APPLICATION NOTE

9 W Linear Class-AB Amplifier with the BLV909 for 935 – 960 MHz

AN98020

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CONTENTS

1 INTRODUCTION

This application note contains information on a 9 W class-AB amplifier based on the SMD transistor BLV909.
The amplifier described can be used for driver stages in cellular radio base stations in GSM band 935 – 960 MHz. The next sections contain information on the transistor, the amplifier construction and the typical RF performance obtained.

2 TRANSISTOR BACKGROUND

The BLV909 is an NPN bipolar RF power transistor in an 8-lead SMD package called SOT409. The package contains an Aluminium Nitride (AIN) substrate to enhance its thermal performance. The bottom surface to is fully metallized to enable reflow soldering of the transistor to the PCB. All leads are isolated from the bottom surface and a ceramic lid is used to cover the transistor. The BLV909 features internal input matching for easy wide band matching over the 935 – 960 MHz frequency band. When operated from a 26 V supply in class-AB mode the transistor has a minimum power gain of 9.5 dB and a minimum collector efficiency of 50%. Two tone IMD performance is typically –30 dBc.

3 AMPLIFIER BACKGROUND

Figure 1 shows the schematic diagram of the amplifier. The matching circuits applied are fixed tuned two-stage lowpass networks using striplines and multilayer chip capacitors. Conventional bias decoupling networks are applied with improved decoupling for two-tone operation. The list of components and stripline dimensions is given in Tabel 2.
Figure 2 contains the printed-circuit board lay-out and components topology of the amplifier. The printed-circuit board contains a footprint of solder pads for collector and base lead interconnect and a thermal pad with vias to provide a low thermal resistance path to the package. Pads with vias for RF grounding of the emitter leads are intergrated with the thermal pad. All SMD components were reflow soldered to the printed-circuit board. The printed-circuit board was soldered to a heatsink in the same process step. More details on the mounting considerations for the SOT409B can be found in application note AN98017. The printed-circuit board material used is Rogers RT/Duroid 6010 with a dielectric constant of 10.2 and thickness of 0.64 mm.

4 AMPLIFIER PERFORMANCE

The amplifiers performance was measured at V_{ce} = 26 V and I_{cq} = 25 mA. The heatsink temperature was held at 25 °C during the measurement. A summary of the performance is given in Table 1.

Table 1

	UNIT	SINGLE-TONE	TWO-TONE
Frequency band	MHz	935 – 960	935 – 960
Load power	W	9	9 (PEP)
Power gain	dB	11	11.5
Power gain flatness	dB	<0.5	–
Collector efficiency	%	50	40
Intermodulation distortion	dBc	–	–32 @ 9 W PEP

Single-tone performance curcves are presented in:
Figure 3; Load power (P1) versus drive power (Pd).
Figure 4; Power gain (Gp) and collector efficiency (Eff) versus load power (P1).

2-tone performance curves are presented in:
Figure 5; Load power (P1-PEP) versus drive power (Pd-PEP)
Figure 6; Power gain (Gp) and collector efficiency (Eff) versus load power (P1-PEP)
Figure 7; Intermodulation distortion (d3) as function of load power (P1-PEP).

5 CONCLUSIONS

An AIN based surface mountable transistor BLV909 has been used to develop an amplifier for driver application in GSM base stations. Biased at 26 V and 25 mA this amplifier has shown a 9 W CW power output capability with a gain of 11 dB and a collector efficiency 50%. For 2-tone operation the IMD performance is better than –32 dBc at 9 W PEP. In addition the IMD over a wide dynamic range can be further optimized by adding a base series resistor of a few ohms combined with a good selection of Icq as described in application note AN98026.

