APPLICATION NOTE

30 W class-AB amplifier with the BLV2045 for 1930 – 1990 MHz (PCS)

AN98023

Philips
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CONTENTS

1 INTRODUCTION

In this application note a 30 W linear base station amplifier for the 1930 – 1990 MHz (PCS) band is given.
The amplifier is equipped with the Philips BLV2045, a NPN silicon planar transistor in a 2-lead SOT390 flange package. The BLV2045 features internal input- and output matching to achieve high power gain and collector efficiency and to ease the design of wideband circuits. Other features of the BLV2045 are gold top metallization for excellent reliability, and emitter ballasting resistors for optimum temperature profile. When operated from a 26 V supply in class AB mode the transistor has a minimum power gain of 8 dB and a minimum collector efficiency of 40% at a 30 W CW output power level. Two-tone IMD performance is typically –30 dBc.

2 CIRCUIT DESCRIPTION

The circuit diagram and list of components of the amplifier is given in Fig.1. Substrate material used in double copper-clad Rogers 6006, with a dielectrical constant of 6.15 and a substrate thickness of 0.635 mm (0.025 inch). Low Q matching networks at input- and output of the transistor are designed for an optimum gain flatness and efficiency over the entire band. Bypass capacitors C5 and C7 resonate at approximately 2 GHz. Capacitors C2, C3 and C8 are added to improve intermodulation distortion. Figure 2 includes component layout and printed-circuit board for both PCS applications.

3 DC BIAS CIRCUIT

Figure 3 does include an example for a temperature compensated DC bias circuit, which operates from a 15 V supply voltage and ensures a constant bias voltage. R5 is added for a flat response of the intermodulation distortion over the amplifier’s total dynamic range. See application note AN98026 for background.

4 RF MEASUREMENT RESULTS

All measurements were taken at 26 V supply voltage at the frequencies of 1900 and 1990 MHz and a heatsink temperature of 25 °C. Both input and output were fixed tuned. The single tone performance of the amplifier is given in the Figs 4 to 7 at a I_{cq} of 80 mA. Figure 8 presents the gain expansion versus drive level at several I_{cq} settings. Two tone intermodulation behaviour of the amplifier is given in Figs 9 and 10.

5 CONCLUSIONS

The amplifier described can be used in PCS applications and is able to deliver 30 W CW power with a gain of 8.5 dB and an efficiency of 46%. For two-tone operation IMD-3 is below –30 dBc for optimal I_{cq} setting. The matching networks applied also allow operation in the 1805 – 1880 MHz band (PCN).

