DATA SHEET

BLW76
HF/VHF power transistor

Product specification

August 1986

Philips
Semiconductors

PHILIPS

HF/VHF power transistor BLW76

DESCRIPTION

N-P-N silicon planar epitaxial transistor intended for use in class-AB or class-B operated high power transmitters in the h.f. and v.h.f. bands. The transistor presents excellent performance as a linear amplifier in the h.f. band. It is resistance stabilized and is guaranteed to withstand severe load mismatch conditions. Transistors are delivered in matched h_{FE} groups.

The transistor has a ½" flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

R.F. performance up to T_h = 25 °C

MODE OF OPERATION	V_{CE} V	$I_{C(ZS)}$ A	f MHz	P_L W	G_p dB	η %	d_3 dB
s.s.b. (class-AB)	**28**	**0,05**	**1,6 – 28**	**8 – 80 (P.E.P.)**	> **13**	> **35**(1)	< **–30**
c.w. (class-B)	28	–	108	80	typ. 7,9	typ. 70	–

Note

1. At 80 W P.E.P.

PIN CONFIGURATION

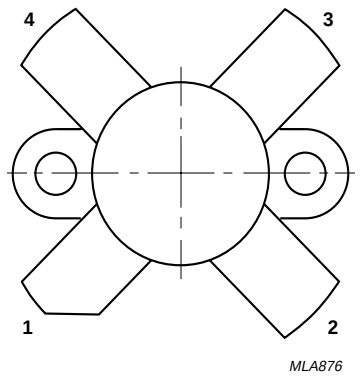


Fig.1 Simplified outline. SOT121B.

PINNING - SOT121B.

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter

PRODUCT SAFETY This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage (V_{BE} = 0)				
peak value	V_{CESM}	max.	70	V
Collector-emitter voltage (open base)	V_{CEO}	max.	35	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4	V
Collector current (average)	$I_{C(AV)}$	max.	8	A
Collector current (peak value); f > 1 MHz	I_{CM}	max.	20	A
R.F. power dissipation (f > 1 MHz); T_{mb} = 25 °C	P_{rf}	max.	140	W
Storage temperature	T_{stg}		−65 to + 150	°C
Operating junction temperature	T_j	max.	200	°C

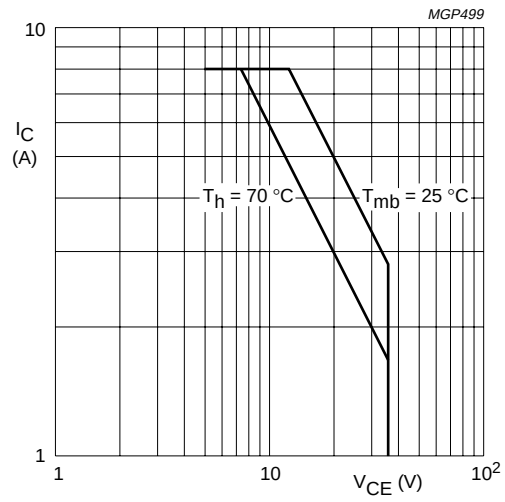
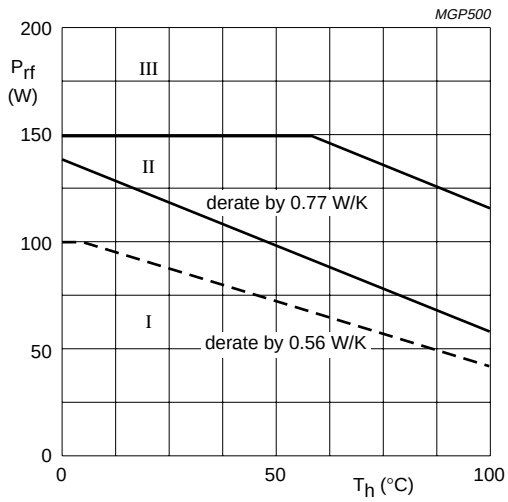


Fig.2 D.C. SOAR.



I Continuous d.c. operation
II Continuous r.f. operation
III Short-time operation during mismatch

Fig.3 R.F. power dissipation; $V_{CE} \leq 28$ V; f > 1 MHz.

