Antennas

Multiband dipole antennas

PHOTO 1: A practical installation of a multiband dipole constructed from drop feed telephone wire and plastic high pressure water pipe as spacing insulators. The spacing between each of the elements should be about 6cm (just over 2in).

MAKING IT BETTER. I often receive e-mails from readers who have an existing antenna arrangement that is not performing as well as it should, asking if I can advise on a way of effecting an improvement. Recently I received an e-mail from Chris, M0PSK, who was quite happy with the performance of his antenna but wondered why it was so good. He says, "Maybe you could comment on the following questions? I live in a second floor apartment (about 200m from the Mersey estuary) with parallel attic dipoles for 15, 17 and 20m, running NW-SE. The wires are a couple of inches apart and horizontal, maybe a foot below the roof ridge at 38 feet. And there is a common coax feed to a room below the attic.

"The question that intrigues me is this: what is the radiation pattern? Initially, I assumed that it would be the same as those for the individual dipoles. However, I've had around 3,000 QSOs over the last 6 years with this setup, and am surprised at the number of good contacts in the NW-SE directions, as well as the SW-NE directions. My understanding is that computer modelling may not necessarily provide an answer, as the coded algorithms start to break down when the wires get too close. Is it possible that I do have extra lobes in the NW-SE directions?

"There is a secondary question on which I would appreciate advice. It would be physically possible to add further parallel dipoles for 10, 12 and 30m. However, I do not want to degrade the good performance of the existing dipoles. Are any of these extra choices likely to do that?"

DIPOLE POLAR DIAGRAMS. We know that the azimuth polar diagram of a dipole is a figure of 8 with the nulls at the ends of the elements. Some people are surprised when they appear to work stations off the ends of the dipole when some antenna theory books imply that this should not be feasible. The answer can be seen in **Figure 1**. The blue pattern is for the theoretical dipole in free space and shows nulls at the ends of the dipole, over 30dB down on the maximum of 2.2dB relative to isotropic. When the dipole is erected about a wavelength high then the gain increases to 6 or 7dB relative to isotropic (due to ground gain but depending on the quality of the ground) and the nulls fill in to just over -10dB relative to maximum.

But this isn't the end of the story. Any radiation from the feeder or re-radiation from nearby electromagnetic obstructions will further fill in the nulls so that it is impossible to predict how the antenna will perform. So there should be no difficulty in working stations off the ends of the multiband dipole. I maintain that is more important where an antenna is than what it is. It would appear that M0PSK's antenna is in a favourable location, some 38ft above ground.

MULTIBAND DIPOLES. I modelled M0PSK's multiband dipole. The radiation pattern for all dipoles in the multiband structure were very similar. It was not possible to predict any adverse effect on the existing structure when a lower frequency element is added because the environmental effects cannot be modelled. The only solution would be to add the additional element and check the performance of the existing system. I feel sure that added elements will not be harmful.

The method of connecting multiple dipoles is to connect them in parallel as shown in **Figure 2**. I used to think that connecting them at single points and just fanning out the separate elements would do the trick but my attempt at that sort of structure was not successful. The elements are best spaced apart in a parallel manner with insulated spacers and brought to the feedpoint over, say, the last 25cm (10in).

A practical installation is shown in **Photo 1** using drop feed telephone wire for the elements and plastic high-pressure water pipe as spacing insulators. The spacing between each of the elements should be about 6cm (just over 2in) so the arrangement used by M0PSK seems about right.

I started to model this multiband arrangement using EZNEC by creating a basic dipole (I will call this the main dipole) and testing its performance, with and without ground, to obtain the images in Figure 1. I then added an extra band element and made a further check before connecting it to the main dipole and found

PHOTO 2: The original two-element beam hybrid quad by TGM Communications.