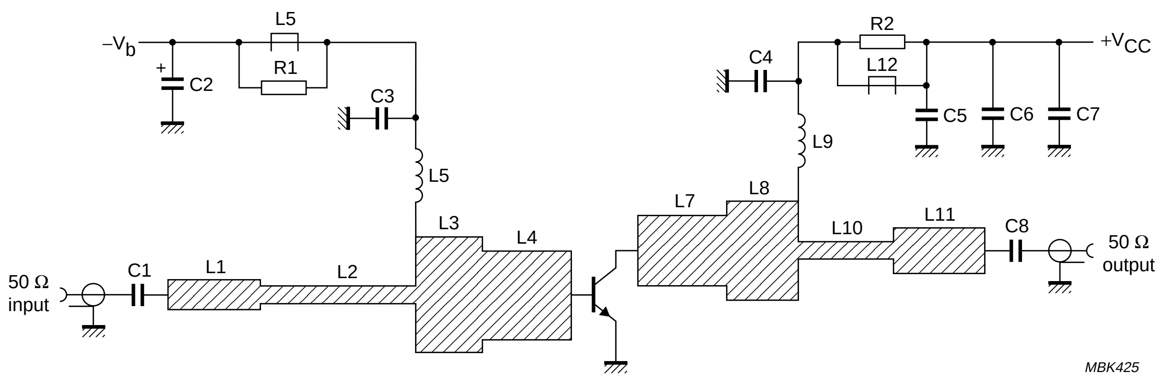


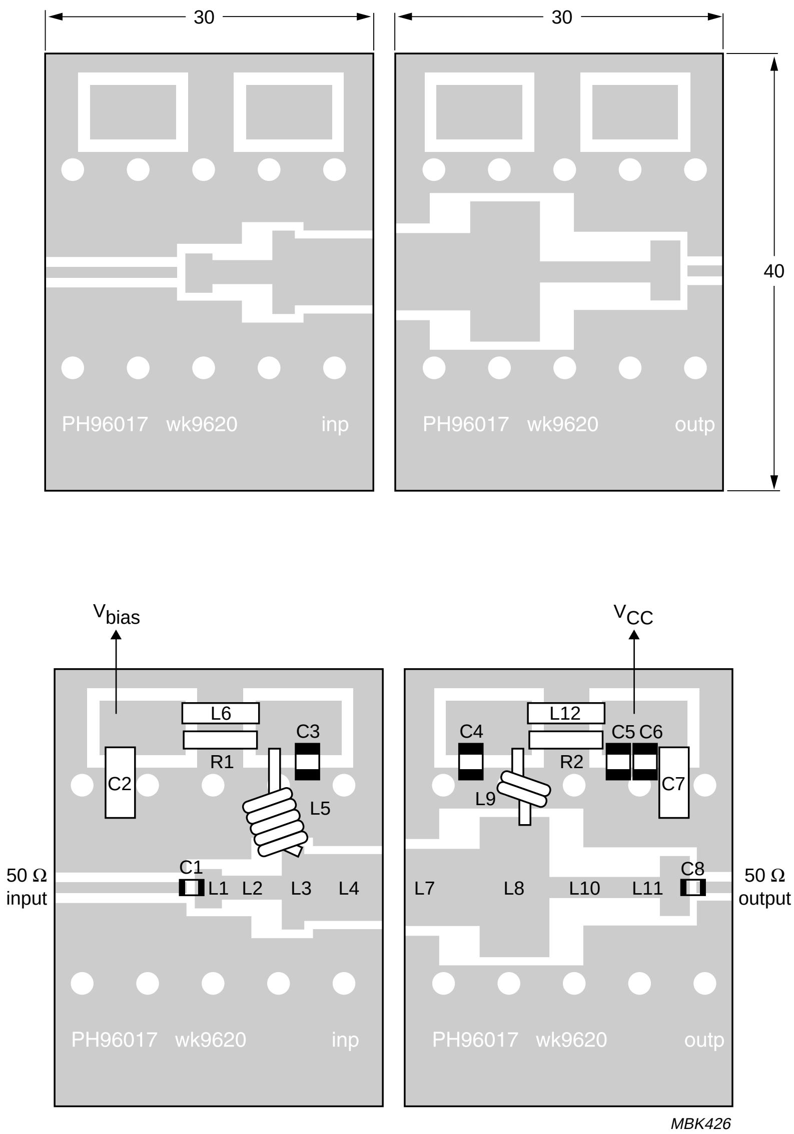
Fig.1 Class-AB testcircuit for 1.8 to 2 GHz.

Table 1 List of components

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1, C8	multilayer ceramic chip capacitor; note 1	30 pF		
C2, C7	tantal SMD capacitor	35 V; 10 μF		
C3, C4	multilayer ceramic chip capacitor; note 2	20 pF		
C5	multilayer ceramic chip capacitor	22 nF		2222 629 08223
C6	multilayer ceramic chip capacitor	100 nF		2222 852 47104
L1	stripline; note 3	20.5 Ω	2.5 × 3.5 mm	
L2	stripline; note 3	29.8 Ω	5.6 × 2.1 mm	
L3	stripline; note 3	11 Ω	2 × 7.4 mm	
L4	stripline; note 3	13.2 Ω	7.2 × 6 mm	
L5	5 turns enamelled 1 mm copper wire	38 nH	int. dia = 3 mm; length = 8 mm	
L6, L12	grade 4S2 ferroxcube chip-bead			4330 030 36301
L7	stripline; note 3	11.5 Ω	6.6 × 7.1 mm	
L8	stripline; note 3	6.9 Ω	6.4 × 12.6 mm	
L9	2 turns enamelled 1 mm copper wire	9 nH	int. dia = 3 mm; length = 4 mm	
L10	stripline; note 3	35.8 Ω	9.9 × 1.6 mm	
L11	stripline; note 3	14.4 Ω	2.7 × 5.4 mm	
R1, R2	metal film resistor	10 Ω; 0.4 W		2311 153 51009

Notes

1. American Technical Ceramics type 100A or capacitor of same quality.
2. American Technical Ceramics type 100B or capacitor of same quality.
3. The striplines are on a double copper-clad PCB with epoxy fibre-glass dielectric (ε_r = 6.15); thickness 0.64 mm.



Dimensions in mm.

