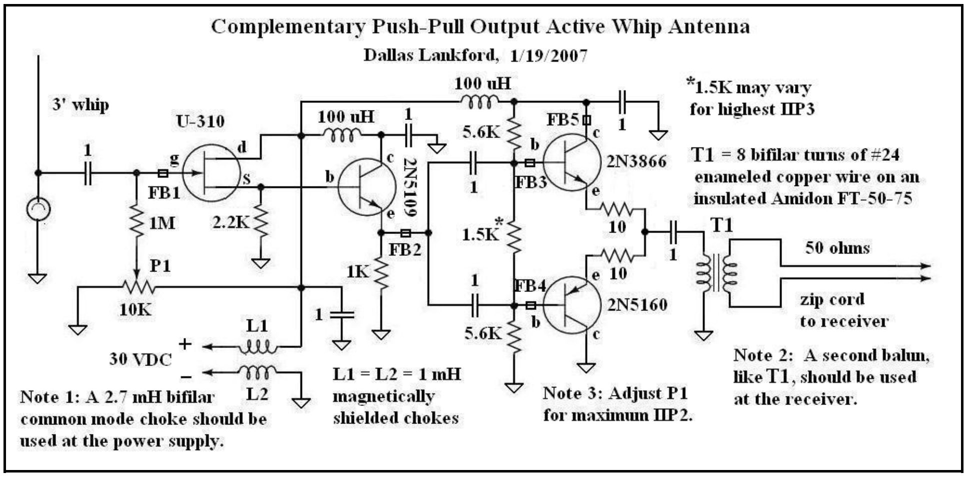
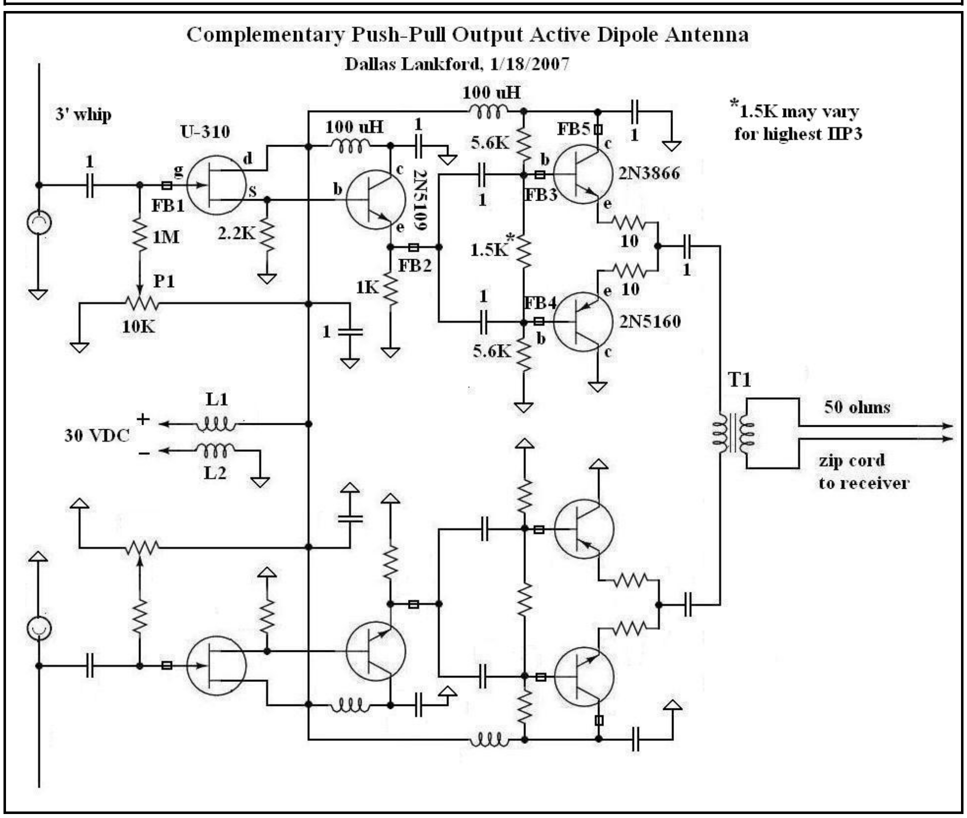
Complementary Push-Pull Output Active Whip And Dipole Antennas

Dallas Lankford, 1/14/2007, rev. 7/22/2007





This is the best LW-MW-SW active whip antenna you can buy or build relative to 2nd and 3rd order input intercepts. In the MW band its 3rd order input intercepts IIP3s are typically +59 dBm, and its 2nd order input intercepts IIP2s are typically +114 dBm. The IIP2s of this whip in the MW band are about 20 dB or more greater than the nearest competitor, and IIP3s of this whip in the MW band are about 8 dB or more greater than the nearest competitor. Intercepts in the SW and LW (NDB) bands are similar.

