Complementary J310 – J271 FET Follower

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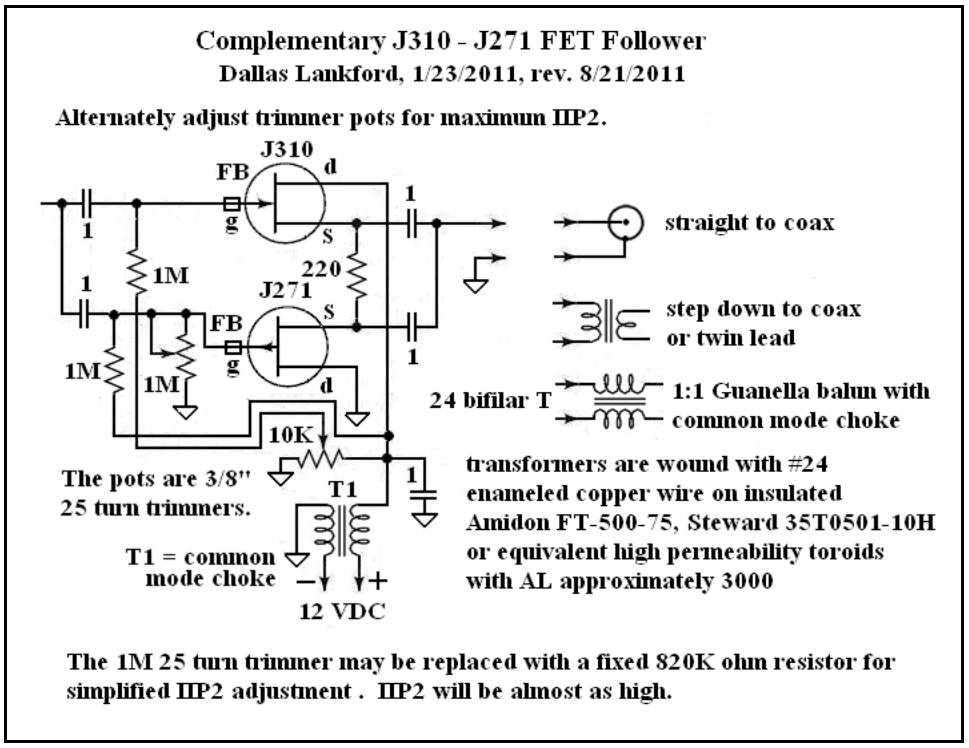

My FET follower above uses a complementary J310 – J271 pair like Trask did in his critical review. But there the similarity ends. Using a J310 – J271 complementary pair was Trask's one and only one good idea.[1] Trask did not develop that one good idea further. The 220 ohm source bias resistor was recommended to me by Jack Smith of Clifton Laboratories some time ago because of problems which Jack encountered with the 100 ohm source bias resistor which Trask used. Trask used no gate bias adjust pots. The J310 gate bias adjust pot is related to the gate bias adjustment used in the KAA 1000 active antenna in 1982. The separation of gate biases is my idea. As Jack said, "Your circuit is better than Trask's in that the P and N FET have different gate voltages. Since the gate voltages are independently set, it's possible to arrive at the correct bias voltage to make the P and N FET's operate at a point where the voltage drop across each is at the desired 50% or so of Vdd." The J310 adjustable gate bias allows IIP2 to be increased compared to a complementary J310 – J271 without adjustable gate bias, and the separated gate bias adjustments allows IIP2 to be further increased. IIP2 is sensitive to variation in the DC supply voltage, so a production version of the FET follower above should use a 12 volt low drop out voltage regulator and the DC supply voltage should be sufficiently greater than 12 volts to maintain regulation which will prevent IIP2 from changing after the gate bias adjustments are made.

The schematic above shows 3 outputs: (1) Direct output to coax, (2) Impedance step down transformer to coax or twin lead, and (3) Guanella 1:1 transformer with built in common mode choke to coax or twin lead. I always use twin lead when using the FET follower as an active head for an antenna. Trask output his FET follower into a low performance BJT complementary pair which degraded the IIP2 of his FET follower. There is a complementary pair of BJT's which can improve the intercepts of the J310 – J271 complementary pair, namely mine. This may be useful when the FET follower above is supercharged. A supercharged FET follower schematic is shown at the end of this article. However, there may be better ways to increase the intercepts of the supercharged FET follower, such as by connecting the output of the FET follower directly to one of my LIN's. That remains to be seen.

1 See his inaccurate attempted copy of my active whip schematic and his incorrect statements about my Simplified Complementary Push-Pull Output Active Whip Antennas in his critical review here .

The main purpose of this note, aside from bring together scattered information on my J310 – J271 FET follower, is to draw attention to a curious fact about the J310 – J271 follower which I only just discovered yesterday. Heretofore all of my applications of the J310 – J271 FET follower as active heads for various antenna elements used a step down transformer (to match the 150 ohms nominal output impedance of the follower to 100 ohms for twinax of 50 ohms for 50 ohm interfaces) follower by a high impedance common mode choke consisting of 24 bifilar turns of #24 enameled copper wire on a Steward 35T0501-10H toroid. The Steward toroid is epoxy coated, so insulating it before winding turns of enameled wire is not necessary. The 0.5" OD Steward toroid will take only about 15 one layer bifilar turns of #24 enameled copper wire, so the remaining 9 turns were wound as a second twisted pair layer. While making preparations yesterday for an upcoming tests of a dual active delta flag array, the measured intercepts of two new J310 – J271 FET followers were both considerably higher than they should have been. Bad FET's? Nope. I replaced the FET's in both and the intercepts were still lower than they should have been. How had I measured the intercepts of the previous J310 – J271 that I measured? I made no record. Bad record keeping. Duuuhhh... So I started "deconstructing" one of the followers. The common mode choke was removed first. No change. When the step down transformer was removed, the intercepts when back up to previously measured values. The intercepts remained high when the common mode choke was reinstalled without the step down transformer. So the Guanella 1:1 balun with built in common mode choke now provides the needed interface for twin lead.

The 10:8 step down transformer had lowered IIP3 by about 10 dB and IIP2 by about 20 dB. This was not an isolated occurrence. The step down transformer was removed from 4 (four) followers, and the intercept change was the same for them all. You could have knocked me over with a feather. I have never heard of or experienced such a thing before. Impedance matching degrades intercepts??? Yep. It did in these cases.

The next question was whether the impedance mismatch affected the dual flag pattern. So last night two new FET followers with Guanella 1:1 balun outputs were connected to two full size delta flag elements with fixed 1000 ohm resister terminations and measurements of a dual delta flag array with 200' each of shielded twinax commenced as the sun set. I am happy to report that the patterns (mainly the nulls) were fine.