The components are situated on one side of the copper-clad epoxy fibre-glass board, the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through metallization.

Fig.2 Component layout and printed-circuit board for 1.8 to 2 GHz class-AB testcircuit.

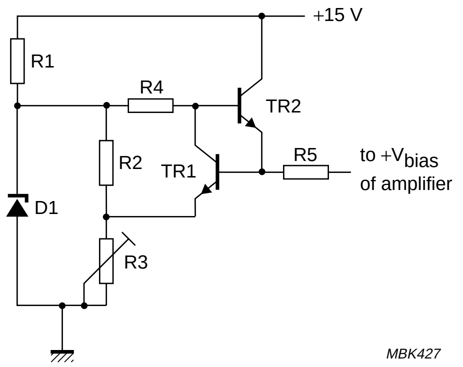


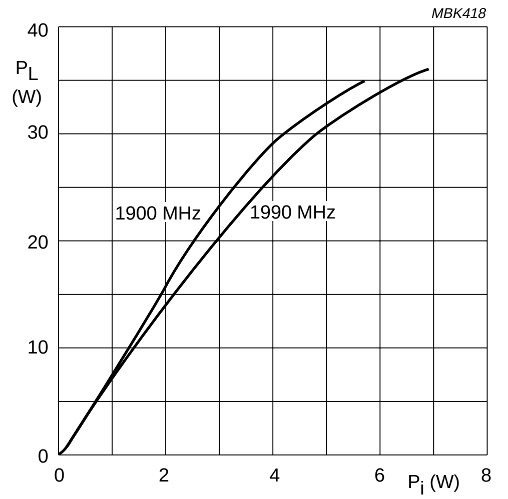
Fig.3 Class AB bias network.

Table 2 Semiconductors

COMPONENTS	TYPE NUMBER	DESCRIPTION
D1	BZX84, C6V2	SMD Zener Diode
T1	MJD31C	SMD NPN Transistor
T2	BC846C	SMC NPN Transistor

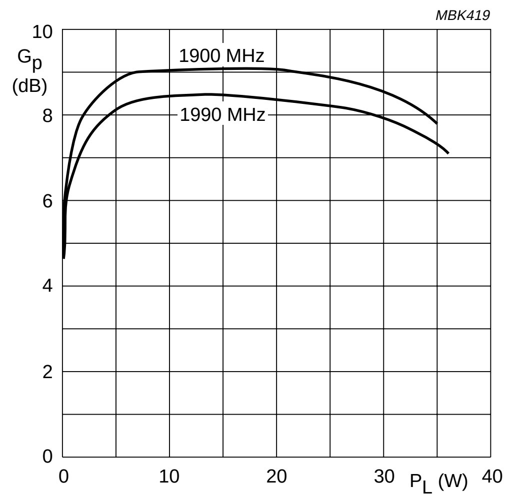
Table 3 Resistors

COMPONENTS	VALUES	DESCRIPTION
R1	1.1 kΩ	SMD resistor Philips 1206
R2	4.3 kΩ	SMD resistor Philips 1206
R3	500 Ω	Bourns 10 turn
R4	3 kΩ	SMD resistor Philips 1206
R5	3.3 Ω	SMD resistor Philips 1206



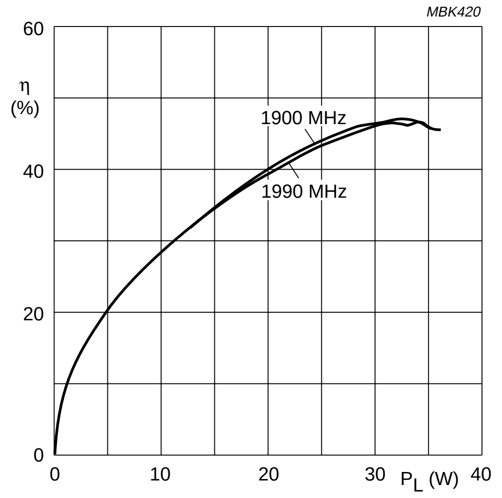
V_{CE} = 26 V; I_{cq} = 80 mA.

Fig.4 Output power as a function of input power; typical values.



