APPLICATION NOTE

4 W Linear Class-AB amplifier with the BLV2042 for 1930 –1990 MHz

AN98018

Philips Semiconductors

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CONTENTS

1 INTRODUCTION

This application note contains information on a 4 W class-AB amplifier based on the SMD transistor BLV2042. The amplifier described can be used for driver stages in cellular radio base stations in the PCS band 1930 – 1990 MHz. The next sections contain information on the transistor, the amplifier construction and the typical RF performance obtained.

2 TRANSISTOR BACKGROUND

The BLV2042 is an NPN bipolar RF power transistor in an 8-lead SMD package called SOT409. The package contains an Aluminium Nitride (AlN) substrate to enhance its thermal performance. The bottom surface is fully metallized to enable reflow soldering of the transistor to the printed-circuit board. All leads are isolated from the bottom surface and a ceramic lid is used to cover the transistor. The BLV2042 features internal input matching for easy wide band matching over the 1930 – 1990 MHz frequency band. When operated from a 26 V supply in class-AB mode the transistor has a minimum power gain of 11 dB and a minimum collector efficiency of 40%. Two tone IMD performance is typically –30 dBc.

3 AMPLIFIER DESCRIPTION

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 Table 2. Figure 2 contains the printed-circuit board layout 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 integrated 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 pc-board material used is Rogers RT/Duroid 6006 with a dielectric constant of 6.15 and a thickness of 0.64 mm.

4 AMPLIFIER PERFORMANCE

The amplifiers performance was measured at V_{ce} = 26 V and I_{cq} = 15 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	1930 – 1990	1930 – 1990
Load power	W	4	4 (PEP)
Power gain	dB	11	11.5
Power gain flatness	dB	1.5	–
Collector efficiency	%	45	35
Intermodulation distortion	dBc	–	–32 @ 4 W PEP

Single-tone performance curves are presented in

Figure 3; Load power(PL) versus drive power(Pd)

Figure 4; Power gain (Gp) and collector efficiency(Eff) versus load power (PL).

Two-tone performance curves are presented in

Figure 5; Load power (PL-PEP) versus drive power (Pd-PEP)

Figure 6; Power gain (Gp) and collector efficiency (Eff) versus load power (PL-PEP).

Figure 7; Intermodulation distortion (d3) as function of load power (PL-PEP).

5 CONCLUSION

An AlN based surface mountable transistor BLV2042 has been used to develop an amplifier for driver application in PCS base stations. Biased at 26 V and 15 mA this amplifier has shown a 4 W CW power output capability with a gain of 11 dB and a collector efficiency 45%. For two-tone operation the IMD performance is better than –32 dBc at 4 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 I_{cq} as described in application note AN98026.

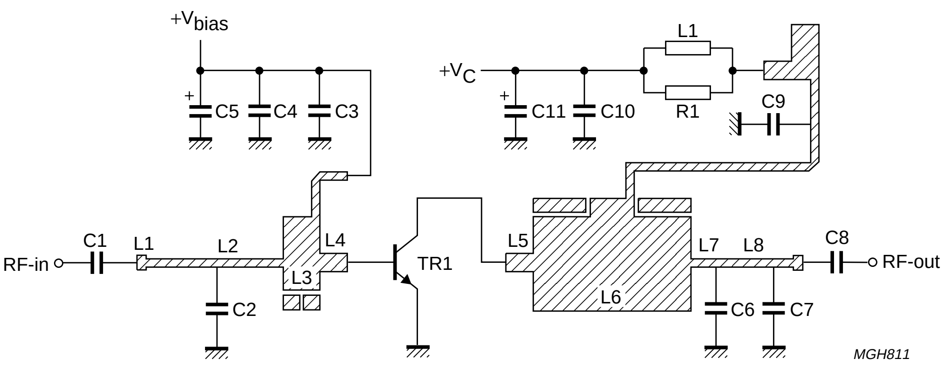


Fig.1 Schematic diagram.