THERMAL RESISTANCE

(dissipation = 60 W; T_{mb} = 82 °C, i.e. T_h = 70 °C)

From junction to mounting base (d.c. dissipation)	$R_{th\ j\text{-}mb(dc)}$	=	1,92	K/W
From junction to mounting base (r.f. dissipation)	$R_{th\ j\text{-}mb(rf)}$	=	1,33	K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,2	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector-emitter breakdown voltage			
V_{BE} = 0; I_C = 50 mA	$V_{(BR)\ CES}$	>	70 V
Collector-emitter breakdown voltage			
open base; I_C = 50 mA	$V_{(BR)\ CEO}$	>	35 V
Emitter-base breakdown voltage			
open collector; I_E = 10 mA	$V_{(BR)EBO}$	>	4 V
Collector cut-off current			
V_{BE} = 0; V_{CE} = 35 V	I_{CES}	<	10 mA
D.C. current gain(1)			
I_C = 4 A; V_{CE} = 5 V	h_{FE}		15 to 80
D.C. current grain ratio of matched devices(1)			
I_C = 4 A; V_{CE} = 5 V	h_{FE1}/h_{FE2}	<	1,2
Collector-emitter saturation voltage(1)			
I_C = 12,5 A; I_B = 2,5 A	V_{CEsat}	typ.	2,5 V
Transition frequency at f = 100 MHz(2)			
$-I_E$ = 4 A; V_{CB} = 28 V	f_T	typ.	315 MHz
$-I_E$ = 12,5 A; V_{CB} = 28 V	f_T	typ.	305 MHz
Collector capacitance at f = 1 MHz			
$I_E = I_e$ = 0; V_{CB} = 28 V	C_c	typ.	125 pF
Feedback capacitance at f = 1 MHz			
I_C = 50 mA; V_{CE} = 28 V	C_{re}	typ.	85 pF
Collector-flange capacitance	C_{cf}	typ.	3 pF

Notes

1. Measured under pulse conditions: $t_p \leq 300\ \mu s$; $\delta \leq 0{,}02$.
2. Measured under pulse conditions: $t_p \leq 50\ \mu s$; $\delta \leq 0{,}01$.

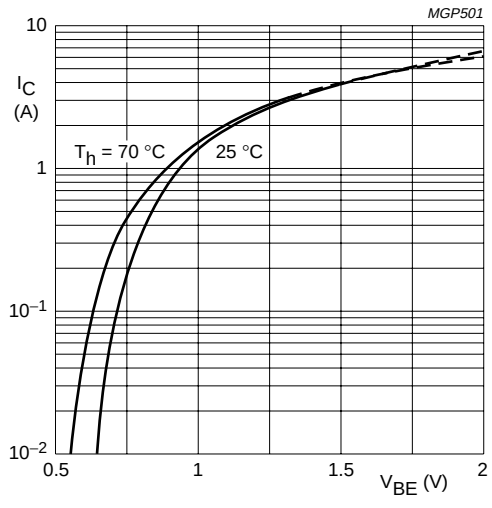


Fig.4 Typical values; V_{CE} = 20 V.

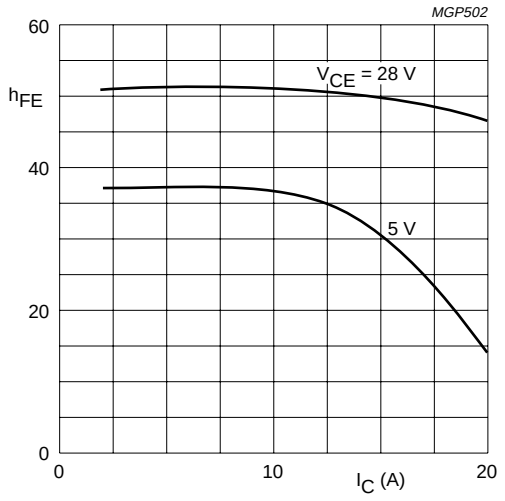


Fig.5 Typical values; T_j = 25 °C.

