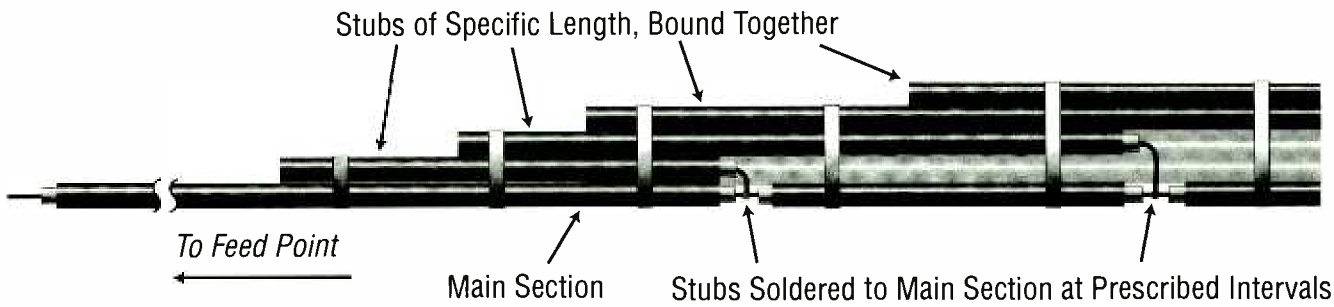
The Multi-Band Multi-Layered Multi-Resonant Antenna



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Unless you are an inveterate knob twiddler (but perhaps that's a requirement to be a *radioist)* you probably do not want to go to the expense and bother of using an antenna tuner between your communications receiver and a random wire antenna. We commonly call these black boxes antenna *tuners*, but they are really not tuning the antenna but trying to match the impedance of the antenna/feedline combination to that of the receiver. They do nothing to "tune" the antenna to resonance at the frequency in use.

It is possible to do away with the cost and bother of a tuner by building this simple multi-band resonant antenna that does not use coils, capacitors, or traps, but just wire and some cable ties! The antenna is automatically "trimmed" to the resonant length of selected bands by the use of 1/4 wavelength stubs.

What is a stub? It is simply a length of wire cut to be a specific fraction of a wavelength to perform an impedance matching or switching function on an antenna or other tuned circuit.

Unlike other multiple frequency resonant antennas, this design does not require the tedious construction of coils and capacitors to form "traps," but simply calls for measuring out lengths of wire of almost any gauge strong enough to support its own weight plus the ability to solder a few connections. For reception purposes, the dimensions given will need no adjustment. If you build the transmitting version, some minor trimming may be needed for optimum SWR.

Look, Ma, no traps! Squeeze the best out of the low propagation with an efficient long wire antenna which — while requiring some mathematical gymnastics to do it right — actually tunes itself.

Although the antenna described is intended to be used as a "long wire," if you construct two identical sections and hook up as also described, they will form an excellent dipole.

For broadcast reception the antenna, as described, will operate on all bands from 90 meters (3 MHz) to 13 meters (22 MHz). (You can include the CB band and the amateur 10 meter band if you so desire with the addition of one stub.) Like all longwire antennas, this one should be operated with a good earth ground. The connection between the radio and the ground rod should be as short as possible using braid or heavy gauge stranded wire.

If your operating position does not allow this because of its location, a "counterpoise" ground will work very well even for transmitting. In this case, make two identical section of the antenna and connect one to the ground post on your radio and deploy it around the perimeter of the operating room. It does not need to be in a straight line to work. Just do not form a small coil or bundle out of it.

Construction

How do we make this wonder? You will need about 220 feet of insulated wire. The gauge is not important but it should be strong enough to support its own weight and the strains place on it by wind and ice if you live in areas where that can be a problem. Sixteen or even 18 gauge will usually be strong enough for the base antenna; the stubs can be almost any gauge you have handy as long as it is insulated.

If you must use thin wire for the base section, bind it together with a length of dacron line to carry the weight. Remember that it must be insulated wire.