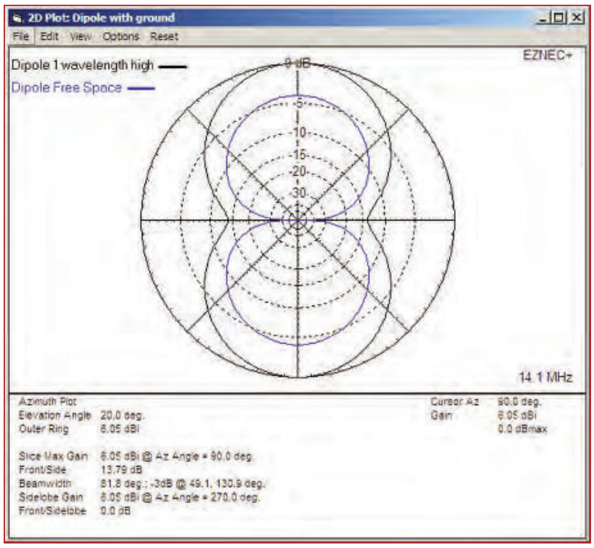

FIGURE 1: Comparison polar diagrams a dipole antenna in free space (blue trace) and the same antenna mounted 10m above ground (black trace), modelled at 20° elevation.

that the antenna exhibited a dual band characteristic. I then added a further band element, again without connecting it to the main dipole. The antenna then had a tri-band characteristic.

In reality this is nothing new and can be found in *The ARRL Antenna Handbook* as the Coupled-Resonator Antenna. I will write about this interesting multiband arrangement in a later Antennas but, in the meantime, I would like to know if anyone out there uses or has used one.

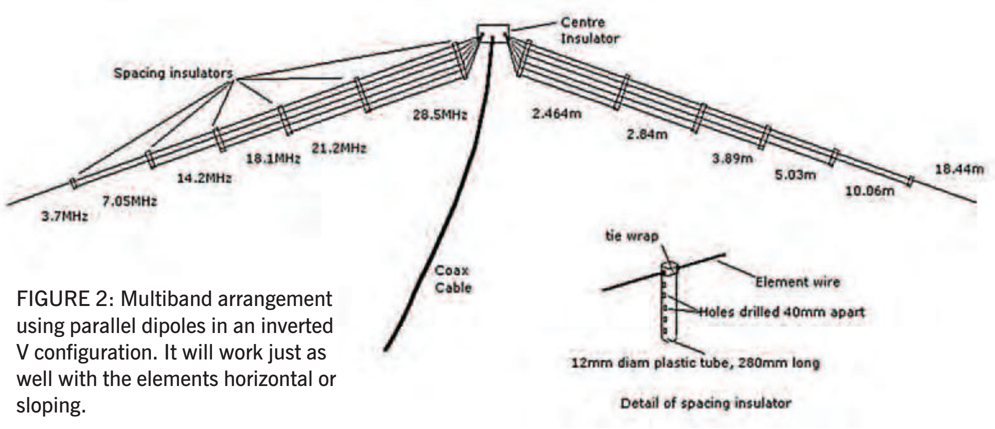

FIGURE 2: Multiband arrangement using parallel dipoles in an inverted V configuration. It will work just as well with the elements horizontal or sloping.

ROTATABLE DIPOLE. While on the subject of dipoles, Steve DeVille, G6TJC, e-mailed me to say "In the November 2010 *RadCom* on page 34, there is a picture of your house showing a rotatable dipole of the roof. May I ask what it is and, assuming you are using it, would it be recommended? I would like to use one as it seems very low profile and neighbour friendly.

This multiband dipole was originally a commercial two-element beam by TGM Communications, called (I think) the MQ-5. It is shown in **Photo 2**. I had this antenna for review. While the SWR characteristics were satisfactory, I found that the F/B directivity was non-existent on the lower frequency bands but reasonable on 10m. Nevertheless, I felt that this arrangement had potential so I bought the antenna after completing the review.

I was not convinced the quad structure was any better than a straight element so I rebuilt the antenna as shown in **Photo 3**. The rebuild included extending the elements and boom and modifying the element end resonators. The object of all this was to hopefully make the directivity adjustment less critical.

