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To: RFI Group
From: Alan E.E. Rogers
Subject: Improved input match for low frequency LNA

Memo #30 gave details of correcting a 3 position switched radiometer for antenna mismatch. The Agilent ATF-S8143 FET transistor has a very low noise at low frequencies. In the 100 to 200 MHz the amplifier noise is about 20k, however the input match is very poor. The poor input match results in large amplitude corrections for antenna mismatch due to the multiple reflections between the antenna and the LNA. At 100 MHz the 58143 input impedance is very high so that a good match could be obtained by placing a 50 ohm resistor in parallel across the input but this would result in increasing the noise temperature to over 300 K and the launching of a 300 K signal to the antenna. In this case we would have traded reflections of the antenna output for reflections of correlated noise. For a high antenna temperature this could be an advantage but an even better solution is to introduce resistive negative feedback across the transistor. In this case the low frequency input impedance z .

$$z = (r + R)/(1 + gR)$$

where r = drain to gate feedback resistor

R = output load resistance

g = transconductance

the voltage gain becomes

$$G = \left[\frac{R - gRr}{R + r} \right]$$

and the noise contribution from the feedback resistor is

$$290 \left[\frac{r}{|z|} \right] \left[\frac{(1 + g|z|R)}{(r + |z| + 1 + g|z|R)} \right]^2 G^{-2} \sim 290 [|z|/r] \text{K}$$

In practice the resistive feedback, which is broadband increases the LNA noise temperature from about 20 K to about 40K. Normal practice is to introduce feedback by increasing the source inductance which preserves the lowest noise but is not broadband.