MW And LW Noise Reducing Antennas

Dallas Lankford, 7/21/05, rev. 12/10/07

Noise reducing antennas (also called interference reducing antennas) were originally developed by F. R. W. Strafford in the 1930's and then redeveloped in the early 1990's by Denzil Wraight who found the articles published by Strafford in the 1930's. Some of the information contained in this article appeared in two articles written by Denzil Wraight and me during the summer of 1991 and published by The National Radio Club in their bulletin, ***DX News***. Reprints of both 1991 articles may be purchased from The National Radio Club . Interestingly, later some crippled commercial coax lead-in versions of Strafford's antenna transformer appeared, called the Magnetic Longwire Balun and similar. It has been claimed that these kinds of MW and LW noise reducing antennas reduce noise in the SW bands, but I have found that to be mostly wishful thinking. Noise reducing antennas are reasonably good SW antennas; they just don't reduce noise much above 3 MHz, and virtually not at all above 6 MHz compared to an ordinary long wire antenna. It has also been claimed that a noise reducing antennas (which was not implemented correctly) was noisy compared to loop antennas in the MW and LW bands. But thorough tests (with correctly implemented antennas) have shown that noise reducing antennas have better signal to man made noise ratios than many kinds of loop antennas in the MW and LW bands; see, for example, "Measurements of some antennas signal to man made noise ratios" in The Dallas Files for comparisons of noise reducing antennas with a 60' circumference ALA-100. My main contributions to the rediscovery of Strafford's noise reducing antennas at that time were to develop antenna and receiver matching transformers which used Amidon ferrite toroids (Denzil's transformers used Siemens toroids), and to investigate the noise reducing properties of Strafford's antennas at my location. More recently I have investigated variants of Strafford's noise reducing vertical antennas.

Strafford's antennas do not reduce noise by being remotely located (far away from your house), which has been proposed by some as a method for reducing noise. Locating the antenna 50 feet away from my house had almost no additional noise reduction compared to locating the transformer a few feet away from my house with the horizontal part pointed away from my house. Strafford's antennas are inherently noise reducing and may be located near your house. Of course, you should locate any antenna as far away from power lines as possible, and turn off all noise makers in your house. It has also been claimed that the noise reduction of remotely located antennas with coax lead-in was due to separating the ground of the primary antenna transformer from the receiver ground and/or coax ground. However, I have found that separating those grounds only slightly reduces noise, if at all, for Strafford antennas with (and without) coax lead-in, for both inverted L and vertical antennas. Others have found no evidence of noise reduction by separating grounds for beverage antennas and coax lead-in. Of course, there is no harm in locating your noise reducing antenna remotely or using separate grounds.

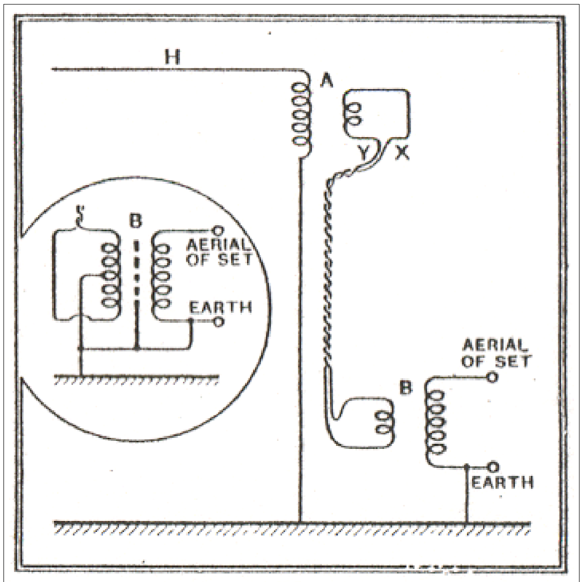


Fig. 4.—Similar arrangement to that of Fig. 3, but with the down-lead screen replaced by an earthed wire. Inset: a balanced centre-tapped transformer.