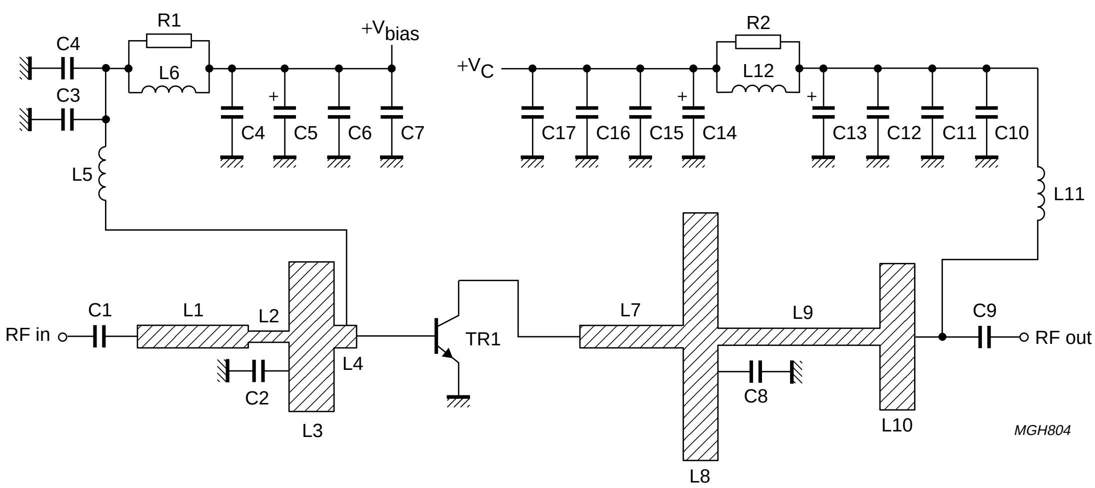


Fig.1 Circuit diagram.

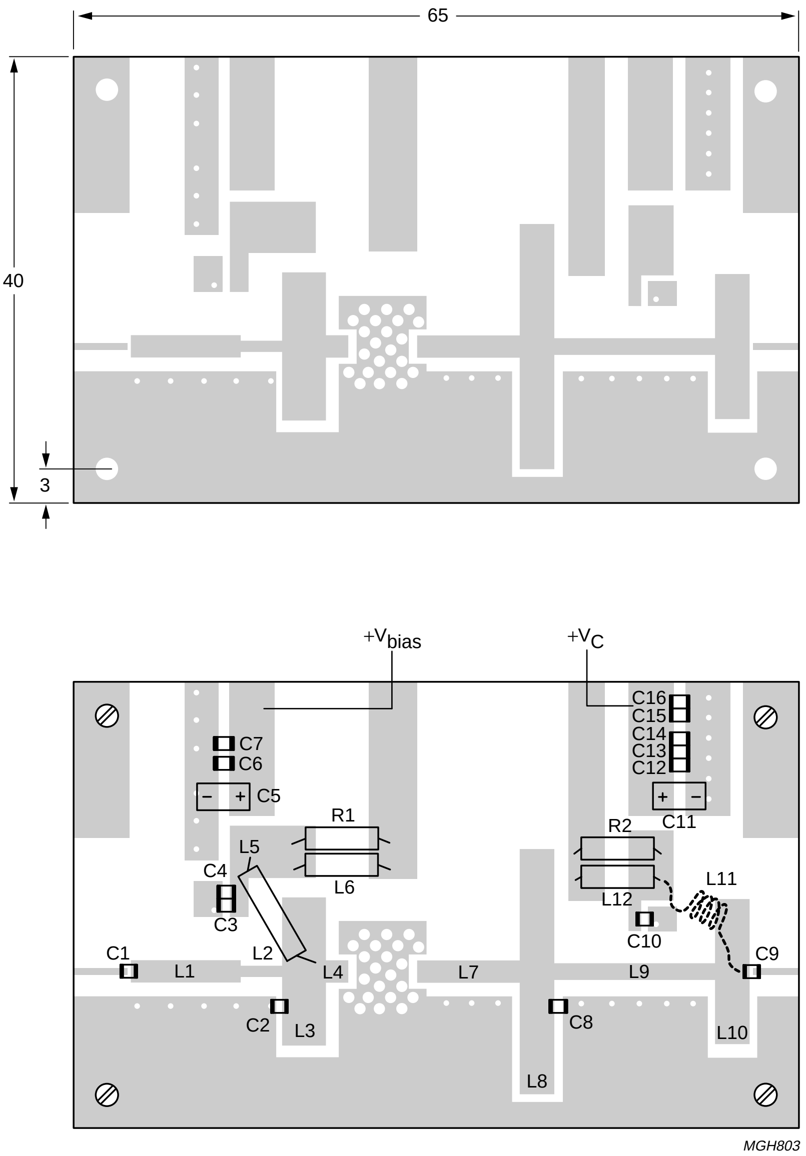


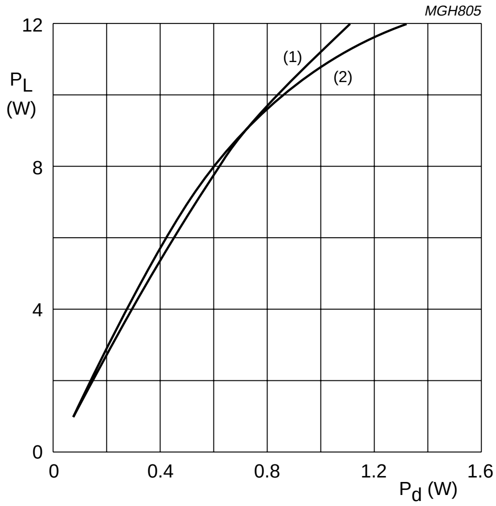
Fig.2 Printed-circuit board and lay-out amplifier.