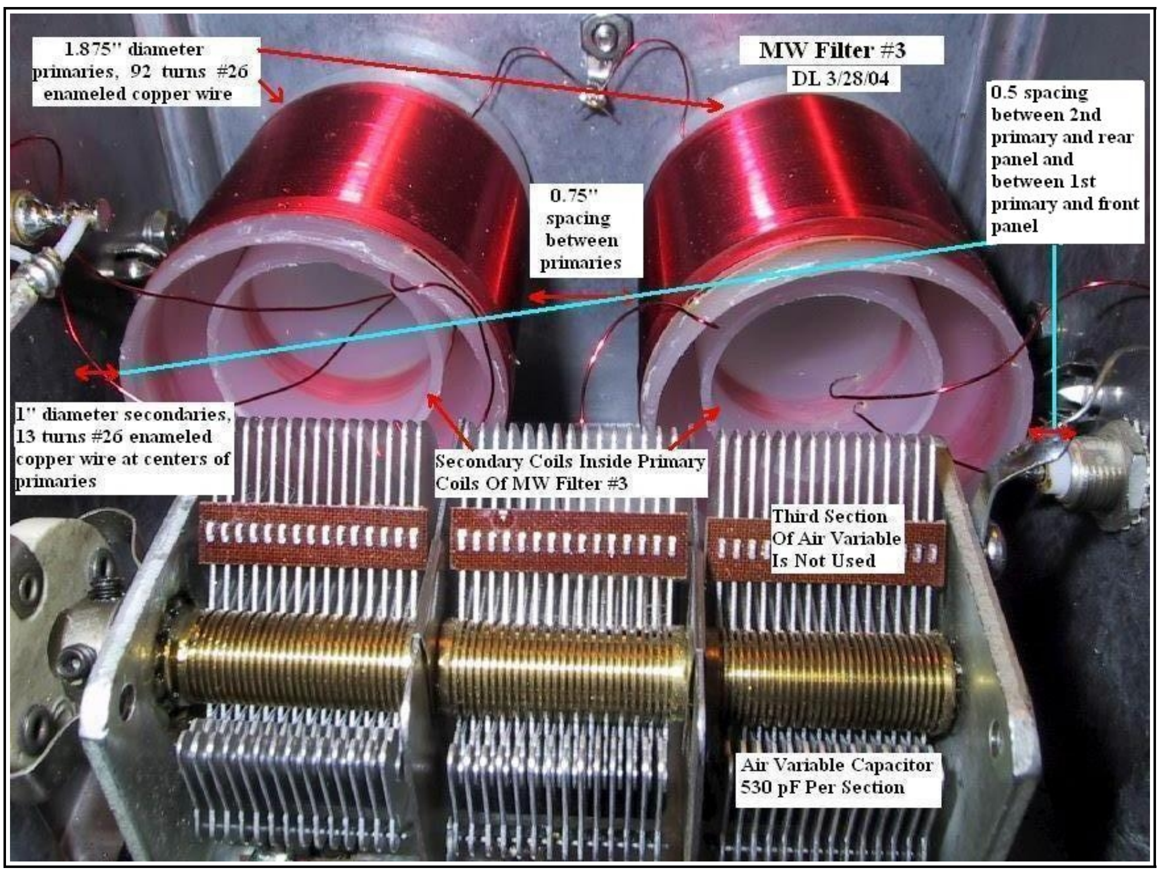
Although similar to parts of other active whip antennas, such as the complementary push-pull output whip antenna designed by Nordholt, my active whip antenna is quite different from any of them, and the differences account for the higher intercepts The parasitic suppression chokes, namely the ferrite beads and the 100 uH decoupling chokes, are especially important for obtaining the high intercepts as well as for suppressing parasitics and should not be omitted. If omitted, the parasitics may be transient, quite difficult to observe, even with the best spectrum analyzers, and look like discontinuities rather than traditional parasitics. A well known DXer has claimed that this is a copy his active whip antenna. Of course, that is not true. Perhaps he is just jealous that I have developed a much better active whip antenna than his. As a matter of fact, he has acknowledged that he can't even measure the much higher intercepts of my active whip antenna (he would need to build a copy my measurement system because no other IMD measurement system can make such high intercept measurements). This is also the same DXer who has built and sold copies of MW Phaser #2 without any reference to MW Phaser #2. Furthermore, “his” active whip antenna is not his. It was designed by an engineer at the company where he worked as a technician. So who do you suppose is copying whose designs? The facts speak for themselves.

All parts for this whip antenna are readily available. For example, you can buy the 2N5160, 2N3866, and 2N5109 on line from [American Microsemiconductor](#) for $9.65, $2.75, and $1.79 respectively plus shipping. The U-310 is available from many suppliers, including Mouser. The FB64-101 (or FB61-101) ferrite beads and FT-50-75 ferrite toroid are also available from many suppliers.

