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To: EDGES Group  
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Subject: Further improvements and tests of the LNA

Memo #165 discusses the last set of adjustments to the LNA used in the current low band receiver. Another unit has been put together and tests made of the temperature sensitivity of the various components.

- a) Would active biasing help reduce temperature sensitivity?

The circuit shown in Figure 1 uses passive self-bias for simplicity. The feedback used already provides a constant drain current. Cooling the HEMT with expanding air from a compressed gas cluster cools the HEMT from 42 °C to about 10 °C which changes the S11 by -2 dB and the HEMT drain current by only 0.3 ma while a change in drain current of 10 ma is needed to make a 2dB change in S11.

Therefore, changing to an active bias to maintain constant drain current would make little difference to S11 sensitivity to temperature.

- b) Sensitivity of individual components to temperature.

When the LNA board is run outside the enclosure in free air the temperature of the components are given in Table 1.

Component	Temperature °C
Air	22
Board	31
HEMT	42
ERA-1SM	35
5v regulator	45

When individual components are cooled the change in S11 magnitude is given in Table 2

Component	$\Delta S_{11} /^\circ C$
HEMT	$1 \times 10^{-4}$
ERA-1SM	$3 \times 10^{-5}$

Table 2. Change of  $|S_{11}|$  per °C

The change of  $|S_{11}|$  is relatively constant with frequency from 50 to 100 MHz. The change in dB is frequency dependent. For example, at 80 MHz the S11 is about -35 dB so that a change of  $10^{-4}$  results in a change of 0.05 dB while at 50 MHz with S11 at about -25 dB a change of  $10^{-4}$  is only 0.015 dB.

Figure 1 shows the measured S11 using the circuit shown in Figure 2. And a photo of the board in Figure 3.

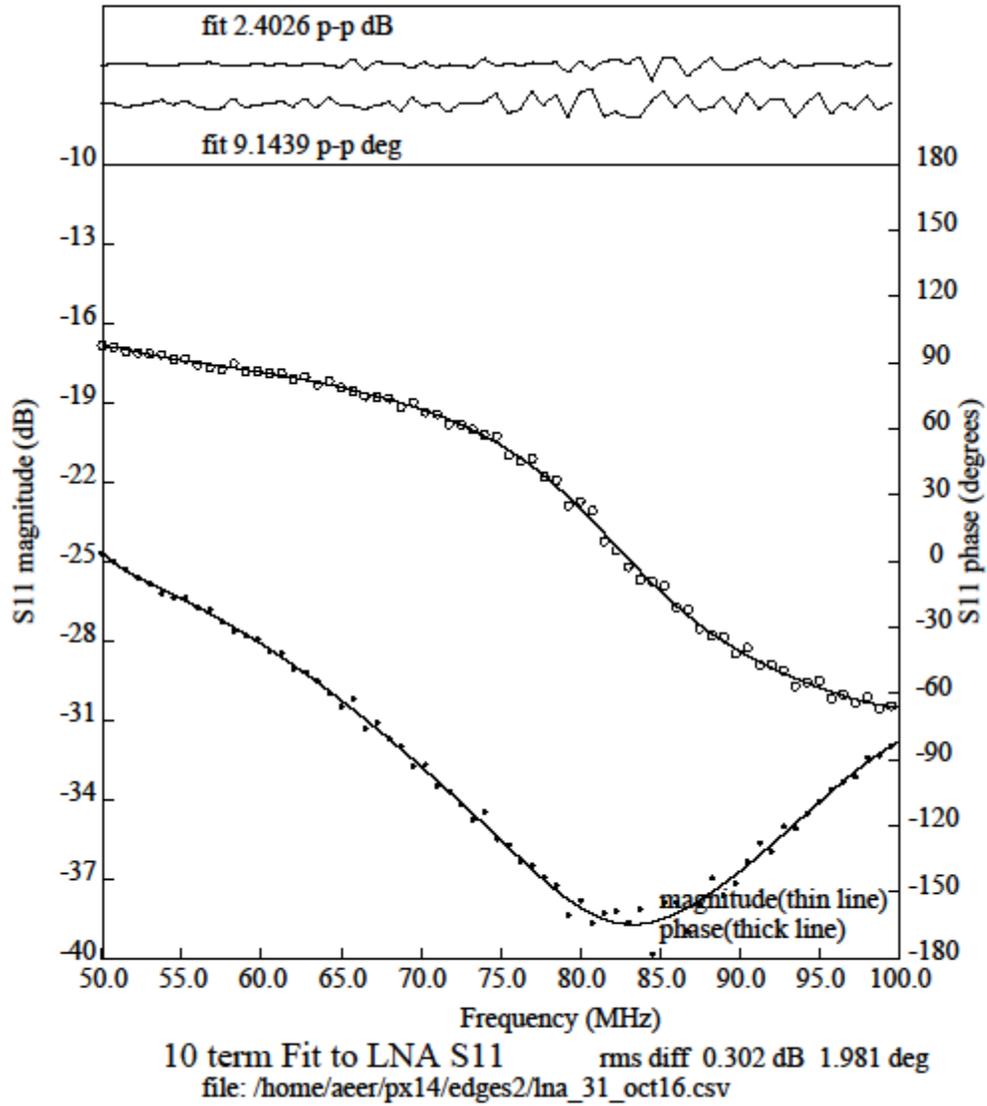


Figure 1. LNA S11.

