APPLICATION NOTE

A wideband LNA using the BFG520 for satellite receivers

AN00003

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Abstract

In this application note an example is given of a wideband Low Noise Amplifier (LNA) with the 9GHz BFG520/X wideband transistor. The LNA is designed for use in satellite TV receivers covering a frequency range from 950MHz to 2150 MHz; V_{sup} = 5 Volt, $I_{sup} \approx$ 20mA

[1] Application note AN99018: TDA8060TS Zero-IF Digital Satellite-TV Receiver Demo Board.

1. INTRODUCTION.

A low noise wideband amplifier has been designed for use in DVB satellite TV receivers using a (cheaper) fourth generation BFG520/X wideband transistor. The LNA will enhance the performance of modern satellite down converter IC's, such as the TDA8060A [1], ensuring optimum receiver sensitivity.

Design targets for the LNA are:

Frequency range: 950MHz – 2150 MHz.
V_{supply} : 5 Volt
VSWRi : < 2.3 (Zi=50Ω), see note 1.
VSWRo: < 2.3 (Zo=50Ω)
Gain: 8dB
NF: ≤ 6dB
IP2: 20dBm (input)
IP3: 13dBm (input)

Figure 1 shows the LNA circuit.

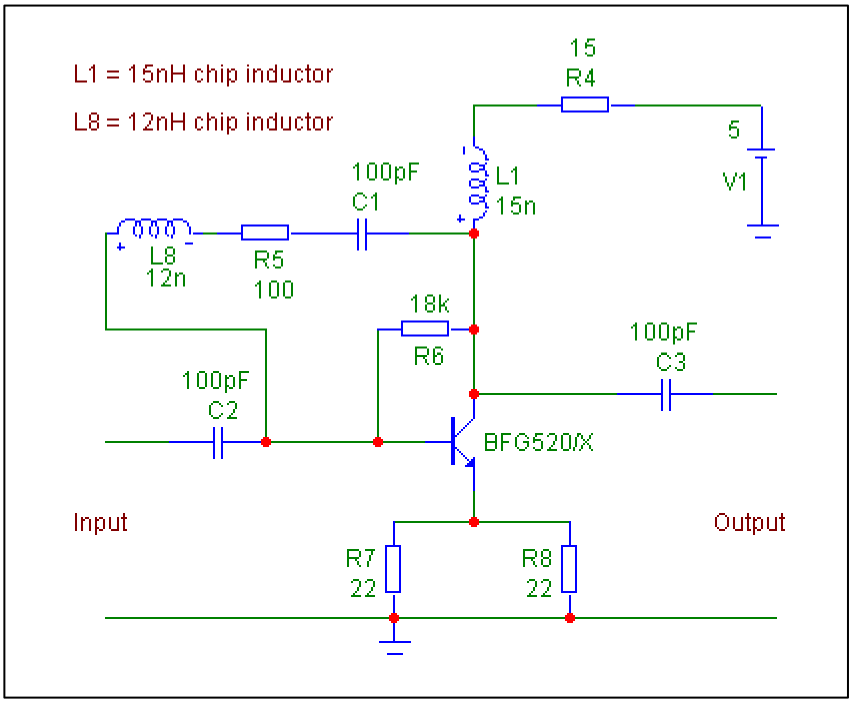


Figure 1.

Note 1: Zi=50Ω only for measurement purpose. Normally for satellite Zi=75Ω.

2. SIMULATIONS AND MEASUREMENTS.

Simulations have been done with MicroCap 5.1, which is a spice based simulation tool, because an accurate model of the BFG520/X was readily available in the RF library. This model data originates from Philips Semiconductors and can also be found in Data Handbook SC14. Additional (parasitic) components and macro's have been added to the schematic of figure 1, to increase the simulation accuracy furthermore, see figure 2.

The LNA is designed to have maximum gain at the end of the frequency band, ≈2 GHz, to compensate for the lower signal levels, mostly due to increased cable losses, at these frequencies. In this way highest tuner sensitivity and a negligible contribution to the total implementation loss of the satellite receiver is assured.

Because of the wide satellite frequency band it is equally important to have good linearity of the LNA; total input power of a satellite receiver can be as high as 10dBm. Therefore IP2 and IP3 are specified.