Figure 4 at right is from one of Strafford's articles. I have used the more elaborate receiver transformer (balanced center-tapped and shielded) on several occasions, but it has never given me any additional noise reduction. The simple receiver transformer version of Figure 4, without the center tapped receiver transformer, and without shielding between the primary and secondary of the receiver transformer, is what I have always used. In the past at an urban location it has typically given 10 to 15 dB or more noise reduction in the 100 kHz to 2 - 3 MHz frequency range. Presently I live at a quieter location and the amount of noise reduction is not as great. I used an insulated Amidon FT-114-75 or -J toroid as described in Fig. 5A below, with 36T:9T turns ratio for my inverted L antenna transformer, Radio Shack speaker wire for twin lead lead-in, and 8 bifilar turns on an insulated Amidon FT-50-75 toroid for a receiver transformer.

Here is what I wrote in my original article about 16 years ago. "According to Strafford, these kinds of noise reducing antennas are most effective against nearby noise, i.e., against noise which originates in your house or apartment, in nearby houses, in nearby power lines, and so on. Noise which will be reduced or eliminated includes, but is not limited to, TV horizontal oscillator harmonics (HOH) and associated noise sidebands, fluorescent light noise, air conditioner compressor motor noise, air conditioner fan and heater fan noise, power line noise, and vacuum cleaner motor noise. The amount of reduction depends on the type of noise, the location of the noise source relative to the antenna, and perhaps other factors. Strafford said that noise reduction with a vertical noise reducing antenna was 30 to 100 (30 dB to 40 dB), but he did not specify what antenna his noise reducing antenna was compared to. In my experience, the amount of noise reduction (both with my inverted L and with a 30 foot vertical noise reducing antenna) is not as great, namely 3 to 56 (10 dB to 35 dB)compared to my original inverted L. With my noise reducing inverted L, fluorescent light noise was reduced 10 to 15 dB, TV HOH and associated noise sidebands were reduced about 15 dB, air conditioner compressor motor and AC/heater fan motor noise were virtually eliminated, power line noise (60 Hz harmonics) were reduced to the threshold of detectability, vacuum cleaner motor noise was reduced more than 30 dB and virtually eliminated, and assorted regular noise "pests" of undetermined origin were reduced 15 to 25 dB. There is now only one irregular "pest" which ruins daytime MW listening, a 40 dB + monster which used to "kill" the entire MW band except for strong locals. It is still a serious problem even though it has been reduced about 20 dB. Fortunately it does not appear often, and never at night. Curiously, it is my only remaining noise source where nulling it with my loop will produce clearer weak signal reception than the noise reducing inverted L."

