

APPLICATION INFORMATION

Demoboard for the BGA2001

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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**

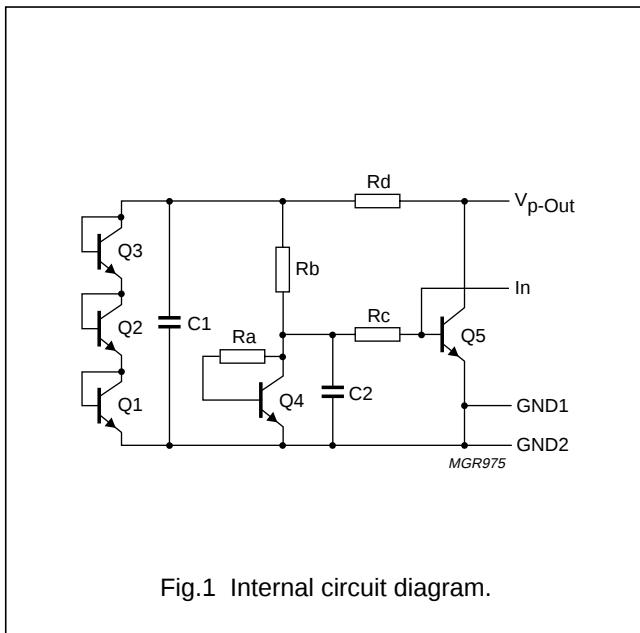
An amplifier has been designed and tested with 10 dB gain, IIP3 = -3 dBm, VSWR_{in} < (1 : 1.7), 1.5 dB Noise Figure at 1900 MHz and 2.7 V and 4.3 mA supply.

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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.



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-Out} and resistors R_a , R_b and R_d . The voltage derived of V_{p-Out} is stabilized by three stacked diodes made with transistors Q1, Q2 and Q3. R_c and C_2 decouple the bias circuit from the RF input signal and C_1 decouples the bias circuit from the RF output signal.

SIMULATION OF THE BGA2001 DEMOBOARD

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

An additional stripline with via, functioning 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.

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BGA2001 APPLICATION 1.9 GHz WITH MINIMUM COMPONENTS

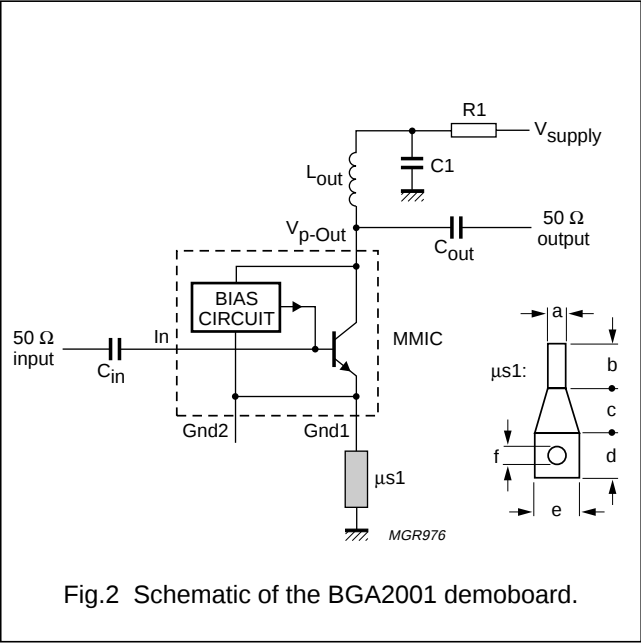


Fig.2 Schematic of the BGA2001 demoboard.