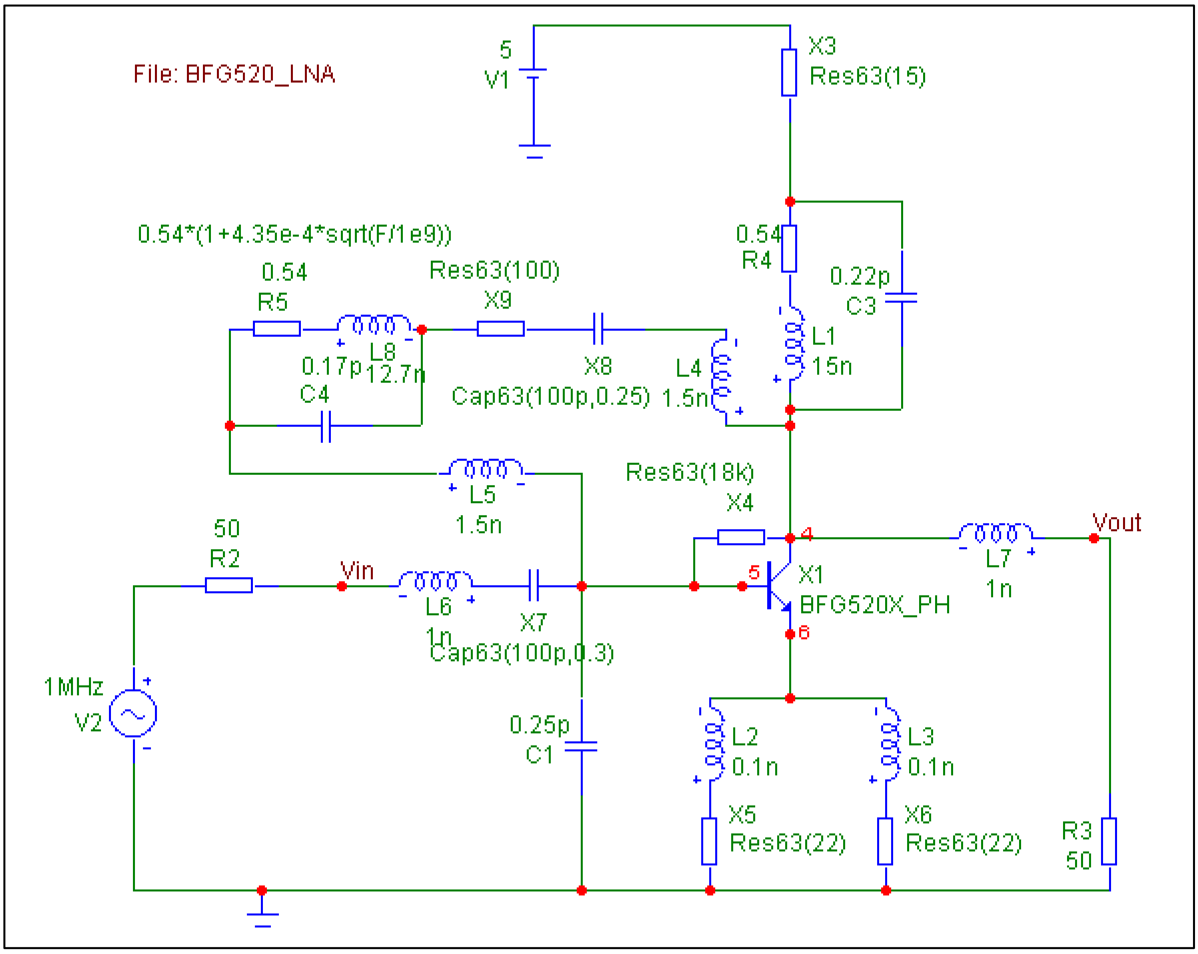