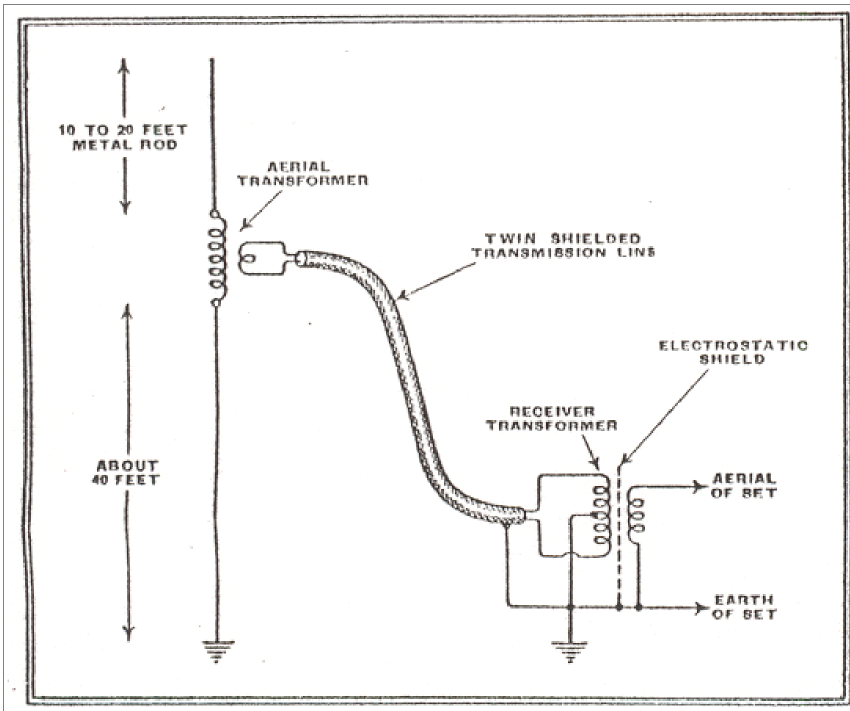
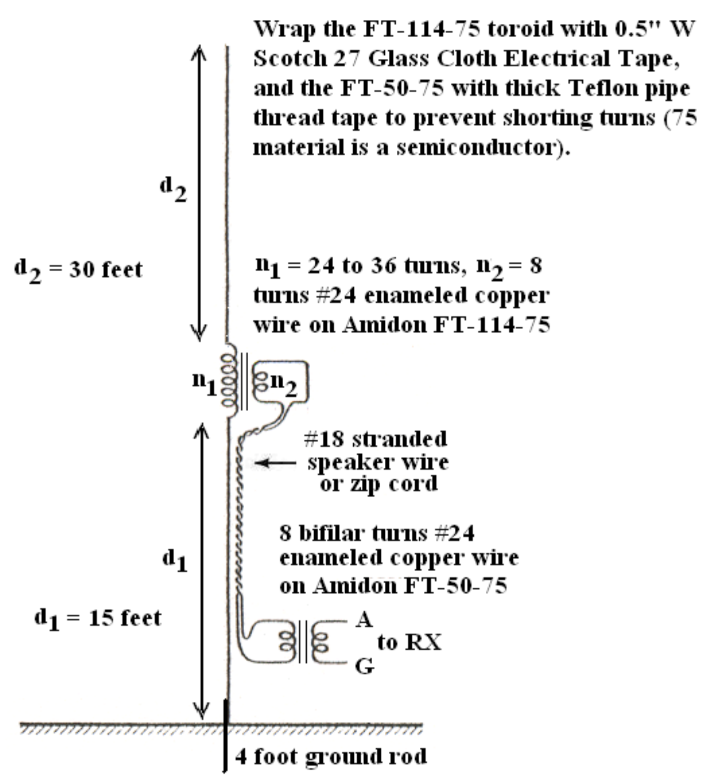


Fig. 5.—Circuit of typical vertical anti-interference aerial.

A few things have changed since the above was written. I never hear TV HOH any more. I don't know why. Maybe my neighbor or I had a noisy TV years ago. Or maybe TV's don't radiate as much HOH nowadays. But now I often hear digital noise which originates from some of my switching power supplies (laptop computer, inkjet printer, wireless network, etc.), as if to make up for the vanished HOH. My switchers are heard in and around the MW band only when ambient power line noise drops to low levels, but are heard regularly above about 10 MHz, where man made noise is lower. When present, my switcher noise is heard approximately every 65 kHz. My noise reducing antennas reduce but do not completely eliminate digital noise at lower frequencies. At higher frequencies, above about 6 MHz, my noise reducing antennas do not reduce digital noise at all. In both cases, to completely eliminate switching power supply digital noise the switchers must be unplugged from the wall socket.

For a few years I used a noise reducing inverted L antenna as my primary MW antenna, both stand alone, and together with a 2 foot air core loop antenna as part of a phased array using simple phasers I developed. Then, beginning about 10 years ago, after I built my first Misek phaser, the loop antenna was retired and I used a phased array based on a pair of noise reducing inverted L antennas separated by about 150 feet. As a precaution against intermodulation distortion, I shortened the horizontal elements from the 65 feet I originally used to 30 feet (the vertical inverted L elements were always about 15 feet). Despite what many people believe, longer is not better (except for beverages, up to a point), unless you have very low levels of man made noise. If you can hear man made noise clearly (and I do not mean 20 dB over S-9 of man made noise), your antenna is long enough. At that time I experimented briefly with noise reducing vertical antennas, but concluded that the signal output was unacceptably low for phased arrays. There matters remained until a few months ago when I gave noise reducing verticals another try. Figure 5 above is what Strafford recommended for a noise reducing vertical antenna, and is probably similar to what I implemented about 10 years ago.