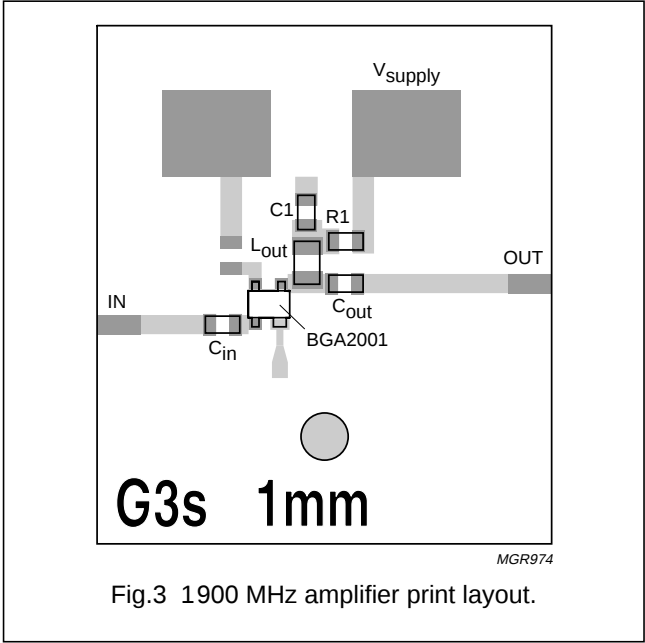


Fig.3 1900 MHz amplifier print layout.

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
Cin	18	pF	0603 Philips	input match, DC-decoupling
Lout	5.6	nH	0603 TDK type MLG1608	output match
Cout	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	εR ~ 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
IIP _{3in} ; 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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Philips Semiconductors – a worldwide company

Argentina: see South America

Australia: 34 Waterloo Road, NORTH RYDE, NSW 2113,
Tel. +61 2 9805 4455, Fax. +61 2 9805 4466

Austria: Computerstr. 6, A-1101 WIEN, P.O. Box 213,
Tel. +43 1 60 101 1248, Fax. +43 1 60 101 1210

Belarus: Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6,
220050 MINSK, Tel. +375 172 20 0733, Fax. +375 172 20 0773

Belgium: see The Netherlands

Brazil: see South America

Bulgaria: Philips Bulgaria Ltd., Energoproject, 15th floor,
51 James Bourchier Blvd., 1407 SOFIA,
Tel. +359 2 68 9211, Fax. +359 2 68 9102

Canada: PHILIPS SEMICONDUCTORS/COMPONENTS,
Tel. +1 800 234 7381, Fax. +1 800 943 0087

China/Hong Kong: 501 Hong Kong Industrial Technology Centre,
72 Tat Chee Avenue, Kowloon Tong, HONG KONG,
Tel. +852 2319 7888, Fax. +852 2319 7700

Colombia: see South America

Czech Republic: see Austria

Denmark: Sydhavnsgade 23, 1780 COPENHAGEN V,
Tel. +45 33 29 3333, Fax. +45 33 29 3905

Finland: Sinikalliontie 3, FIN-02630 ESPOO,
Tel. +358 9 615 800, Fax. +358 9 6158 0920

France: 51 Rue Carnot, BP317, 92156 SURESNES Cedex,
Tel. +33 1 4099 6161, Fax. +33 1 4099 6427

Germany: Hammerbrookstraße 69, D-20097 HAMBURG,
Tel. +49 40 2353 60, Fax. +49 40 2353 6300

Greece: No. 15, 25th March Street, GR 17778 TAVROS/ATHENS,
Tel. +30 1 489 4339/4239, Fax. +30 1 481 4240

Hungary: see Austria

India: Philips INDIA Ltd, Band Box Building, 2nd floor,
254-D, Dr. Annie Besant Road, Worli, MUMBAI 400 025,
Tel. +91 22 493 8541, Fax. +91 22 493 0966

Indonesia: PT Philips Development Corporation, Semiconductors Division,
Gedung Philips, Jl. Buncit Raya Kav.99-100, JAKARTA 12510,
Tel. +62 21 794 0040 ext. 2501, Fax. +62 21 794 0080

Ireland: Newstead, Clonskeagh, DUBLIN 14,
Tel. +353 1 7640 000, Fax. +353 1 7640 200

Israel: RAPAC Electronics, 7 Kehilat Saloniki St, PO Box 18053,
TEL AVIV 61180, Tel. +972 3 645 0444, Fax. +972 3 649 1007

Italy: PHILIPS SEMICONDUCTORS, Piazza IV Novembre 3,
20124 MILANO, Tel. +39 2 6752 2531, Fax. +39 2 6752 2557

Japan: Philips Bldg 13-37, Kohnan 2-chome, Minato-ku,
TOKYO 108-8507, Tel. +81 3 3740 5130, Fax. +81 3 3740 5077