Table 2

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1 and C9	multilayer ceramic chip capacitor; note 1	24 pF		
C2	multilayer ceramic chip capacitor; notes 1 and 2	5.6 pF		
C3, C7, C10 and C16	multilayer ceramic chip capacitor; note 3	110 pF		
C4 and C15	multilayer ceramic chip capacitor; note 3	200 pF		
C5 and C11	tantal SMD capacitor	35 V; 10 μF		
C6, C12, C13 and C14	ceramic chip capacitor	100 nF		2222 852 47104
C8	multilayer ceramic chip capacitor; note 1	8.2 pF		
L1	stripline	24.3 Ω	9.85 × 2 mm	
L2	stripline	37.5 Ω	3.63 × 1 mm	
L3	stripline	5.11 Ω	4.1 × 13.3 mm	
L4	stripline	24.3 Ω	2 × 2 mm	
L5	RF choke	0.22 μH		
L6, L12	grade 4S2 ferroxcube chip-bead			4330 030 36301
L7	stripline	24.3 Ω	9.2 × 2 mm	
L8	stripline	3.2 Ω	3.1 × 22 mm	
L9	stripline	29.4 Ω	14.4 × 1.5 mm	
L10	stripline	5.22 Ω	3.2 × 13 mm	
L11	5 turns enamelled 1 mm copper wire	35 nH	int. dia. = 3.2 mm pitch = 1.23 mm	
R1 and R2	metal film resistor	100 Ω; 0.4 W		
T1	RF transistor	BLV909		

Notes

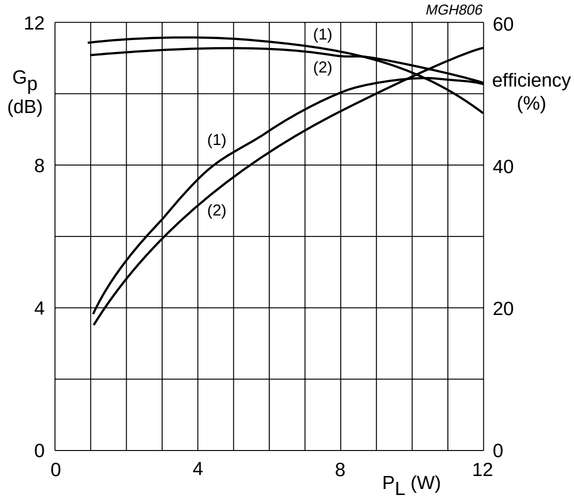
1. American Technical Ceramics type 100A or capacitor of same quality.
2. For operation 820 – 900 MHz: C_2 = 6.2 pF.
3. American Technical Ceramics type 100B or capacitor of same quality.



(1) f = 960 MHz.
(2) f = 935 MHz.

Class AB: V_{ce} = 26 V, I_{cq} = 25 mA, 9 W loadline, f = 960 MHz.

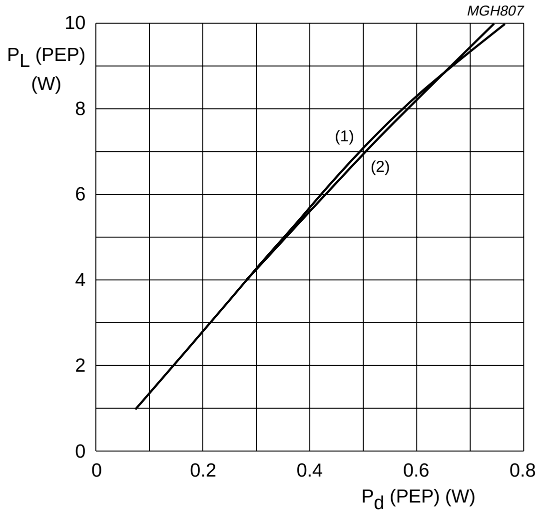
Fig.3 BLV909 PL = f (Pd).



(1) f = 935 MHz.
(2) f = 960 MHz.

Class AB: V_{ce} = 26 V, I_{cq} = 25 mA, 9 W loadline, f1 = 960 MHz.

