APPLICATION INFORMATION

900 MHz low noise amplifier with the BFG480W

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ABSTRACT

- Description of the product

  The BFG480W, one of the Philips double polysilicon wideband transistors of the BFG400W series.
- Application area

  Low voltage high frequency wireless applications.
- Presented application

  A low noise amplifier for 900 MHz.
- Main results

  At a frequency of 900 MHz, the amplifier has an insertion power gain of approximately 15.5 dB, a noise figure of approximately 2 dB, and a third order intercept point of approximately 10 dBm (measured at input).

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INTRODUCTION

With the Philips double polysilicon wideband transistor BFG480W, it is possible to design Low Noise Amplifiers (LNAs) 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. A feature of the BFG480W is that it has a good linearity performance. Therefore the BFG480W is well suited for LNAs with high linearity demands, such as Code Division Multiple Access (CDMA) systems. This application note gives an example of a 900 MHz LNA with the BFG480W.

CIRCUIT DESCRIPTION

The following initial conditions apply for the amplifier design:

- $V_{supply} \approx 3.6$ V
- $V_{CE} \approx 2$ V
- $I_C \approx 20$ mA
- f = 900 MHz.

The circuit is designed to show the following performance:

- $|s_{21}|^2 \approx 15$ dB
- $VSWR_{IN} < 2$
- $VSWR_{OUT} < 2$
- NF ≤ 2 dB
- $IP3_i > 9$ dBm.

The input and output matching is realised with an LC-combination. Also extra emitter inductance (micro stripline) is used on both emitter-leads to improve the matching and the noise figure.

CIRCUIT DIAGRAM

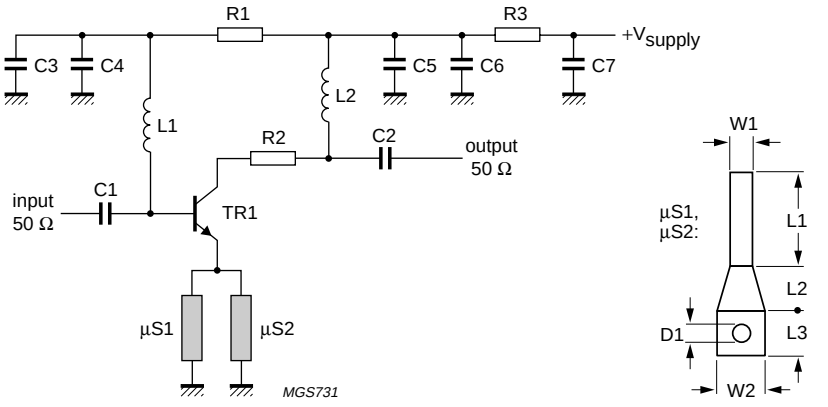

Fig.1 Circuit diagram.

COMPONENT LIST

Table 1 Component list for the 900 MHz LNA

COMPONENT	VALUE	UNIT	SIZE, MANUFACTURER	PURPOSE, COMMENT
TR1	BFG480W		SOT343R Philips	RF transistor
R1	8.2	kΩ	0603 Philips	collector to base bias
R2	10	Ω	0603 Philips	improvement RF stability (K-factor > 1)
R3	56	Ω	0603 Philips	collector bias; levelling h_{FE} spread
C1	27	pF	0603 Philips	input match (base coupling)
C2	27	pF	0603 Philips	output match (collector coupling)
C3	27	pF	0603 Philips	900 MHz short (L1 and L2 to ground)
C4	100	nF	0805 Philips	improvement IP3 by decoupling LF IP3 products
C5	27	pF	0603 Philips	900 MHz short (L1 and L2 to ground)
C6	100	nF	0805 Philips	improvement IP3 by decoupling LF IP3 products
C7	1	nF	0603 Philips	RF decoupling collector bias
L1	15	nH	0805CS Coilcraft	input match
L2	8.2	nH	0805CS Coilcraft	output match
μS1	see Table 2			emitter induction: micro stripline and via-hole
μS2	see Table 2			emitter induction: micro stripline and via-hole
PCB	FR4			ε_r = 4.6; d = 0.5 mm

Table 2 Dimensions of the micro striplines μS1 and μS2 (see Fig.1)

DIMENSION	VALUE	UNIT	DESCRIPTION
L1	2.0	mm	length micro stripline; $Z_o \approx 48\ \Omega$
L2	1.0	mm	length interconnect micro stripline and via-hole area
L3	1.0	mm	length via-hole area
W1	0.5	mm	width micro stripline
W2	1.0	mm	width via-hole area
D1	0.4	mm	diameter of via-hole

BOARD LAYOUT

The layout has been designed with the Hewlett Packard Microwave Design System (HP-MDS).

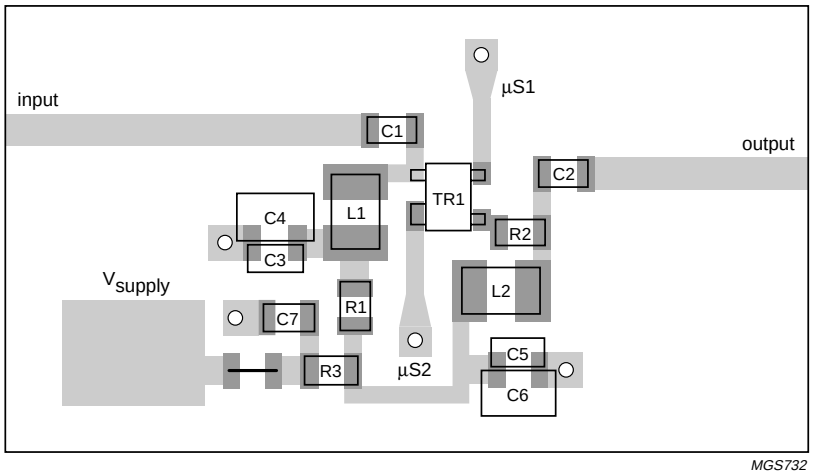

Fig.2 PCB layout.

MEASUREMENTS

The measurements have been done under the following conditions (unless otherwise stated):

- Supply voltage 3.6 V
- Supply current 19 mA
- Frequency 900 MHz.

Table 3 Measuring results of the 900 MHz amplifier

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$\|s_{21}\|^2$	insertion power gain		15.5	dB
$VSWR_{IN}$	input voltage standing wave ratio		1.9	
$VSWR_{OUT}$	output voltage standing wave ratio		1.2	
NF	noise figure		2.0	dB
$IP3_i$	third order intercept point	Δf = 200 kHz; P_i = –20 dBm	10	dBm

NOTES

NOTES

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