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900MHz LOW NOISE AMPLIFIER WITH THE BFG403W

Abstract:
This application note contains an example of a Low Noise Amplifier with the new BFG403W Double Poly RF-transistor. The LNA is designed for a frequency f=900MHz, V_{SUP}~1.5V, I_{SUP}~1mA.
Measured performance at f=900MHz: Noise Figure NF~1.8dB, gain S_{21} ~16dB.

Appendix I: 900MHz LNA circuit

Appendix II: Printlayout and list of used components & materials

Appendix III: Measured Performance

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Introduction:
With the new Philips silicon bipolar double poly BFG400W series, it is possible to design low noise amplifiers for high frequency applications with a low current and a low supply voltage. These amplifiers are well suited for the new generation low voltage high frequency wireless applications. In this note an example of such an amplifier will be given. This amplifier is designed for a working frequency of 900MHz. Because this LNA has an extreme low power-consumption, it is well suited for **pager front-end applications**.

Designing the circuit:
The circuit is designed to show the following performance:

transistor: BFG403W

V_{ce}~0.9V, I_c~1mA, V_{SUP}~1.5V
freq=900MHz
Gain~16dB
NF<=1.8dB
VSWRi<1:3
VSWRo<1:2

Designing the layout:
A lay-out has been designed with HP-MDS. Appendix II contains the printlayout.

Measurements:
Measurements of the total circuit are done (Appendix III).

Appendix I: Schematic of the circuit

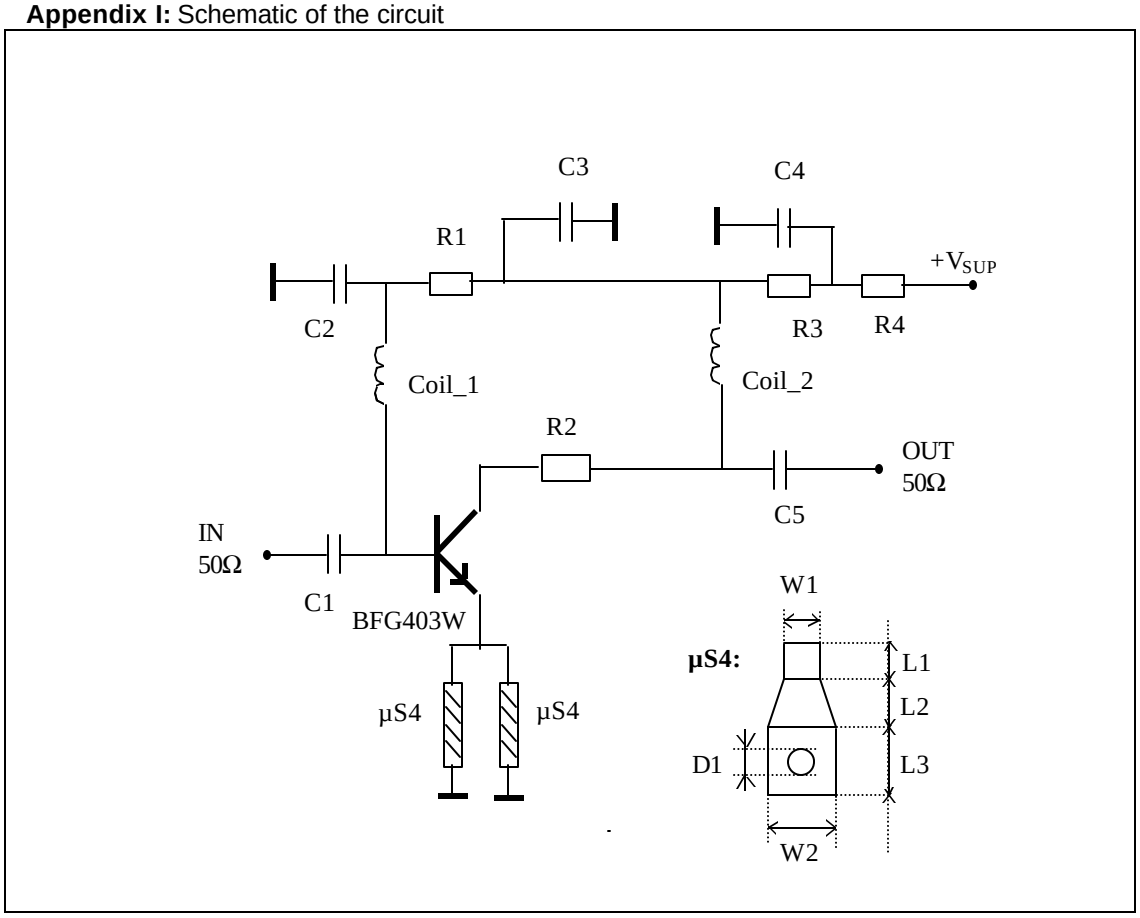

Figure 1: LNA circuit

900MHz LNA Component list: 900MHz LNA Component list:

Component	Value	Purpose, comment
R1	13 kΩ	Bias (coll.-base)
R2	150 Ω	in series with coll. for better S22, stability and reducing gain.
R3	22 Ω	RF blocking
R4	390 Ω	Bias, series with coll., cancelling hFE spread
C1	1.2 pF	Input match (input to base)
C2	27 pF	900 MHz short (L1 to ground)
C3	27 pF	900 MHz short (L2 to ground)
C4	100 nF	RF decoupling collector bias
C5	1.2 pF	Output match (collector to output)
Coil_1	15 nH	Input match (base-bias)
Coil_2	15 nH	Output match (collector-bias)
µs4	(see next table)	µ-stripline Emitter-induction

µS4 Emitter inductance of µ-stripline and via-hole (see on former page: Schematic of the circuit):

Name	Dimension	Description
L1	1.0mm	length µ-stripline; Z_0~48Ω (PCB: ε_r ~4.6, H=0.5mm)
L2	1.0mm	length interconnect stripline and via-hole area
L3	1.0mm	length via-hole area
W1	0.5mm	width µ-stripline
W2	1.0mm	width via-hole area
D1	0.4mm	diameter of via-hole

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Appendix II: Printlayout and list of used components & materials

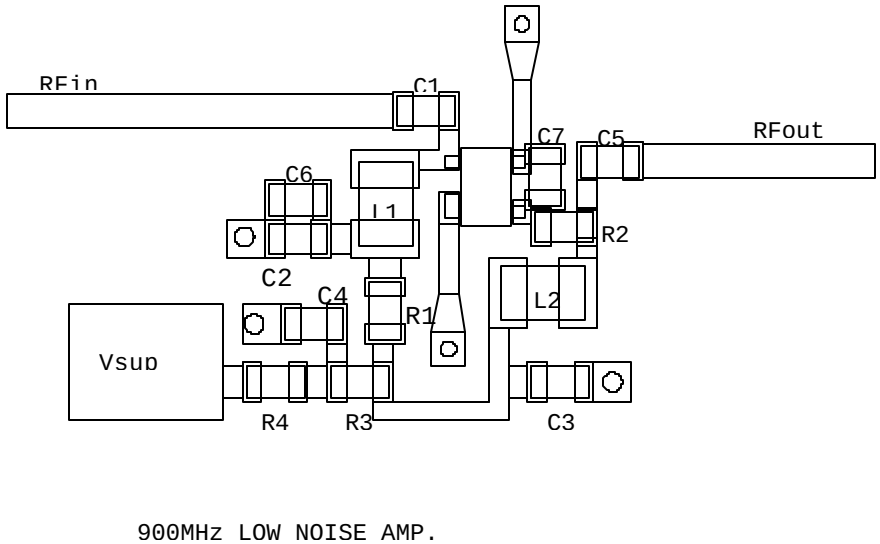

Figure 2: Printlayout

Comment: C6 and C7 are *not used* in this LNA.

900MHz LNA Component list:

Component:	Value:	size:
PCB	FR4: ε_r ~4.6	H=0.5mm
R1	13 kΩ	0603 Philips
R2	150 Ω	0603 Philips
R3	22 Ω	0603 Philips
R4	390 Ω	0603 Philips
C1	1.2 pF	0603 Philips
C2	27 pF	0603 Philips
C3	27 pF	0603 Philips
C4	100 nF	0805 Philips
C5	1.2 pF	0603 Philips
L1	15 nH	0805CS Coilcraft
L2	15 nH	0805CS Coilcraft

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Appendix III: Measured Performance

BFG403W; f=900MHz

V_{SUP} [V]	I_{SUP} [mA]	$\|S_{21}\|^2$ [dB]	$\|S_{12}\|^2$ [dB]	VSWRi	VSWRo	Noise Figure [dB]
		Gain	Isolation			
1.1	0.5	13	-27	3.0	1.6	1.7
1.5	1.0	16	-30	2.7	1.5	1.8
1.7	1.5	17	-31	2.8	1.5	2.0