However, this time I did not copy Strafford's Figure 5 exactly. Instead of locating the antenna transformer near the top of the vertical antenna, I located it near the bottom, about 15 feet above the ground rod, and used 30 feet of wire above the antenna transformer.



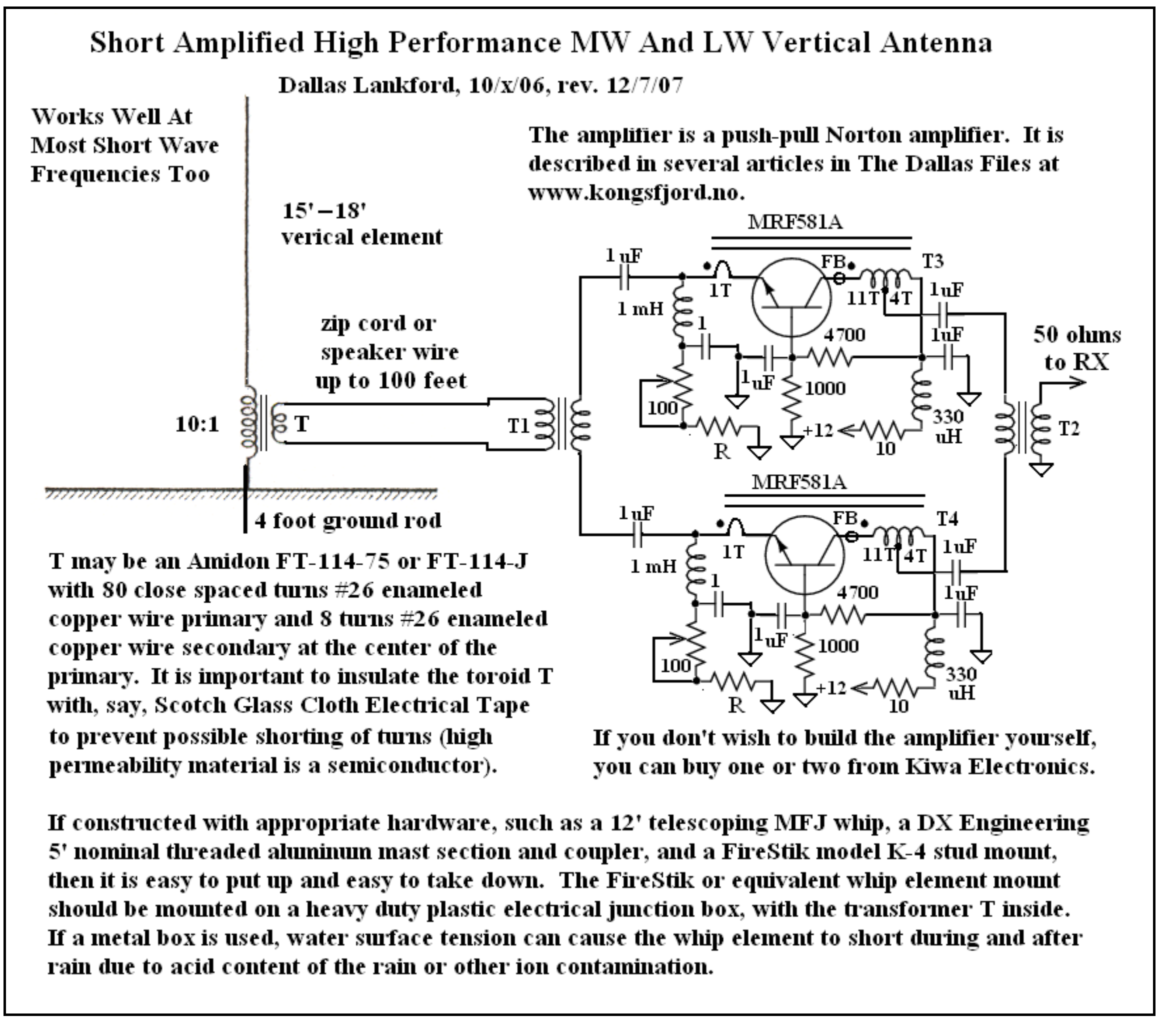
My New Noise Reducing Vertical Antenna

Fig. 5A

As a matter of fact I used one of my inverted L's and some 1/4 inch diameter nylon rope to hoist the vertical contraption over a high branch of a pine tree in my yard. The nylon rope was pulled over the high branch with 20 lb test fishing line which had been shot over the limb using a 2 ounce lead sinker and a heavy duty sling shot. The 15 foot height of the antenna transformer permits the twin lead to be run high enough above ground level so that people can walk underneath it. I briefly tried a balanced center-tapped receiver transformer and electrostatic shield with one of my verticals which Strafford recommended, but it gave no additional noise reduction compared to the simple 8 turn bifilar transformer which I normally use.

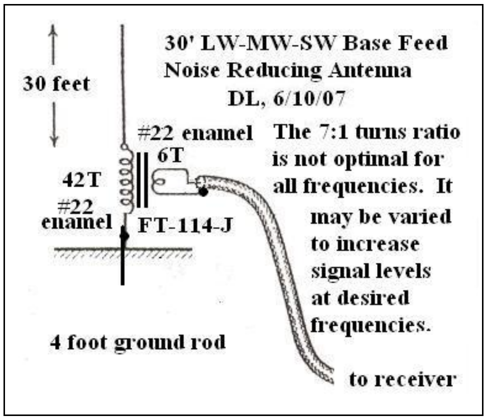
Signal levels for this 15'v+30'v noise reducing vertical antenna have been excellent, greater than my 15'v+30'h inverted L's. The verticals reduce noise at least as well as the L's in all cases, and for some daytime groundwave signals my new verticals reduce noise up to 10 dB more than the L's. Eventually I may reduce the heights of my verticals to minimize potential intermod because the signal levels are greater than necessary at my location. My new noise reducing verticals also have better long term null stability for daytime groundwave signals than my noise reducing inverted L's, and work equally well with my big air core loop antennas for LW nulls. It is difficult to say if the phased verticals have better long term null stability for nighttime skywaves than phased inverted L's because of inherent differences (polarization, etc.) between verticals and L's; in any case, the verticals seem no worse than inverted L's for skywaves. Consequently, my inverted L's have been retired, and my new noise reducing verticals spaced 150 feet apart (but see my recent article on MW phased verticals spaced 60 feet) are my primary phased array for MW. For information on the phasers I use go to The Dallas Files .