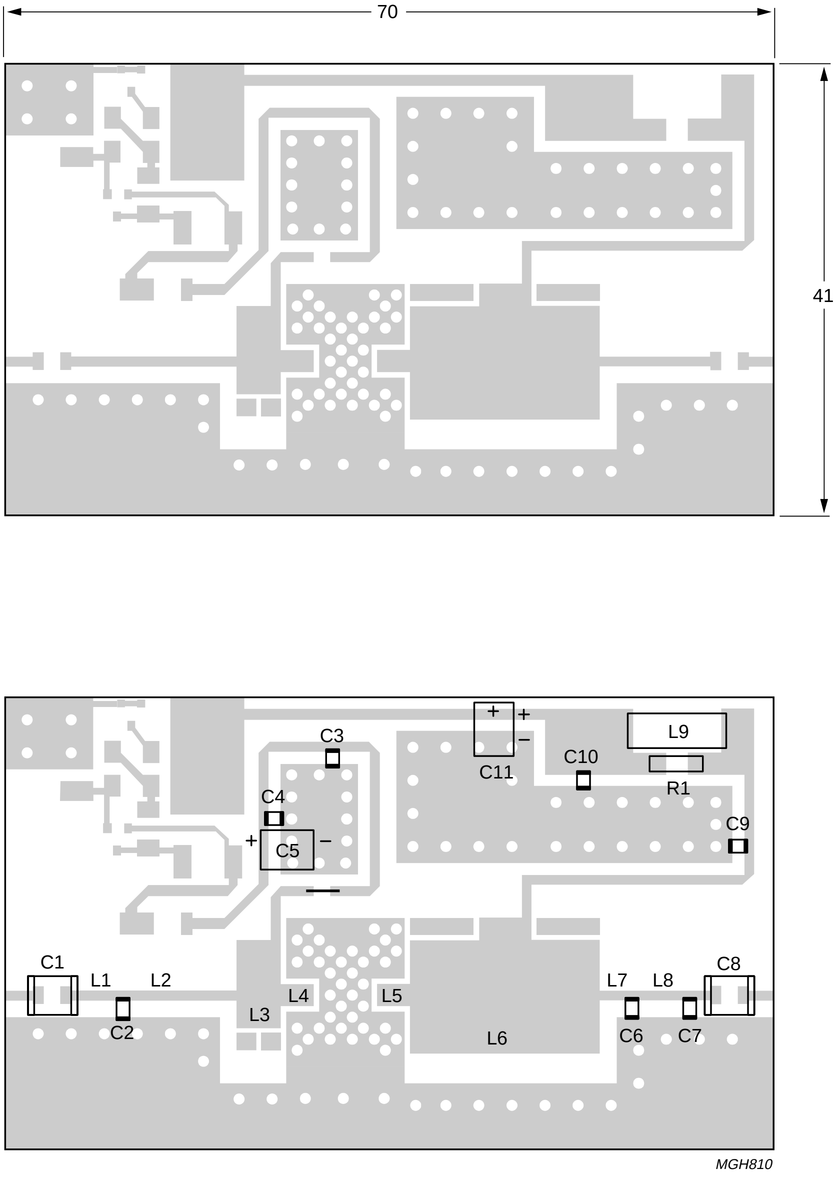


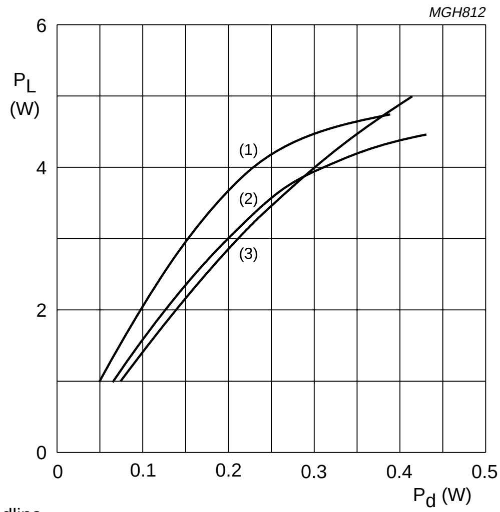
Fig.2 Printed-circuit board and layout.

Table 2

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1 and C9	multilayer ceramic chip capacitor; note 1	100 pF		
C2 and C6	multilayer ceramic chip capacitor; note 2	3.0 pF		
C3 and C8	multilayer ceramic chip capacitor; note 2	27.0 pF		
C4 and C10	multilayer ceramic chip capacitor	100 pF		2222 581 16641
C5 and C11	tantal SMD capacitor	35 V; 47 μF		
C7	multilayer ceramic chip capacitor; note 2	1.2 pF		
L1	stripline; note 3	50 Ω	9.91 × 0.91 mm	
L2	stripline; note 3	50 Ω	13 × 0.91 mm	
L3	stripline; note 3	10 Ω	4 × 8 mm	
L4	stripline; note 3	31 Ω	3 × 2 mm	
L5	stripline; note 3	31 Ω	3 × 2 mm	
L6	stripline; note 3	8.3 Ω	17.25 × 10.3 mm	
L7	stripline; note 3	50 Ω	2.42 × 0.91 mm	
L8	stripline; note 3	50 Ω	6.14 × 0.91 mm	
L9	grade 4S2 ferroxcube chip-bead			4330 030 36301
R1	metal film resistor	100 Ω; 0.4 W		
T1	RF transistor	BLV2042		

Notes

1. American Technical Ceramics type 100B or capacitor of same quality.
2. American Technical Ceramics type 100A or capacitor of same quality.
3. The stripline are on double copper-clad printed-circuit board RT/Duroid 6006 (ε_r = 6.15); thickness 0.64 mm.