Korea: Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL,
Tel. +82 2 709 1412, Fax. +82 2 709 1415

Malaysia: No. 76 Jalan Universiti, 46200 PETALING JAYA, SELANGOR,
Tel. +60 3 750 5214, Fax. +60 3 757 4880

Mexico: 5900 Gateway East, Suite 200, EL PASO, TEXAS 79905,
Tel. +9-5 800 234 7381, Fax +9-5 800 943 0087

Middle East: see Italy

Netherlands: Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB,
Tel. +31 40 27 82785, Fax. +31 40 27 88399

New Zealand: 2 Wagener Place, C.P.O. Box 1041, AUCKLAND,
Tel. +64 9 849 4160, Fax. +64 9 849 7811

Norway: Box 1, Manglerud 0612, OSLO,
Tel. +47 22 74 8000, Fax. +47 22 74 8341

Pakistan: see Singapore

Philippines: Philips Semiconductors Philippines Inc.,
106 Valero St. Salcedo Village, P.O. Box 2108 MCC, MAKATI,
Metro MANILA, Tel. +63 2 816 6380, Fax. +63 2 817 3474

Poland: Ul. Lukiska 10, PL 04-123 WARSZAWA,
Tel. +48 22 612 2831, Fax. +48 22 612 2327

Portugal: see Spain

Romania: see Italy

Russia: Philips Russia, Ul. Usatcheva 35A, 119048 MOSCOW,
Tel. +7 095 755 6918, Fax. +7 095 755 6919

Singapore: Lorong 1, Toa Payoh, SINGAPORE 319762,
Tel. +65 350 2538, Fax. +65 251 6500

Slovakia: see Austria

Slovenia: see Italy

South Africa: S.A. PHILIPS Pty Ltd., 195-215 Main Road Martindale,
2092 JOHANNESBURG, P.O. Box 7430 Johannesburg 2000,
Tel. +27 11 470 5911, Fax. +27 11 470 5494

South America: Al. Vicente Pinzon, 173, 6th floor,
04547-130 SÃO PAULO, SP, Brazil,
Tel. +55 11 821 2333, Fax. +55 11 821 2382

Spain: Balmes 22, 08007 BARCELONA,
Tel. +34 93 301 6312, Fax. +34 93 301 4107

Sweden: Kottbygatan 7, Akalla, S-16485 STOCKHOLM,
Tel. +46 8 5985 2000, Fax. +46 8 5985 2745

Switzerland: Allmendstrasse 140, CH-8027 ZÜRICH,
Tel. +41 1 488 2741 Fax. +41 1 488 3263

Taiwan: Philips Semiconductors, 6F, No. 96, Chien Kuo N. Rd., Sec. 1,
TAIPEI, Taiwan Tel. +886 2 2134 2886, Fax. +886 2 2134 2874

Thailand: PHILIPS ELECTRONICS (THAILAND) Ltd.,
209/2 Sanpavuth-Bangna Road Prakanong, BANGKOK 10260,
Tel. +66 2 745 4090, Fax. +66 2 398 0793

Turkey: Talatpasa Cad. No. 5, 80640 GÜLTEPE/ISTANBUL,
Tel. +90 212 279 2770, Fax. +90 212 282 6707

Ukraine: PHILIPS UKRAINE, 4 Patrice Lumumba str., Building B, Floor 7,
252042 KIEV, Tel. +380 44 264 2776, Fax. +380 44 268 0461

United Kingdom: Philips Semiconductors Ltd., 276 Bath Road, Hayes,
MIDDLESEX UB3 5BX, Tel. +44 181 730 5000, Fax. +44 181 754 8421

United States: 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,
Tel. +1 800 234 7381, Fax. +1 800 943 0087

Uruguay: see South America

Vietnam: see Singapore

Yugoslavia: PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD,
Tel. +381 11 62 5344, Fax. +381 11 63 5777

For all other countries apply to: Philips Semiconductors,
International Marketing & Sales Communications, Building BE-p, P.O. Box 218,
5600 MD EINDHOVEN, The Netherlands, Fax. +31 40 27 24825

Internet: <http://www.semiconductors.philips.com>

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