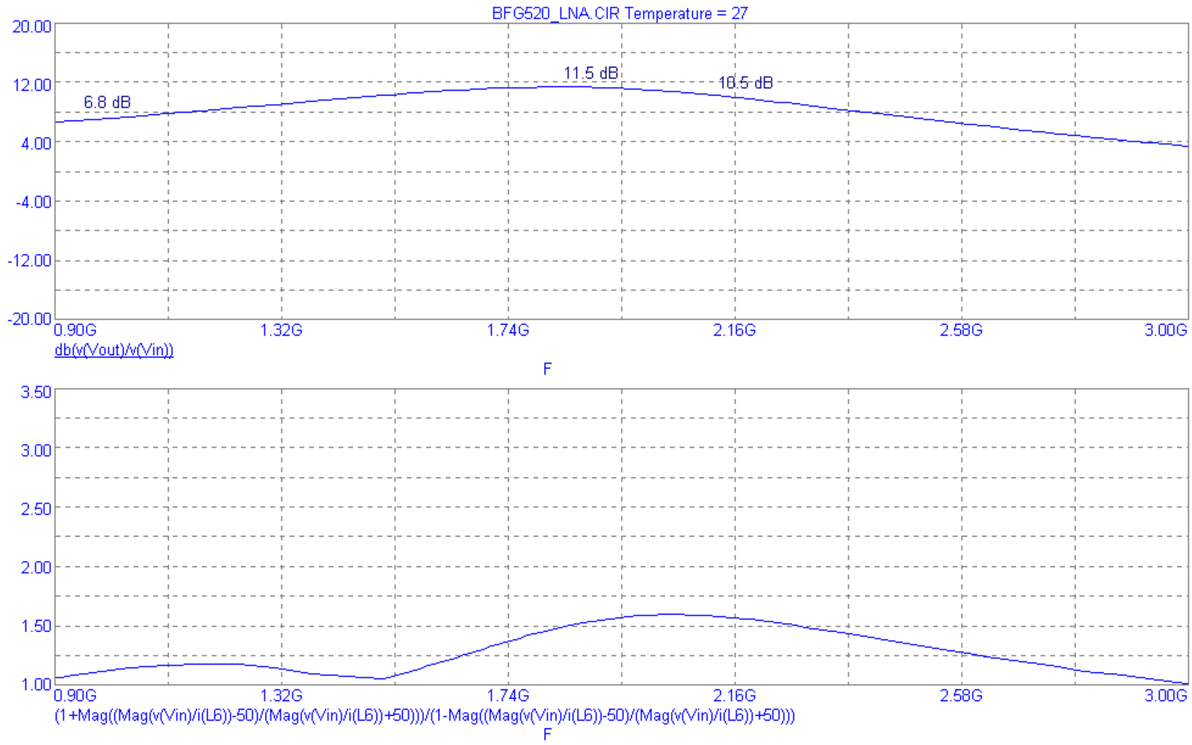