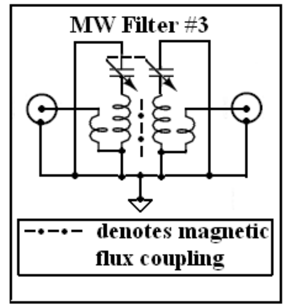
The active dipole antenna version of this active whip is a pair of opposed whips with push-pull output. These active whip and dipole antennas have a frequency range of about 100 kHz to more than 30 MHz. Gain is about 2.5 dB. The 2N3866 and 2N5160 should be heat sinked. The front end of the active whip should be protected with a gas discharge tube, and the active dipole protected with two gas discharge tubes.

The active whip and dipole may be operated from 24 VDC with slightly lower IIP3. When the operating voltage is changed, the adjustment of P1 for maximum IIP2 must be redone. For an active dipole, adjust each P1 separately. In theory the dipole IIP2 should be at least 20 dB higher than the whip, but my intermodulation distortion measurement system can not measure such high 2nd order intercepts.

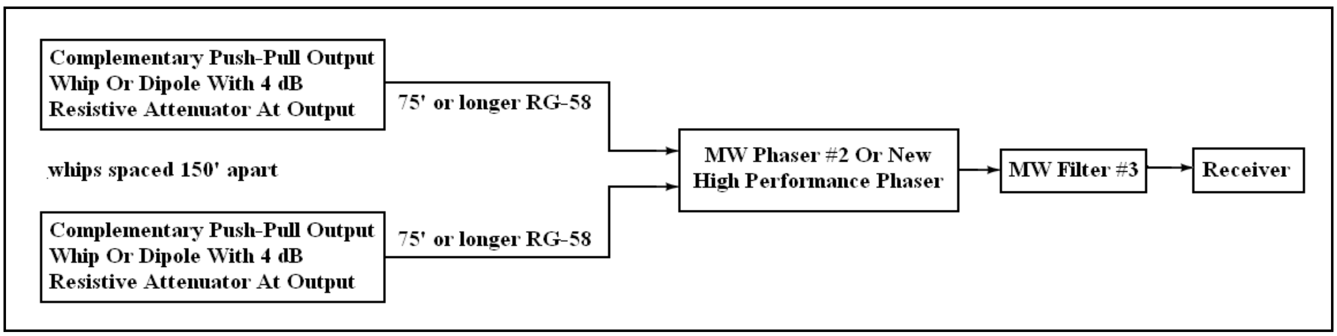
Excluding home made receivers, there are no receivers with IIP2s as high as the active whip antenna above, and only a few with wide spaced IIP3s anywhere nearly as high. To determine if a filter with extremely high intercepts could be used between the active whip antenna and a receiver to raise the IIO2 and wide spaced IIP3 of a whip antenna and receiver, a MW Filter #3 (cf. The Dallas Files) was inserted between the output of of the active whip and the antenna input of an R-390A, with 50 feet of RG-58 coax between the whip and the filter to simulate an actual whip



installation. Some wide spaced IIP3s were degraded about 5 dB compared to the stand alone whip with 50 ohm real termination, and IIP2s of the active whip were degraded by about 10 dB, presumably by the reactive load of the filter input. A 4 dB resistive attenuator was inserted at the output of the whip to provide better whip termination. That resulted in IIP2s $\geq$ +104 dBm IIP3s $\geq$ +54 dBm, provided the tones are spaced wide enough apart, in the MW band for the active whip antenna, MW Filter #3, and R-390A or ICOM IC-746Pro. For other receivers the resulting intercepts may be different. In the unlikely event that an amplifier is needed to make up for the attenuator loss, a push-pull Norton amp is recommended. A few details of MW Filter #3 are given here. Whether or not these results can be extended to the SW and LW bands remains to be seen.



The complementary push-pull output whips and MW Filter #3 combination interface well with my MW Phaser #2 or my New High Performance Phasers (in The Dallas Files), resulting in a phased array receiving system with extremely high intercepts; see the system diagram below. If a whip and dipole are used, the dipole may need to be amplified, say by a 10 dB gain push-pull Norton amplifier, and the amplifier should be inserted at the input of the phaser, which may lower system intercepts. The only case where a whip and dipole should be used is for LF phasing, and they need not be separated. For MW, two spaced whips should be used. If other phasers are used, the resulting system will not have intercepts anywhere nearly as high as the system below, which are IIP2 $\geq$ +104 dBm and IIP3 $\geq$ +54 dBm in the MW band, provided the tones are spaced far enough apart, when using an R-390A or an ICOM IC-746Pro. Performance should be similar when using other receivers. Filters are not presently available to measure performance of a similar system for LW and SW.



If you hear it, it's there. I heard that said about R-390As many years ago. While it is somewhat true (R-390A 2nd order and close in 3rd order performance leave something to be desired), the accessories and systems presented here make it closer to the truth, not only for R-390As, but for other receivers as well.

A phased array system similar to the above can be developed for SW frequencies. The article “SW Filter #2” in The Dallas Files describes a tuned filter similar to MW Filter #3 which provides high intercepts in the 2 – 10.5 MHz frequency range.

For adjustment of P1 a very high 2nd order intercept intermodulation distortion measurement system is required. Such a system is described in “Virtually Linear RF Notch Filters” in The Dallas Files.