DIAGRAM 1: Diagramatic View of the Stub Antenna

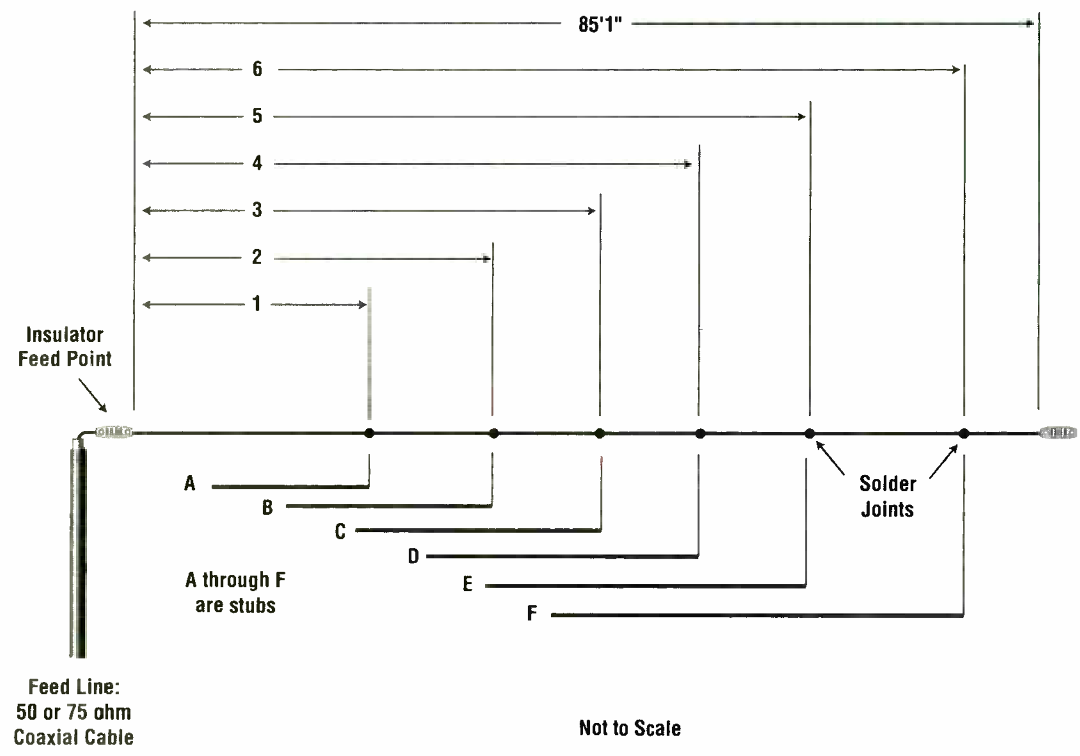


Diagram one shows diagrammatically the construction of the antenna. The stubs are shown away from the main antenna for the sake of this diagram only; they will be all bundled together and held with tape or preferably cable ties when the antenna is finished. If you use cable ties and want the antenna to be as durable as possible, use the black ultraviolet light resistant type. They cost a little more but will last many years in normal use.

The construction of the antenna is very simple. Measure off the length of the main section — 85 feet 1 inch — allowing a little extra at each end to form a loop to attach the suspension cord that will fasten the antenna to your supports. Carefully measure off the distances to the solder points and strip 1/2 inch or so of the insulation at each point; take care not to nick the conductor. Now measure the stubs and cut to length. Strip about 1/2 inch of insulation at one end of each stub.

Bend the bare end into a "hook." Hook it over the correct solder point and solder into place. Check that you have the right stub on the solder point before soldering. Remember the old carpenter's adage: "measure twice, cut once." All that remains is to fold all the stubs back along the main dipole with their free ends toward the fed point.

The whole bundle should now be tightly secured with cable ties or exterior quality tape. The center conductor of the feedline (50 or 75 ohm coaxial cable) should now be attached to the feed point. The shield is not connected at this end. Seal the end of the coax with silicone sealant and hoist the antenna up as high and in the clear as you can get it. Connect the feedline to your radio and you are in business.