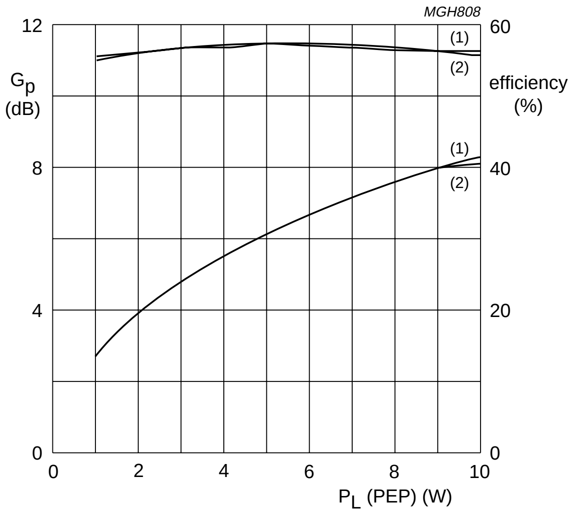
Fig.4 BLV909 Gp and Eff. = f (PL).



(1) f = 960 MHz.
(2) f = 935 MHz.

Class AB: V_{ce} = 26 V, I_{cq} = 25 mA, 9 W PEP loadline delta-f = 0.1 MHz, f1 = 960.1 MHz.

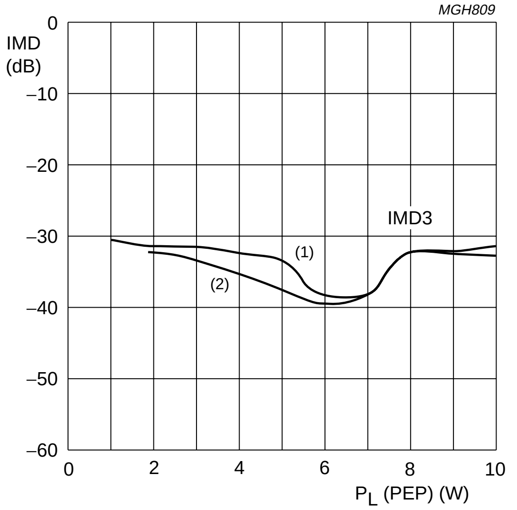
Fig.5 BLV909 PL-PEP = f (Pd).



(1) f = 960 MHz.
(2) f = 935 MHz.

Class AB: V_{ce} = 26 V, I_{cq} = 25 mA, 9 W PEP loadline, delta-f = 0.1 MHz, f1 = 960 MHz, f2 = 960 MHz.

Fig.6 BLV909 Gp and Eff. = f (PL-PEP).



(1) f = 960 MHz.
(2) f = 935 MHz.

Class AB: V_{ce} = 26 V, I_{cq} = 25 mA, 9 W PEP loadline, delta-f = 0.1 MHz, f1 = 960 MHz, f2 = 960.1 MHz.

Fig.7 BLV909 IMD = f (PL PEP).

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. +43 160 1010, Fax. +43 160 101 1210

Belarus: Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6, 220050 MINSK, Tel. +375 172 200 733, Fax. +375 172 200 773

Belgium: see The Netherlands

Brazil: see South America

Bulgaria: Philips Bulgaria Ltd., Energoproject, 15th floor, 51 James Bourchier Blvd., 1407 SOFIA, Tel. +359 2 689 211, Fax. +359 2 689 102

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

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: Prags Boulevard 80, PB 1919, DK-2300 COPENHAGEN S, Tel. +45 32 88 2636, Fax. +45 31 57 0044

Finland: Sinikalliontie 3, FIN-02630 ESPOO, Tel. +358 9 615800, Fax. +358 9 61580920

France: 51 Rue Carnot, BP317, 92156 SURESNES Cedex, Tel. +33 1 40 99 6161, Fax. +33 1 40 99 6427

Germany: Hammerbrookstraße 69, D-20097 HAMBURG, Tel. +49 40 23 53 60, Fax. +49 40 23 536 300

Greece: No. 15, 25th March Street, GR 17778 TAVROS/ATHENS, Tel. +30 1 4894 339/239, Fax. +30 1 4814 240

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: see Singapore

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, 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

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

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 1231, 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 3 301 6312, Fax. +34 3 301 4107

Sweden: Kottbygatan 7, Akalla, S-16485 STOCKHOLM, Tel. +46 8 632 2000, Fax. +46 8 632 2745

Switzerland: Allmendstrasse 140, CH-8027 ZÜRICH, Tel. +41 1 488 2686, Fax. +41 1 488 3263

Taiwan: Philips Semiconductors, 6F, No. 96, Chien Kuo N. Rd., Sec. 1, TAIPEI, Taiwan Tel. +886 2 2134 2865, 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

Uruguay: see South America

Vietnam: see Singapore

Yugoslavia: PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD, Tel. +381 11 625 344, Fax.+381 11 635 777

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

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