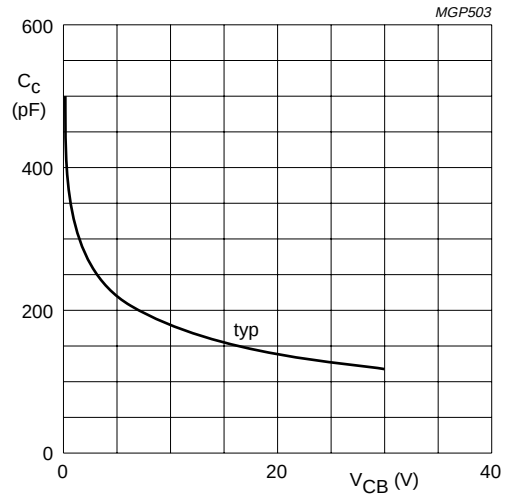


Fig.6 $I_E = I_e = 0$; f = 1 MHz; T_j = 25 °C.

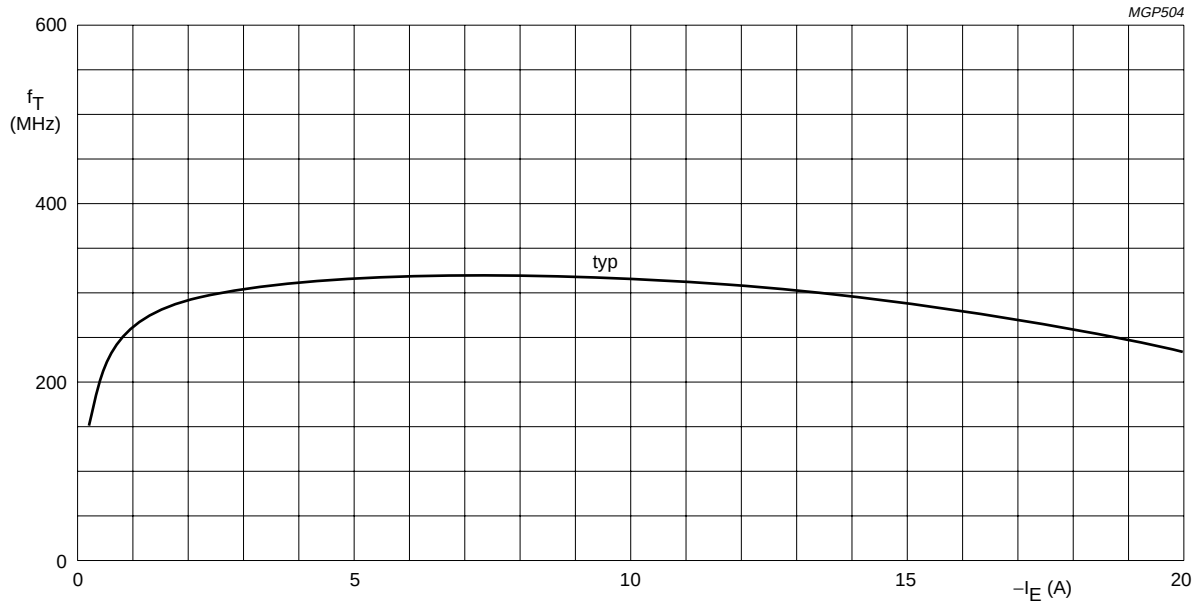


Fig.7 V_{CB} = 28 V; f = 100 MHz; T_j = 25 °C.

APPLICATION INFORMATION

R.F. performance in s.s.b. class-AB operation (linear power amplifier)
V_{CE} = 28 V; T_h = 25 °C; f_1 = 28,000 MHz; f_2 = 28,001 MHz

OUTPUT POWER	G_p	η_{dt} (%)	I_C (A)	d_3	d_5	$I_{C(ZS)}$
W	**dB**	**at 80 W P.E.P.**		**dB**	**dB**	**A**
8 to 80 (P.E.P.)	> 13	> 35	< 4,1	< –30	< –30	0,05