The turns ratio of the antenna transformer of my new noise reducing vertical antenna may be anything from 3:1 (9:1 impedance ratio) to 4:1 (16:1 Z), or even 5:1 (25:1 Z). The vertical antenna transformer may be mounted at the ground ($d_1 = 0$). I chose $d_1 = 15$ feet because is was easy to reach by ladder to provide strain relief for the twin lead (by tying the twin lead to the trunk of the tree). I have found no difference in noise reduction between mounting the antenna transformer at the ground or 15 feet up.



Above is what might be called a "miniature" or "portable" noise reducing vertical antenna. It can be easily moved if one of your neighbors develops a new man made noise source, which happened recently to me. The compressor motor of their heat pump “sprang a leak” and started emitting RFI in the 15 – 30 MHz frequency range. My 15' noise reducing vertical was too close to my neighbor's heat pump to eliminate its noise, so I moved the antenna as far away as possible. The only convenient new location for my vertical noise reducing antenna was a few feet from the corner of my garage which was also just outside my kitchen. After turning off my garage door wireless transmitter and turning off my kitchen florescent light the the new location man made noise was as low as it had been 30' away from my house. A more elaborate version of the miniature 15' noise reducing vertical antenna with greater signal output at the higher SW frequencies is described in my article “LW-MW-SW Relay Tuned 15' Noise Reducing Vertical Antenna” in The Dallas Files . An insulated box should be used to mount the whip element; otherwise shorts may/will occur during and after rain due to acid or other ion contamination of the rain if/when surface tension bridges the insulator. My main MW antenna array at present is a phased pair of these amplified 15' noise reducing vertical antennas; they are tough to beat.

