Note on: INCREASING ANTENNA BANDWIDTH

During the summer of 1982, the author's attention was very much taken up with the idea of CB radio. And, having an interest in amateur radio as well, the DXing field became prominent. A problem that came up in several discussions with other enthusiasts was the tuning of antennas for use over a wide bandwidth. The band in question was 26-28 MHz, as equipment was obtainable which covered that part of the spectrum.

The nature of the problem was that if the whole 2 MHz was to be covered, then some form of antenna tuning was required in order to keep the SWR down to reasonable levels. The only commercially available tuners were in little tin boxes with a couple of screwdriver adjustments which were always fiddly, particularly in a mobile environment.

The author was perusing through an ancient Military Line Communications Handbook one day, when an interesting diagram caught his eye - it showed a quarter wave stub connected at the feed point of a dipole and the accompanying text explained that it was to broaden the bandwidth of the dipole. It further noted that a dipole behaved like a tuned circuit in terms of the way the reactance varied with frequency. However, the stub, although it behaves like a tuned circuit, has one odd feature: the reactance has the opposite sign to that of the tuned circuit! Thus a stub can be used to cancel out positive reactance because it has a negative reactance and vice versa.

The experiment was conducted using a Ford Escort Van with the aerial mounted vertically in the centre of the roof. The antenna feed point was just below the roof and easily accessible. The stub and feed coaxes were UR43 with all connections made using BNC type connectors. Adjustments were done by adding or removing lengths of coax using these connectors. At this frequency, an inch or two does not make too much difference to the result so that in this respect it is an easy band to work on.

The first set of results that were obtained was for comparison purposes. This was a SWR v. frequency plots for the quarter wave (102") whip. NB the antenna was extended at the bottom end in that it was mounted on quick a release connector which effectively increased its length by 2".

The next set of results were obtained using a closed ended stub 56.5" long connected to the antenna feed point just below the van roof. Please remember the velocity factor (0.66) when doing stub length calculations.

As these readings were not what were needed, a half wave open ended stub was tried with some success. This was followed by a three quarter wave closed ended stub and finally by a full wavelength open ended stub. The experiment was halted at this point as a suitable working model had been demonstrated but there is no reason why it should not be extended further, particularly if the antenna is interacting with other reactive elements.

You will see from the graph that the bandwidth of the antenna has been considerably broadened. The stub was shortened slightly so as to tune the 102" whip to the centre
of the band. When the whip was further tested, it was shown to have an SWR of 1.4 at 25.5 MHz and 1.4 at 28.5 MHz. This could be of considerable interest to a radio amateur wishing to cover the whole of the 27 and 28 MHz bands without the bother of aerial tuning.

One factor not taken into account during this exercise was the amount of power dissipated in the stub. The author would be grateful if someone would undertake this task as he feels that it could be quite complex (no pun intended!).

Otherwise, it is felt that this principle could well be extended to beam antennas such as quads with the intention of much improving the front to back 'notch' over the band of interest. At the moment, examination of the specifications of the front to back ratios will demonstrate that it is painfully sensitive to frequency variations and is always quoted at the centre of the band with little or no reference to the performance at the band edges. Remote tuning of quad reflectors is a well documented technique. However, this suggestion takes it a step further in that if both elements of a quad were to have these extended stubs connected to them, then there is the possibility of a wideband beam where no tuning is needed.

Another area worth exploring would be to extent the bandwidth of the resonator in a Coupled Resonator Dipole system.

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