

# Lankford-Ikin-Norton Feedback Amplifiers

Dallas Lankford, 12/31/2010, rev. 7/6/2011

The amplifier described here was originally believed to have been 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, and also originally based on a variation of Norton's circuit due to Ikin.

The amplifier is actually a capacitor cross coupled push-pull Norton transformer feedback amplifier. Its development is described in the figure at right. A capacitor cross coupled push-pull common gate MOSFET amplifier described [here](#) was found to have higher gain and a lower noise figure than an ordinary push-pull common gate MOSFET amplifier. Similar improvements, at the expense of slightly lower IIP3, were obtained for the push-pull common base Norton transformer feedback amplifier at right. It was also observed [here](#) that capacitor cross coupling lowered the input impedance of the MOSFET amplifier, which turned out to be the case for the capacitor cross coupled push-pull common base transformer feedback amplifier at right.

For maximum IIP2 one of the 68 ohm emitter bias resistors should be replaced with a 25 turn 100 ohm trimmer pot and adjusted for maximum IIP2.

Recently I developed a scrutable and correct derivation of Friis' noise factor cascade formula which contained some formulas from which the noise figure of an amplifier can be calculated from the measured noise power output of the amplifier. Using an amplifier with NF calibrated at 10 MHz supplied by Clifton Laboratories, and assuming the NF remains the same at 1.9 MHz, it was found that typical 10.4 dB gain 11:4:1 transformer ratio Norton feedback amplifiers with MRF581A's have a noise figure of about 1.7 dB with uncertainty of about 0.4 dB at 1.9 MHz. The noise figure of the 13.4 dB gain LIN-MRF581A amplifier at right was subsequently measured and found to be about 0.9 dB with an uncertainty of about 0.4 dB .

Higher gain Norton-Rohde amplifiers were found to have higher noise figures; for example a 19 dB gain N-R amp had about a 3.2 dB noise figure.

Thus it appears that the best way to obtain a higher gain amplifier with a low noise figure would be to cascade two capacitor cross coupled 13.4 dB gain

As pointed out by Jack Smith of Clifton Laboratories, it is difficult to measure low noise figures accurately. So the 0.9 dB NF above should be considered with caution.

The previous version of this article contained a description of a LIN modification to a Clifton Laboratories Z10042A amplifier. It was assumed that the NF of the LIN- Z10042A would be more or less the same as the LIN-MRF581, but this has turned out not to be the case. After Jack discovered that the LIN modification increased the NF of a Z10043A to over 3.0 dB, I measured the NF of the LIN-Z10042A and found its NF also increased to over 3.0 dB. It is presently not understood why the NF of the Z10042A and Z10043A increases when the LIN mod is done to them.