Figure 2. MicroCap simulation circuit.

Figure 3 MicroCap simulation result of Gain and VSWRi, see table 1.



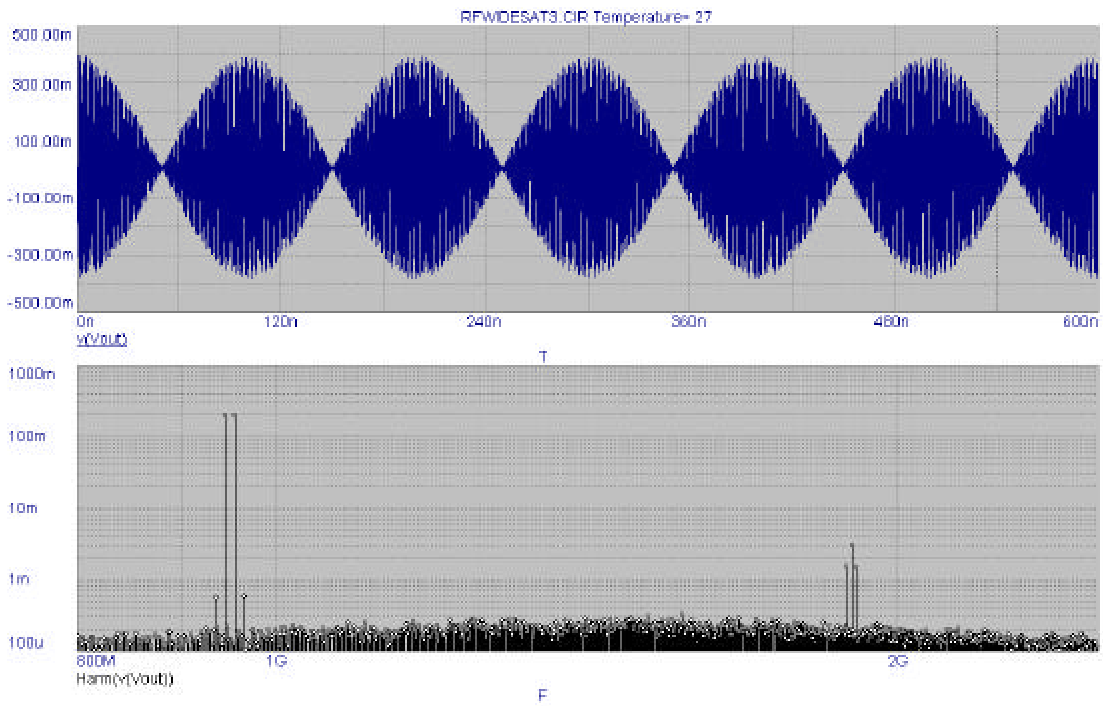


Figure 4 MicroCap simulation result of IP2 and IP3, see table 1.

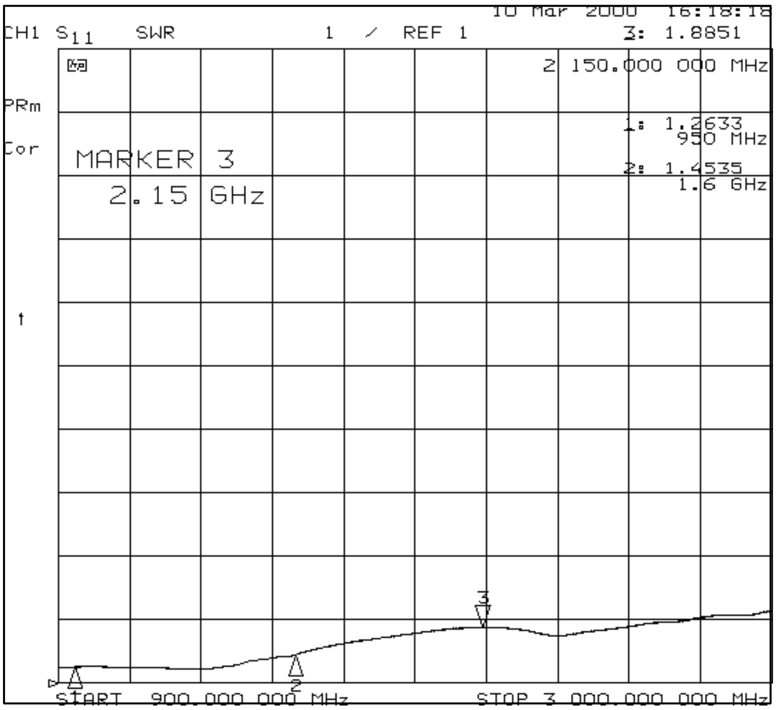


Figure 5 VSWRi (S11) measurement result, see table 1.