A friend of mine asked if I would design a base fed 30 foot noise reducing antenna for a friend of his. His friend lived in a subdivision with restrictions which prevented him from putting up a traditional antenna. However, the restrictions did not prevent him from putting up a 30 foot aluminum flag pole. Craftily he made an insulator for the flag pole base, ran buried coax from his house to the flag pole, and installed a ground rod near the base. All that he needed to make this a “stealth” noise reducing antenna was a transformer, which I provided. I believe he ended up with a 42T to 7T ratio, which gave him slightly better SW signal levels. The 42T to 6T is optimal for the MW band. As we have said before, the FT-114-75 or -J toroid should be insulated.



For a short wave noise reducing antenna Strafford recommended a 40 foot (horizontal length) doublet. Two versions of Strafford's noise reducing short wave doublet antenna are given in his Figure 6. I briefly used two copies of Figure 6 (b) in the 21.5 MHz band for experiments with HF phased arrays, but did not investigate their noise reducing properties. Noise in the SW bands has seldom been a problem for me, and when it has, null steering a pair of standard Strafford MW/LW antennas always eliminated SW noise for me, even above 20 MHz. Moreover, short dipoles at low heights have progressively less signal output as frequency decreases compared to inverted L's and verticals of similar lengths, which makes them unacceptable as MW and LW antennas.

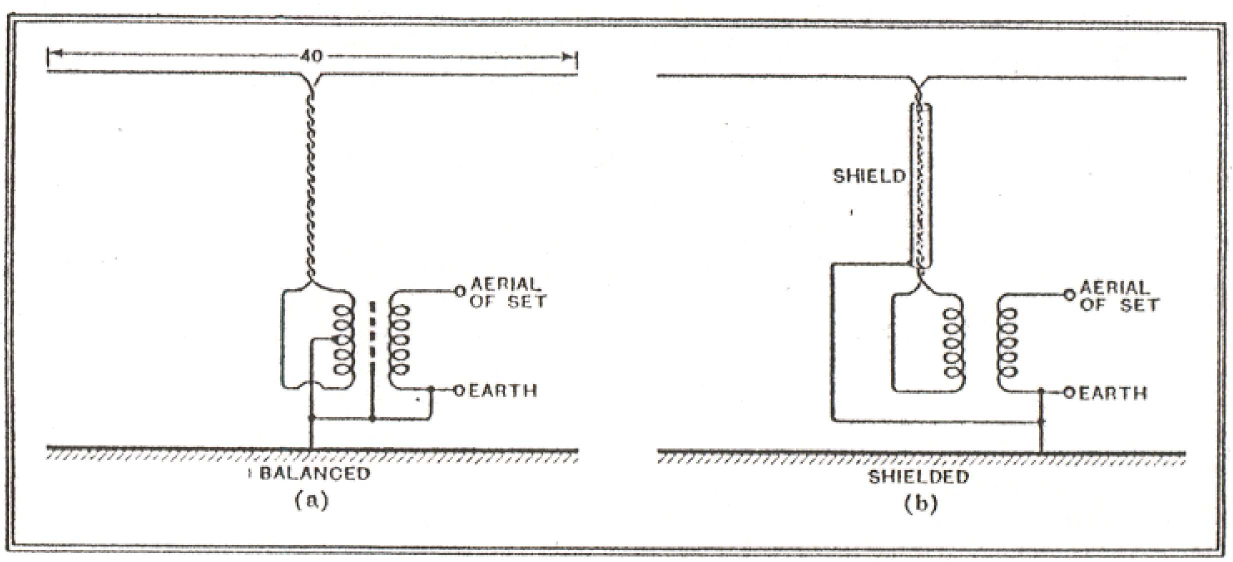


Fig. 6.—Balanced and shielded anti-interference aerials for short-wave reception.