Customizing the Design

If you wish to use this technique as a dipole rather than an end fed wire, construct two identical sections and connect the shield of the coax to one and the center to the other. This will now be the center of your antenna. A piece of plywood or plastic should be used as a support to the junction of the feedline and elements as the wire joint should not carry the train. The assembly can be used as a conventional antenna with both ends supported as high as possible, or as an inverted "V" configuration with only the center elevated.

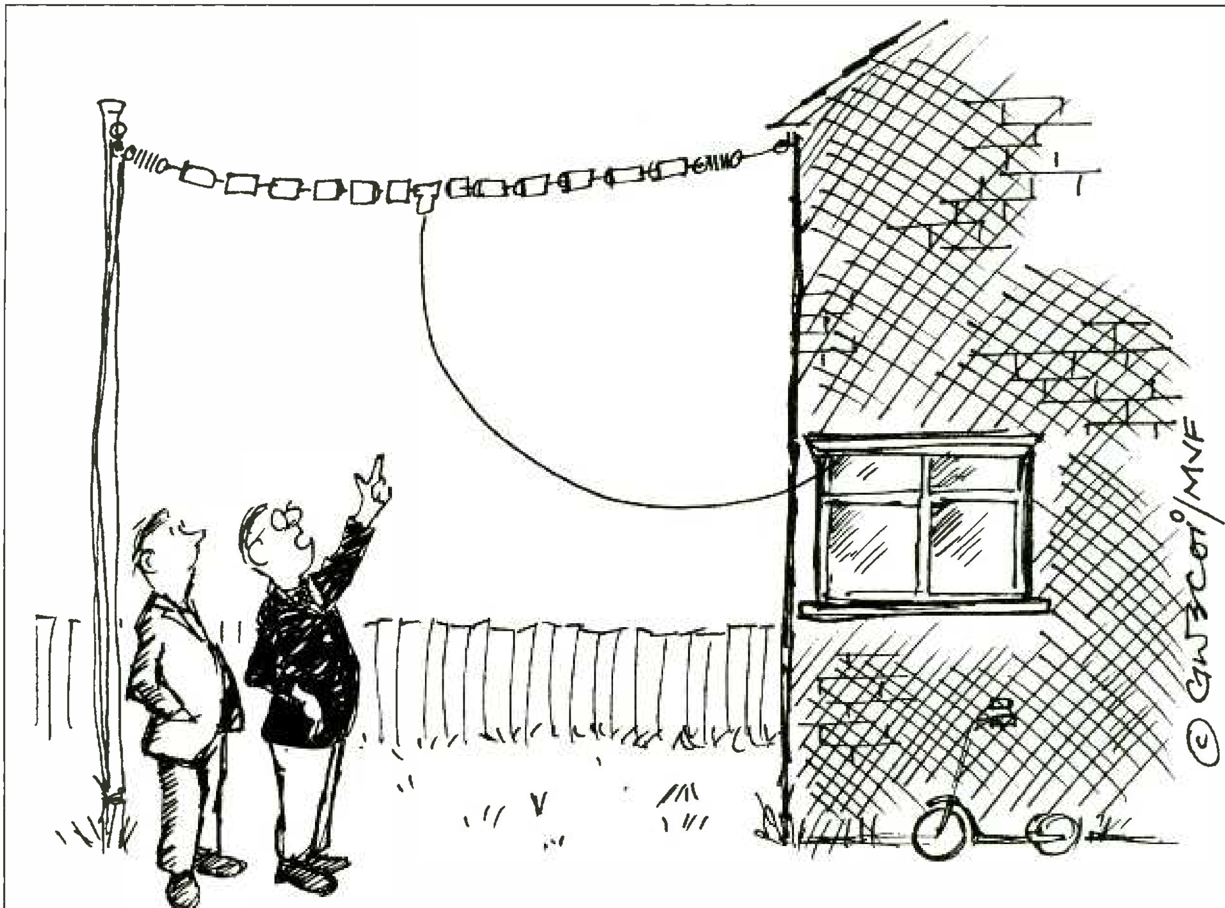
If you wish to try the antenna on other bands for ham use or utility monitoring, the distances of the solder points and lengths of the stubs can be easily calculated. I would recommend using metric units for the measurements as this makes for less errors in calculation.