In the event the improvement in F/B directivity was not a good as I had hoped but the SWR bandwidth was increased. Furthermore, the antenna performed reasonably well so it stayed up on the chimney for many years, until I did some maintenance work on it in the summer of 2010.

Getting a two-element beam off the roof proved to be problematic for this 78 year old G3 so I reduced it to a dipole by dispensing with the reflector and boom. I removed the silicone compound that covered the element end resonators and inspected the trap inductors, which proved to be in remarkable good shape considering my QTH is only about 400m from the beach. New silicone compound was applied to the resonators and the antenna reinstalled.

The simple dipole antenna was much easier to fix in place, see **Photo 4**. It and performs much the same as it did before removing the reflector. An SWR plot is shown in **Figure 3**. The SWR bandwidth is very narrow at 14MHz and has been tuned to the CW section of the band. It will operate up as the SSB end when used with the internal ATU of my FT-990.

The null at the end of the elements is about 12dB down on the main lobe, which is what you might expect for a dipole in the clear. The only downside it that it picks up electrical noise from the house. I use this multiband dipole as standard for testing other antennas (as described in recent Antennas when comparing it with the multiband quad and the magnetic loop).

In reply to G6TJC's question – would I recommend it? The answer is yes, however at this time I regret I am unable to give constructional details of the resonators. The method I used to modify them was to couple the element to a GDO and adjust the coil turns until the element dipped at the right frequency. I will probably convert the unused reflector into a multi-band dipole when I get the inclination and time and make a note of how it was done.

The only similar dipole I know of is the MFJ-1775, which covers 40 to 10m but not the WARC bands. It also claims to cover the 6 and 2m bands.

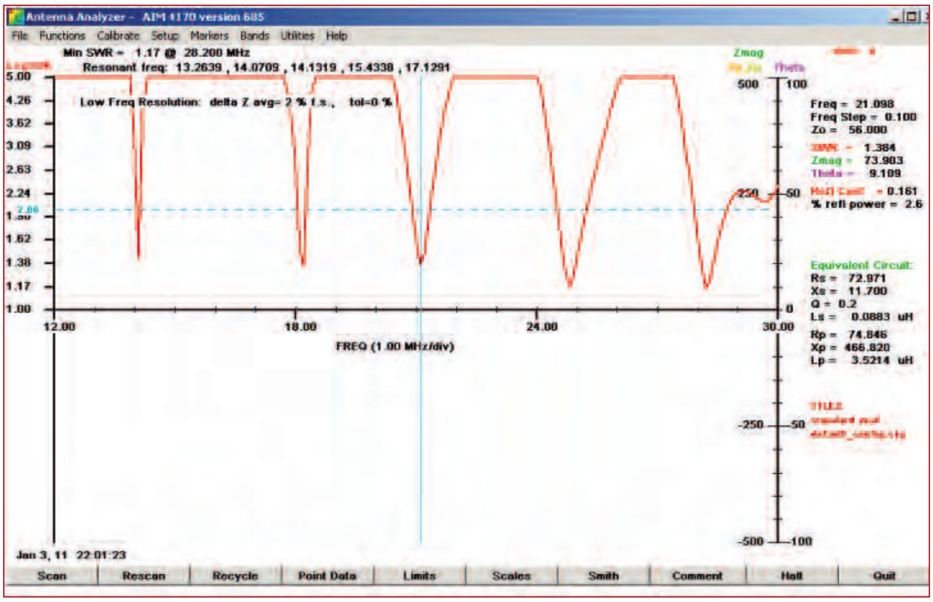

FIGURE 3: SWR plot of my multiband dipole measured using the AIM 4170. The impedance plots have been switched off for clarity.

PHOTO 3: The antenna in Photo 2 rebuilt by extending the elements and boom and modifying the element end resonators.

PHOTO 4: The antenna in Photo 3 converted into a multiband dipole by removing the reflector and the boom.