APPLICATION INFORMATION

Demoboard for the BGA2001

Application Note

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Demoboard for the BGA2001 Application Note

SUMMARY

- **Description of products**
  BGA2001: RF transistor with internal bias circuit. Benefit is lower component count, internal compensation for temperature and diffusion spread.
- **Application Area**
  Low noise amplifiers for systems like GSM, DECT, DCS with low component count.
- **Presented Application**
  The application presents a low noise amplifiers at 1900 MHz at 2.7 V supply voltage and 4 mA supply current with matching components.
- **Main results**
  An amplifier has been designed and tested with 10 dB gain, IIP3 = –3 dBm, $VSWR_{in}$ <(1 : 1.7), 1.5 dB Noise Figure at 1900 MHz and 2.7 V and 4.3 mA supply.

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THE BGA2001 MONOLITHIC MICROWAVE INTEGRATED CIRCUIT

For understanding of the behaviour of the BGA2001 Monolithic Microwave Integrated Circuit (MMIC), the internal circuit diagram is given in Fig.1.

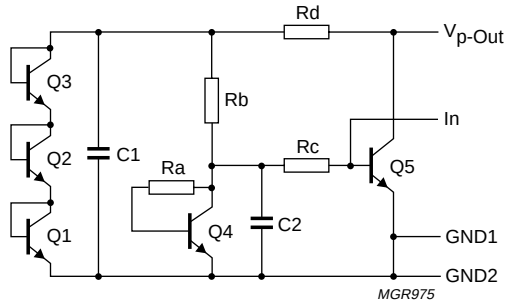

Fig.1 Internal circuit diagram.

Q5 is the main RF transistor. Q4 forms a current mirror with Q5. The input current of this current mirror is determined by the voltage on node $V_{p\text{-}Out}$ and resistors Ra, Rb and Rd. The voltage derived of $V_{p\text{-}Out}$ is stabilized by three stacked diodes made with transistors Q1, Q2 and Q3. Rc and C2 decouple the bias circuit from the RF input signal and C1 decouples the bias circuit from the RF output signal.

SIMULATION OF THE BGA2001 DEMOBOARD

S-parameters of the BGA2001 MMIC were measured at $V_{p\text{-}Out}$ = 2.5 V, IC = 4 mA.

An additional stripline with via, fuctioning as emitter inductance of about 0.8 nH, was added in the (HP-MDS) simulation. The emitter inductance on the Printed Circuit Board (PCB) is beneficial for achieving good noise match, for stability and easier impedance match.

Optimization of the matching components was done for the parameters $VSWR_{in}$ and $VSWR_{out}$ (<1 : 1.5), resulting in component values, which were rounded up to nearby practical values. These values have been used on the PCB.

COMMENTS ON THE PRINTED CIRCUIT BOARD

The PCB used for this application example was designed for the BGA2003, which is the reason for the unused component position on the board. With the BGA2003 this is a control input and with the BGA2001 this is the GND2 pin. This pin is not connected, only GND1 is connected to the circuit ground via a stripline.

BGA2001 APPLICATION 1.9 GHz WITH MINIMUM COMPONENTS

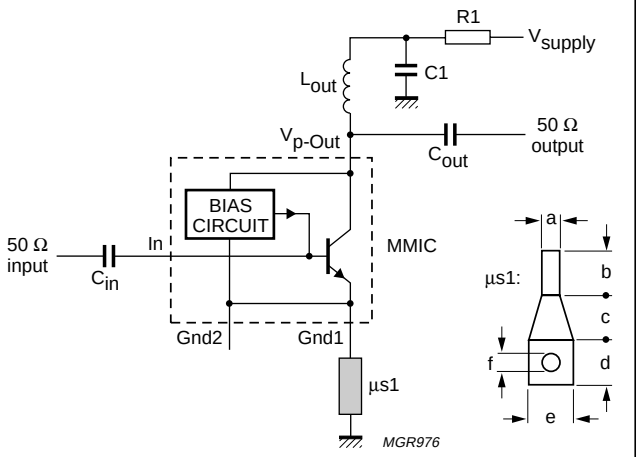

Fig.2 Schematic of the BGA2001 demoboard.

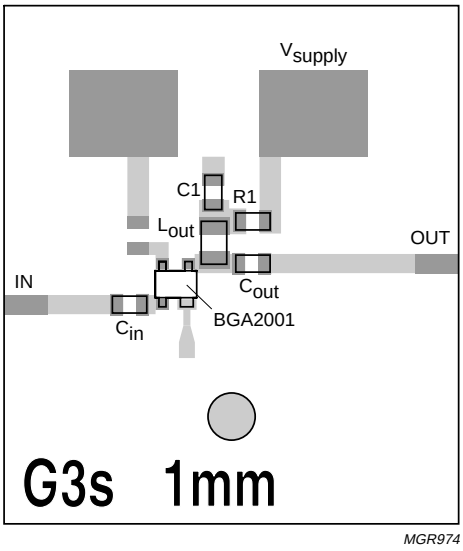

Fig.3 1900 MHz amplifier print layout.

Table 1 Used components for the BGA2001

COMPONENT	VALUE	UNIT	SIZE - MANUFACTURER	PURPOSE, COMMENT
R1	68	Ω	0603 Philips	DC-bias
C1	5.6	pF	0603 Philips	RF-short to ground
C_{in}	18	pF	0603 Philips	input match, DC-decoupling
L_{out}	5.6	nH	0603 TDK type MLG1608	output match
C_{out}	1.2	pF	0603 Philips	output match
µs 1	–	–	PCB-stripline 50 Ω, via	a = 0.5 mm, b = c = d = e = 1 mm and f = 0.4 mm
MMIC	BGA2001	–	Philips SOT343R2	marking A1, at the device
PCB	–	–	FR4	ε_R ~ 4.6, H = 0.5 mm

Table 2 Measured values

I_{supply} = 4.35 mA, V_{supply} = 2.7 V, V_{ce} = 2.4 V; f = 1900 MHz.

S-PARAMETERS	1.8 GHz	1.9 GHz	2.0 GHz
S_{11}	–10.48 dB	–12.00 dB	–12.86 dB
S_{21}	11.65 dB	10.82 dB	10.28 dB
S_{12}	–17.82 dB	–17.35 dB	–17.02 dB
S_{22}	–12.25 dB	–8.95 dB	–7.12 dB
$IIP3_{in}$; note 1	–	–3.0 dBm	–
NF	1.4 dB	1.5 dB	1.6 dB

Note

1. –30 dBm at f1 = 1900.1 MHz, f2 = 1900 MHz.

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Germany: Hammerbrookstraße 69, D-20097 HAMBURG,
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United States: 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,
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