The base section must be 1/4 wavelength at the lowest frequency on which you wish to operate. This is calculated by the simple formula: 71.5/freq (in MHz) for an answer in metric units, or 234/freq (in MHz) for an

TABLE 1: Length of stubs and solder points for selected SW broadcast bands

Stub	Band	Length in Ft	Length Cms	Solder Point	Dist. from Feed Pt. Ft	Dist. from Feed Pt. Cms
A	13 (21 MHz)	10'5"	317	1	20'10"	634
B	19 (15 MHz)	15'1"	230	2	30'2"	460
C	25 (11.5 MHz)	10'2"	310	3	20'8"	750
D	31 (9.5 MHz)	20'4"	620	4	40'8"	1,240
E	41 (7.2 MHz)	32'11"	1,004	5	65'11"	2,009
F	49 (6 MHz)	38'4"	1,169	6	76'9"	2,339

The base length of 85 ft. 1 in. covers the 90 meter (3.2-3.4 MHz) band



"....ITS THE ULTIMATE IN ALL-BAND TRAP DIPOLES – NO WIRE NEEDED...."

answer in feet. The stub for the next higher frequency is attached to a solder point 1/2 wavelength *from* the feed point. It will be obvious from this that the lowest frequency to be covered must be at least equal to twice the frequency of the next higher frequency. If this seems complicated, look at the diagram given and it should become clear.

Here is an example of the calculation, should you want to add the 10m ham band to the design shown here. The calculation would go as follows:

Length of stub:
71.5/28.4 - 2.54 meters, or 254 cms.
(or)
243/284 - 8.56 feet, or 8 ft. 6-3/4 inches

The attachment point for this would be 1/2 wavelength from the feed point or twice the stub length. In this case, 2 x 8 ft. 6-3/4 in. = 17 ft. 2-1/2 in.

If you wish to design an antenna for utility frequencies, for example, just remember that the base section must be at least as long as 1/2 wavelength of the next lower frequency on which you wish to operate. If not, there will not be enough length to accommodate the stub and its attachment point!

A table is provided in Table 2 for the 40 meter (7 MHz) through 10 meter (29 MHz) ham bands. As the relationship of the 20 (14 MHz) and 40 meter (7 MHz) bands is harmonic, the full length of the base section is the same as the distance to the first solder point. This will be the exception rather than the rule for other services.

This antenna is much simpler to build than describe, will give you a resonant antenna on several bands, and does not require a tuner. The wire size is not critical and, in fact, you can use different gauge wire for each section if that is what you have on hand. Like most any antenna, the higher in the clear that it can be mounted, the better it will perform. And, like all end fed antennas, it will work most effectively against a good earth ground.

Always remember when mounting antennas to keep personal safety in mind and look out for high voltage cable.

Whether you're an amateur radio operator or a shortwave listener, half the fun is using something you built yourself. Break out of the "appliance operator" mode and try this simple and inexpensive project.

TABLE 2: Length of stubs and solder point distances for selected ham bands

Stub	Band	Length in Ft.	Length Cms.	Solder Point	Dist. from Feed Pt. Ft.	Dist. from Feed Pt. Cms.
A	10 (29 MHz)	8' 4-1/2"	255	1	18'9"	510
B	12 (24 MHz)	9'5"	287	2	18'120"	573
C	15 (21 MHz)	11'1-1/2"	340	3	22'3"	679
D	17 (18 MHz)	12'11-1/2"	395	4	25'11"	789
E	20 (14 MHz)	16'8-1/2"	510	5	32'5"	1,109

Basic antenna length is 32 ft. 5 in. Note: In this special case the solder point E is at the end of the basic section due to the exact harmonic relationship of the 40 (7 MHz) and 20 meter (14 MHz) bands.