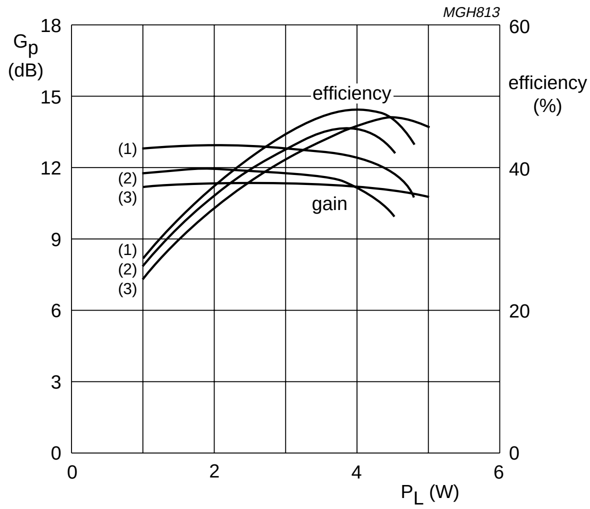
Class AB: V_{ce} = 26 V; I_{cq} = 15 mA; 4 W loadline.

(1) f = 1930 MHz.

(2) f = 1990 MHz.

(3) f = 1950 MHz.

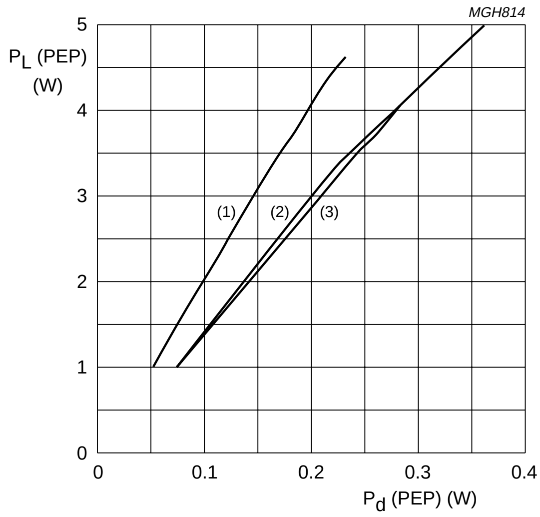
Fig.3 PL = f (Pd).



Class AB: V_{ce} = 26 V; I_{cq} = 15 mA; 4 W loadline.

Gian:	Efficiency
(1) f = 1930 MHz.	(1) f = 1930 MHz.
(2) f = 1990 MHz.	(2) f = 1990 MHz.
(3) f = 1950 MHz.	(3) f = 1950 MHz.

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



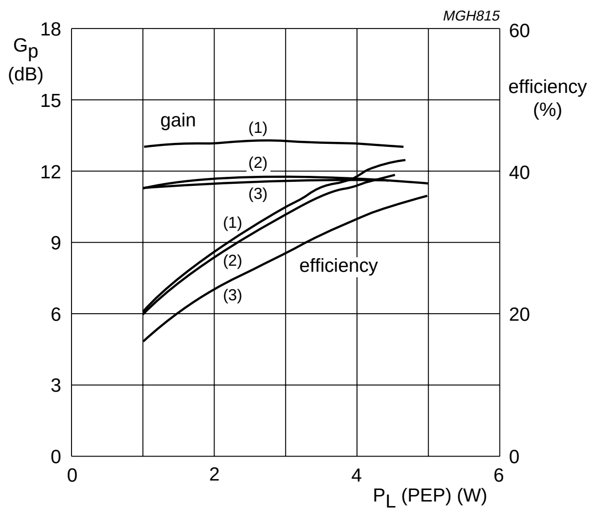
Class AB: V_{ce} = 26 V; I_{cq} = 15 mA; 4 W PEP loadline; delta-f = 0.1 MHz.

(1) f = 1930 MHz.

(2) f = 1990 MHz.

(3) f = 1950 MHz.

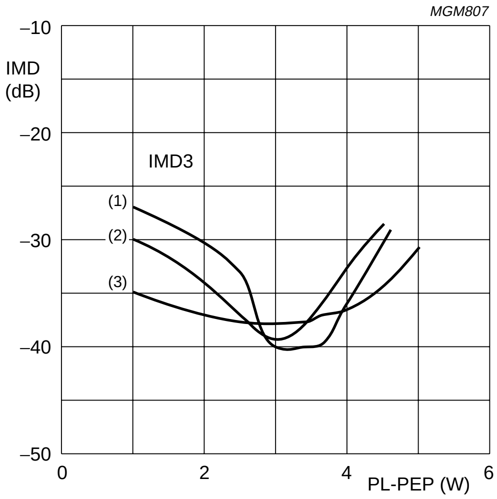
Fig.5 f = PL-PEP = f (Pd).



Class AB: V_{ce} = 26 V; I_{cq} = 15 mA; 4 W PEP loadline; delta-f = 0.1 MHz.

Gian:	Efficiency
(1) f = 1930 MHz.	(1) f = 1930 MHz.
(2) f = 1990 MHz.	(2) f = 1990 MHz.
(3) f = 1950 MHz.	(3) f = 1950 MHz.

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



Class AB: V_{ce} = 26 V; I_{cq} = 15 mA; 4 W PEP loadline; delta-f = 0.1 MHz.
(1) f = 1930 MHz.
(2) f = 1990 MHz.
(3) f = 1950 MHz.

Fig.7 IMD = f (PL PEP).

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