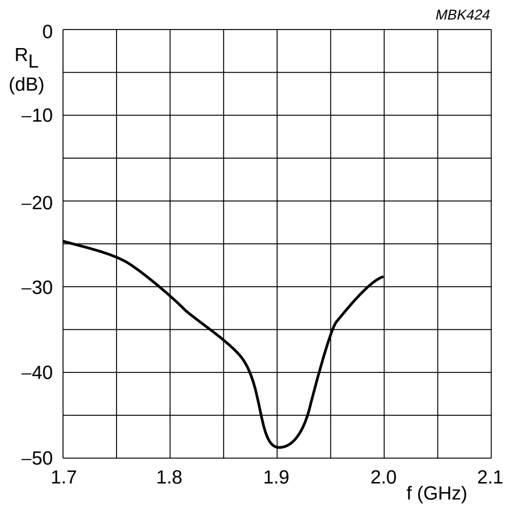
V_{CE} = 26 V; I_{cq} = 80 mA.

Fig.5 Power gain versus output power; typical values.



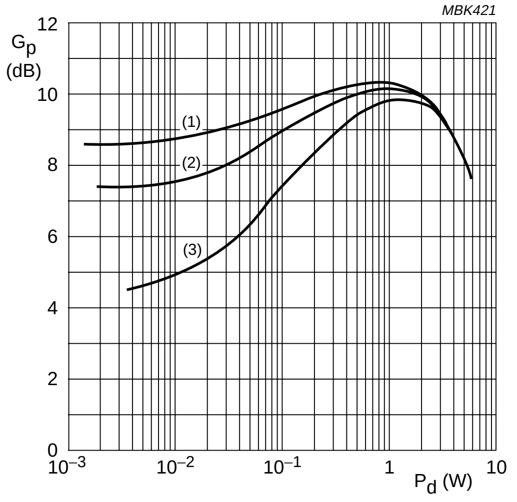
V_{CE} = 26 V; I_{cq} = 80 mA.

Fig.6 Collector-efficiency as a function of output power; typical values.



V_{CE} = 26 V; I_{cq} = 80 mA.

Fig.7 Input return loss as a function of frequency.



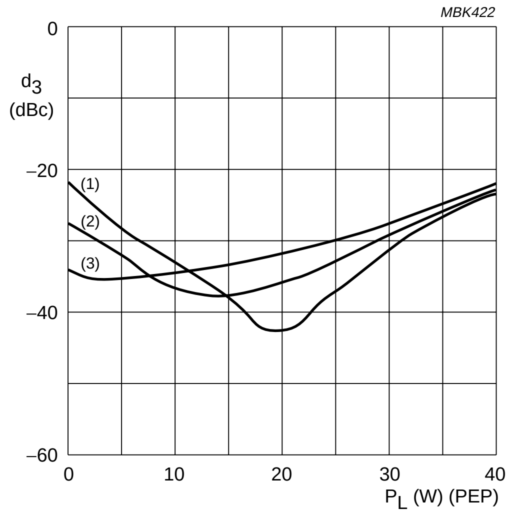
V_{CE} = 26 V; f = 1950 MHz.

(1) I_{CQ} = 240 mA.

(2) I_{CQ} = 160 mA.

(3) I_{CQ} = 80 mA.

Fig.8 Power gain expansion as a function of the drive power; typical values.



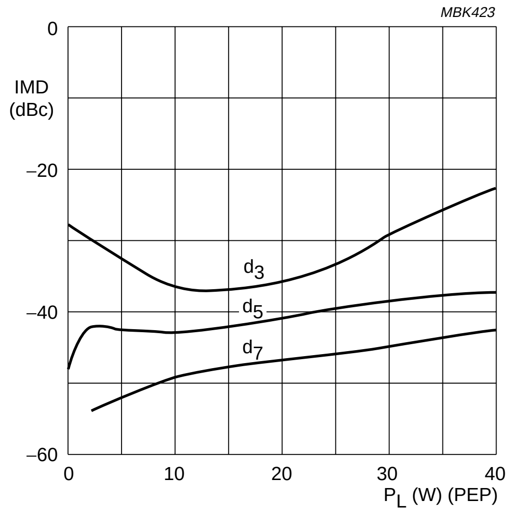
V_{CE} = 26 V; f_1 = 1950 MHz; f_2 = 1950.1 MHz.

(1) I_{CQ} = 40 mA.

(2) I_{CQ} = 80 mA.

(3) I_{CQ} = 120 mA.

Fig.9 Intermodulation distortion as a function of the load power; typical values.



V_{CE} = 26 V; I_{cq} = 80 mA; f_1 = 1950 MHz; f_2 = 1950.1 MHz.

Fig.10 Intermodulation distortion as a function of the load power; typical values.

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