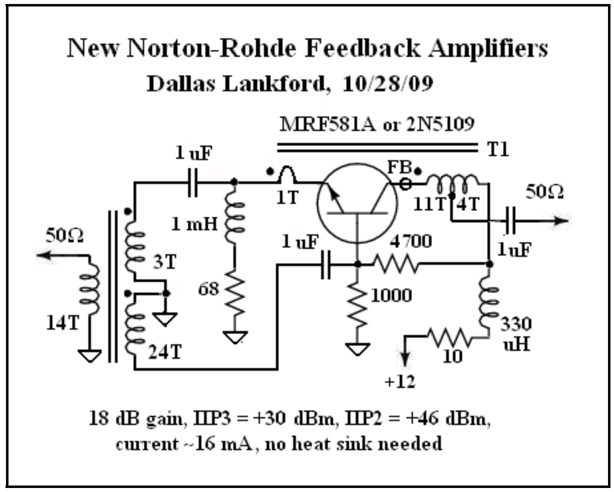
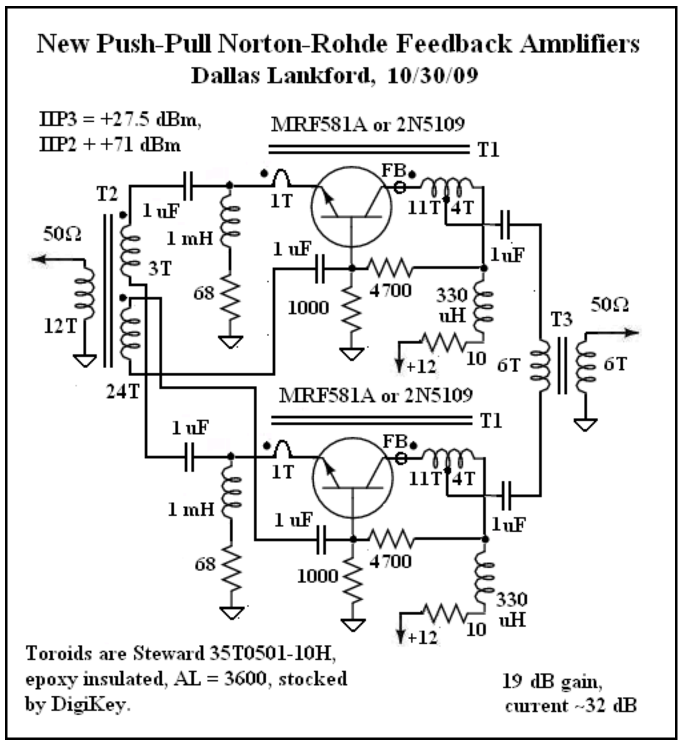
New Norton-Rohde Feedback Amplifiers

Dallas Lankford, 10/31/09



The amplifiers described here are based on the circuit in Figure 3 of Rohde's November 1979 ***Ham Radio*** article, "Wideband amplifier summary," which in turn was based on Norton's transformer feedback amplifiers.

The low noise and high gain amplifiers in this article were developed for use with low signal output flag, delta flag, and similar antennas. The intercepts are not especially high, only high enough so that the effective intercepts (the amp intercepts plus the relative signal loss of the antenna) would be regarded as good. For example, the push-pull amplifier below right has input intercepts +27.5 dBm and +71 dBm for 3rd and 2nd order respectively. For a quad delta flag antenna array with approximately 20 dB signal output loss, the effective input intercepts of the push pull amplifier when attached to the output of a QDFA combiner would be +47.5 dBm and +91 dBm for 3rd and 2nd order respectively. Furthermore, the noise output of the push-pull amp at right is less than the noise output of two cascaded 10.8 dB gain push-pull Norton amps.



These features make the Rohde-Norton amp at right attractive for amplifying low signal level output antennas. There has also been some concern that lead-in signal pickup due to long lengths of lead-in between the phaser and receiver might compromise the patterns of low signal output arrays. If so, the push-pull amp at right might also be useful for that application.

As can be seen from the first figure above, these new amps are Norton transformer feedback amps with the emitter bypass capacitor "lifted" to provide a second signal input to the base, and with a different input transformer to accommodate the additional signal input. So it is like combining a transformer feedback common emitter amplifier (Norton) with a common base amplifier (this change due to Rohde). Different input transformer turns ratios (and, presumably, different transistor transformer turns ratios as well as different output turns ratios) provide different gains and different intercepts. Rohde's article contains formulas which may be useful to estimating turns ratios, but they were beyond me. I used trial and error to arrive at the turns ratios for my amplifiers.

With the input turns ratios more nearly equal one can get an amplifier with lower and considerably higher intercepts For push-pull amplifiers the case of equal emitter and base turns can be simplified by omitting the base turns and cross coupling the base input capacitors to the emitter winding, which was inspired by a somewhat different 11 dB gain push-pull Norton-Rohde amplifier developed by Andrew Ikin. However, for 50 ohm input impedance the antenna input winding must have more turns than the emitter winding. The turns ratio for 50 ohms input is about 10:7 or 11:8. This also has the beneficial effect of increasing the gain of my LINR amp by about 1.5 dB to 14 dB.

LINR Amplifier, Rev. B

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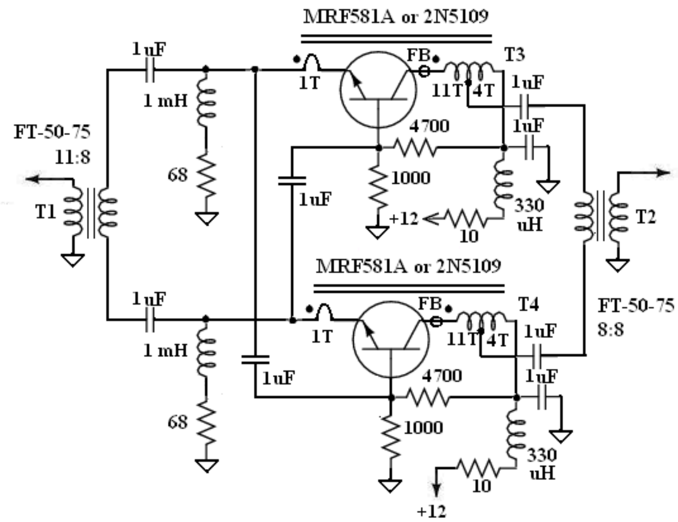

I converted one of my push-pull MRF581A Norton transformer feedback amplifiers to a variation of an Ikin-Norton-Rohde feedback amplifier by lifting the grounded ends of the 1 uF base bypass capacitors and connecting them to the opposite signal paths preceding the Norton emitter feedback links. My Norton amp was biassed for 16 mA per BJT, and this was not changed. The input and output transformers were MiniCircuits T1-6, the BJT transformers were wound on Amidon FT-50-75 (turns given on schematic). Before: IIP2 = +83 dBm, IIP3 = +36 dBm, gain = 10.3 dB. After: IIP2 = +80 dBm, IIP3 = +34 dBm, gain = 12.6 dB. Tones at 1.100 and 1.600 MHz, IMD2 at 0.500 MHz, IMD3 at 0.600 MHz.

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With the changes above, the input impedance was considerably less than 50 ohms. Eventually I tried different turns ratios until 11:8 gave 50 ohms. This also increased the gain to 14 dB, decreased IIP3 to 32.5, and IIP2 was unchanged.

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