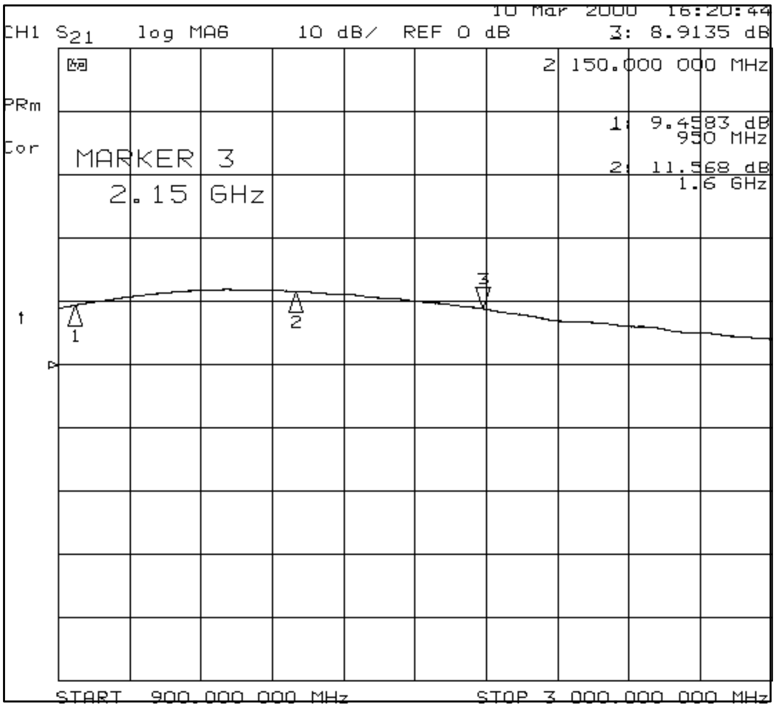


Figure 6 Gain (S21) measurement result, see table 1.

Table 1 Simulation and measurement results.

	950MHz		1600MHz		2150MHz	
	simulation	meas	simulation	meas	simulation	meas
IP2	26.4dBm	23dBm				
IP3	15.4dBm	13.5dBm		11dBm		14dBm
$\lvert S21 \rvert^2$	6.8	9.5	11.4	11.6	10.5	8.9
VSWRi	1.1	1.2	1.2	1.5	1.6	1.9
NF	5.1	4.9	5.0	4.9	5.5	5.5

Measurement conditions:

Vsup : 5 Volt
Isup : 22.5mA
Z_{gen}, Z_{load}: 50Ω
Gain: Ui=80dBμV_{rms}
IP2/IP3: two tones of 80dBμV_{rms}

Simulation conditions:

Model: BFG520X_PH from RF library
Vsup : 5 Volt
Isup : 20mA
Z_{gen}, Z_{load}: 50Ω
Gain: Ui=97dBμV_{rms} (transient simulation).
IP2/IP3: two tones of 97dBμV_{rms}

Note 1: The circuit was stable for all frequencies.

Note 2: Measurement and simulation results differ due to estimated circuit parasitics and accuracy of the used spice model of the BFG520.

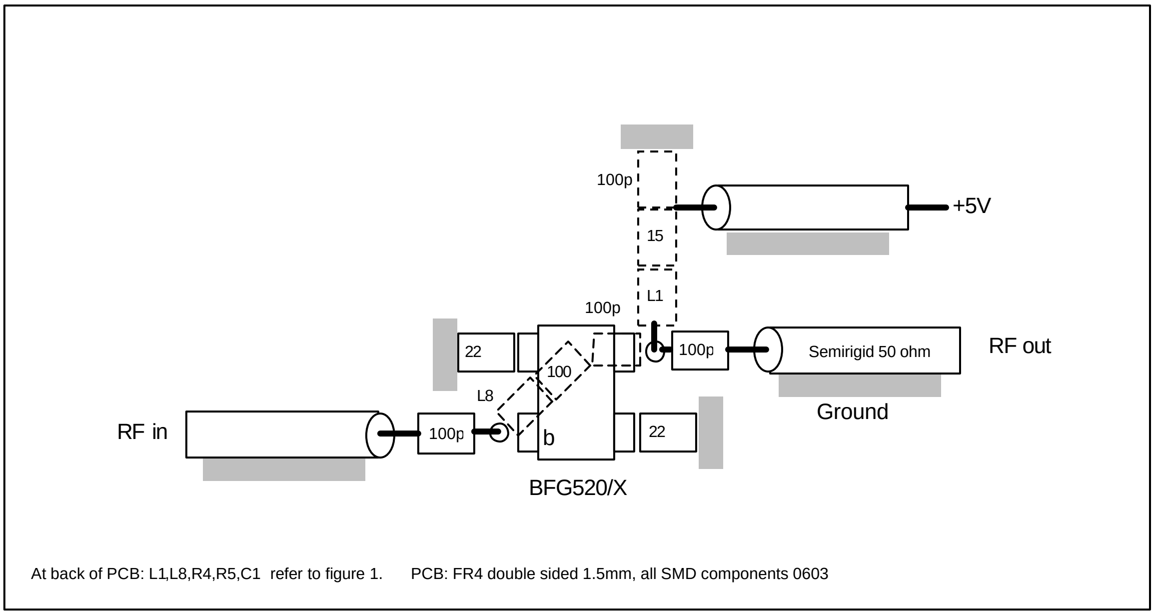


Figure 7: Print layout satellite LNA.