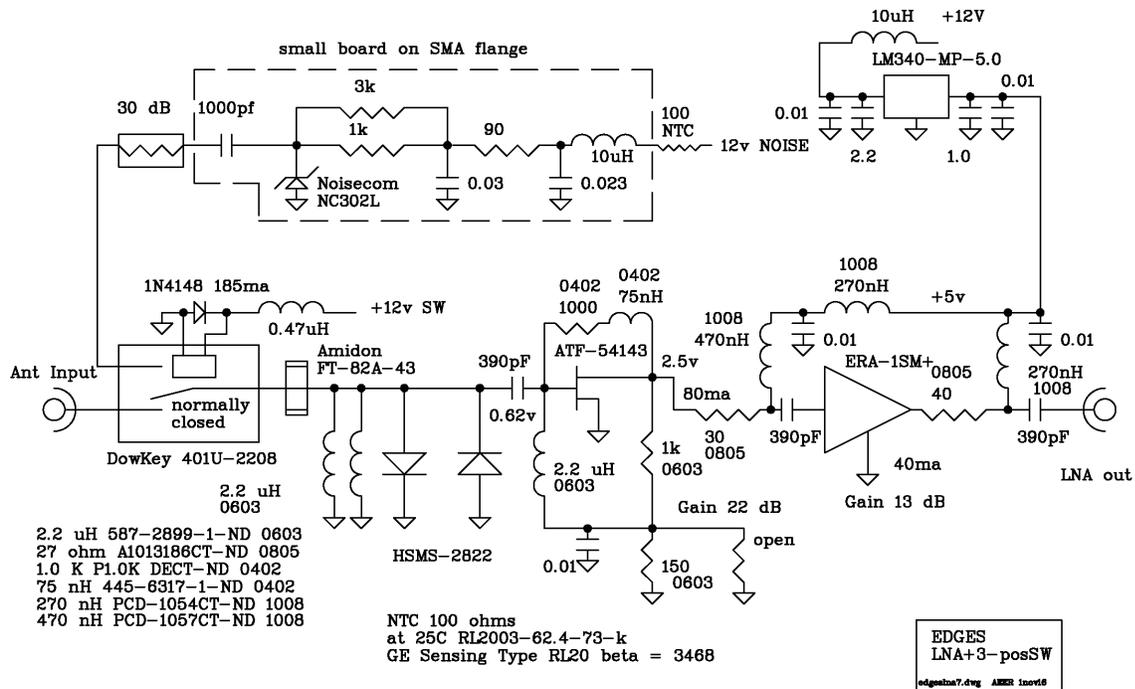


Figure 2. Circuit.

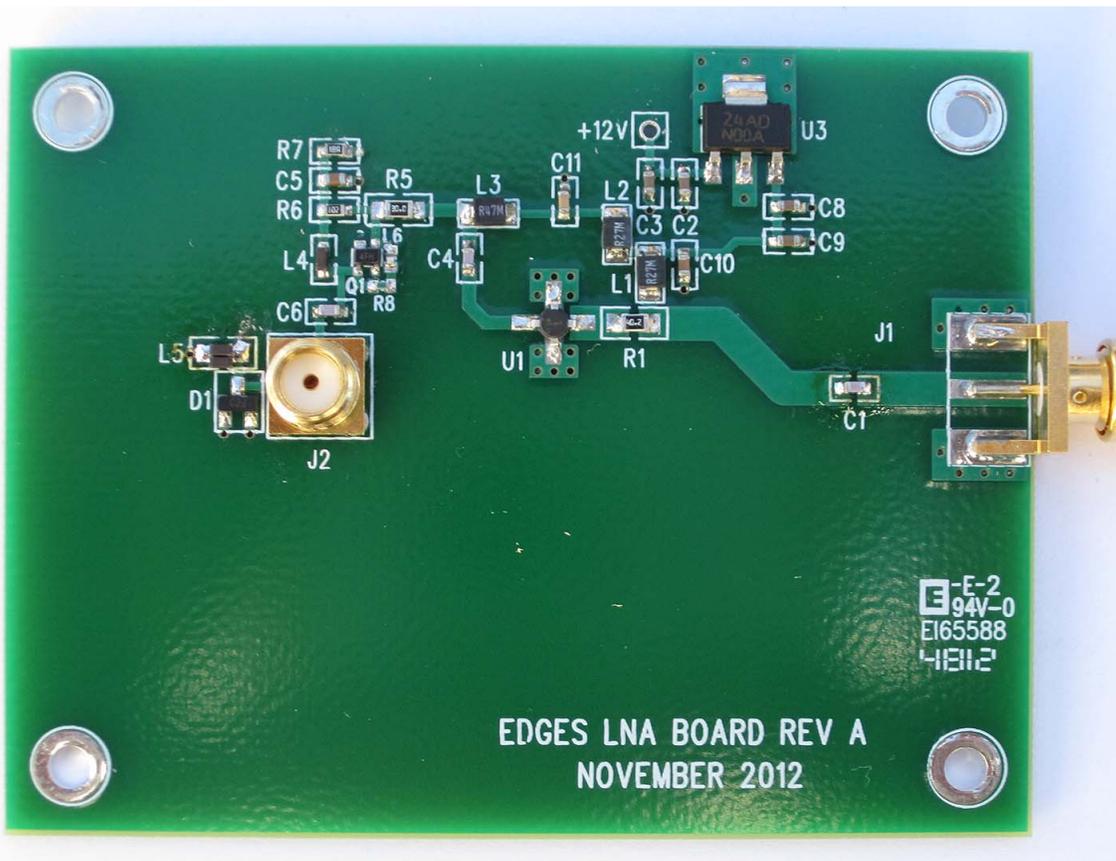


Figure 3. LNA PC Board.