Amateurs use a variant both at home and away.



● Fig. 6: An antenna using open-wire feeder.

SEASONS GREETINGS

Best wishes to all and enjoy your radio activities in 2002! Next time I'll summarise antenna recommendations from the previous two columns.

There will also be a report on some interesting DX destinations from a well-known DX traveller. Your comments are welcome. The deadline for the April column is the middle of January.

73, Ed G3SZX