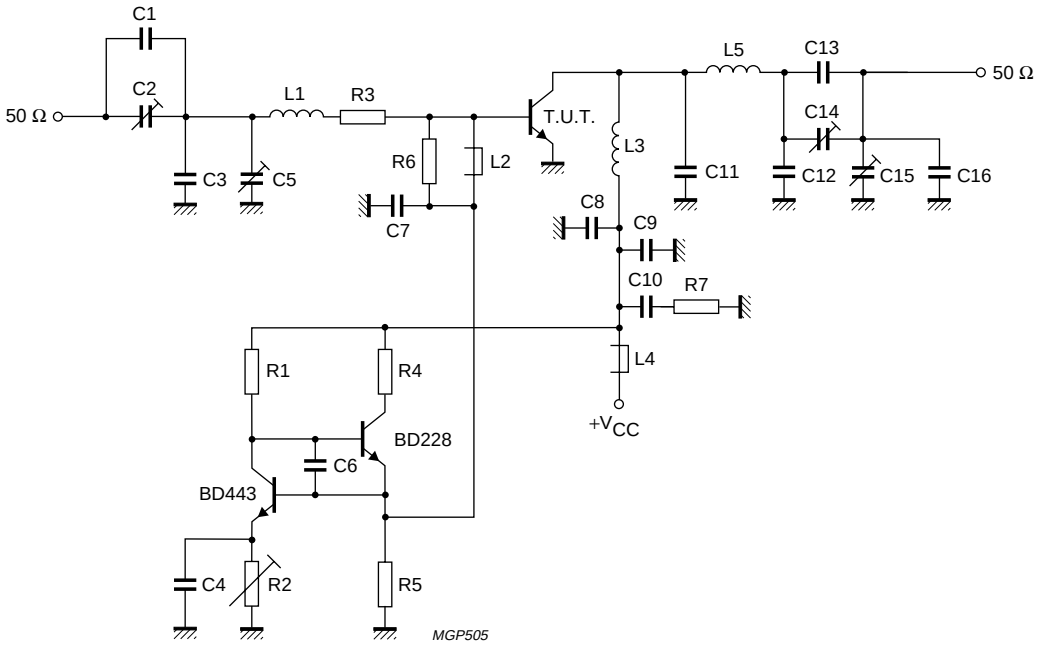
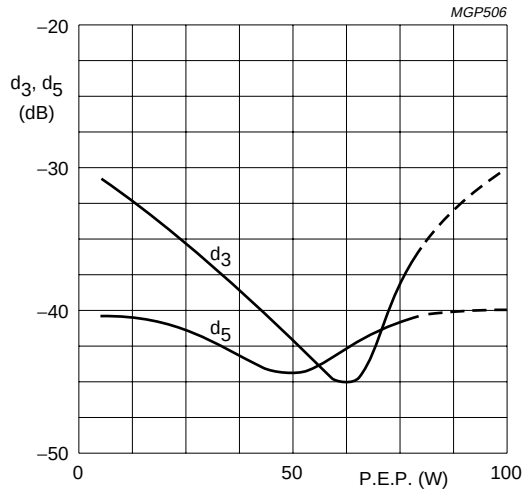


Fig.8 Test circuit; s.s.b. class-AB.

List of components:

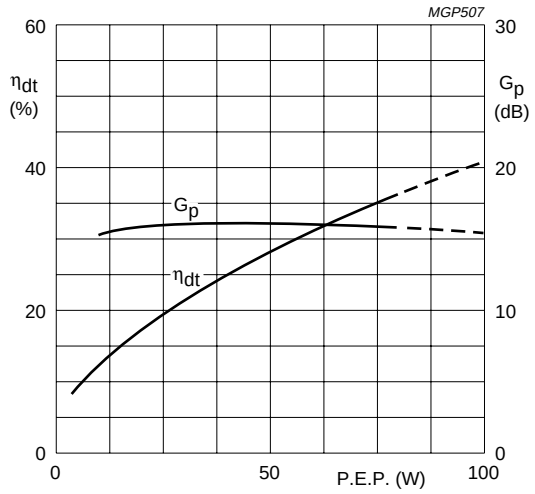
C1	=	27 pF ceramic capacitor (500 V)
C2	=	100 pF air dielectric trimmer (single insulated rotor type)
C3	=	100 pF polystyrene capacitor
C4	=	C6 = C9 = 100 nF polyester capacitor
C5	=	280 pF air dielectric trimmer (single non-insulated rotor type)
C7	=	C8 = 3,9 nF ceramic capacitor
C10	=	2,2 μF moulded metallized polyester capacitor
C11	=	180 pF polystyrene capacitor
C12	=	2 × 68 pF ceramic capacitors in parallel (500 V)
C13	=	120 pF polystyrene capacitor
C14	=	C15 = 280 pF air dielectric trimmer (single insulated rotor type)
C16	=	56 pF ceramic capacitor (500 V)
L1	=	108 nH; 4 turns Cu wire (1,6 mm); int. dia. 8,7 mm; length 11,2 mm; leads 2 × 7 mm
L2	=	L4 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L3	=	88 nH; 3 turns Cu wire (1,6 mm); int. dia. 8,0 mm; length 8,0 mm; leads 2 × 7 mm
L5	=	120 nH; 4 turns Cu wire (1,6 mm); int. dia. 9,3 mm; length 11,2 mm; leads 2 × 7 mm
R1	=	1,5 kΩ (± 5%) carbon resistor (0,5 W)
R2	=	10 Ω wirewound potentiometer (3 W)
R3	=	0,9 Ω; parallel connection of 2 × 1,8 Ω carbon resistors (± 5%; 0,5 W each)
R4	=	60 Ω; parallel connection of 2 × 120 Ω wirewound resistors (5,5 W each)
R5	=	56 Ω (± 5%) carbon resistor (0,5 W)
R6	=	33 Ω (± 5%) carbon resistor (0,5 W)
R7	=	4,7 Ω (± 5%) carbon resistor (0,5 W)



V_{CE} = 28 V; $I_{C(ZS)}$ = 50 mA; f_1 = 28,000 MHz;
f_2 = 28,001 MHz; T_h = 25 °C; typical values.

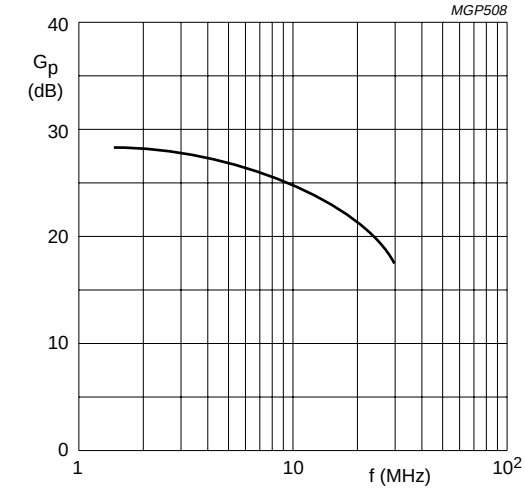
Fig.9 Intermodulation distortion as a function of output power.(1.)

1. Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.



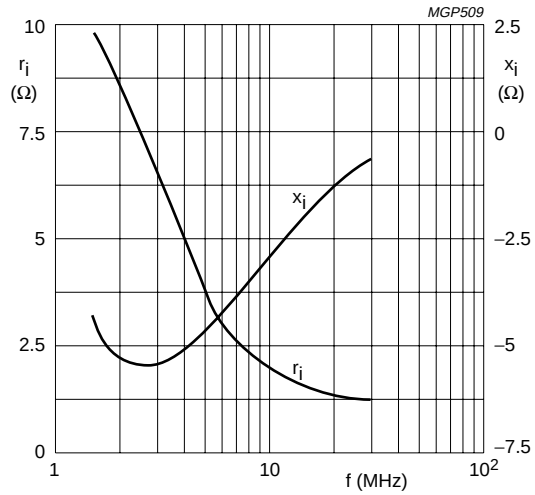
V_{CE} = 28 V; $I_{C(ZS)}$ = 50 mA; f_1 = 28,000 MHz;
f_2 = 28,001 MHz; T_h = 25 °C; typical values.

Fig.10 Double-tone efficiency and power gain as a function of output power.



V_{CE} = 28 V; $I_{C(ZS)}$ = 50 mA; P_L = 80 W;
T_h 25 °C; Z_L = 3,9 Ω.

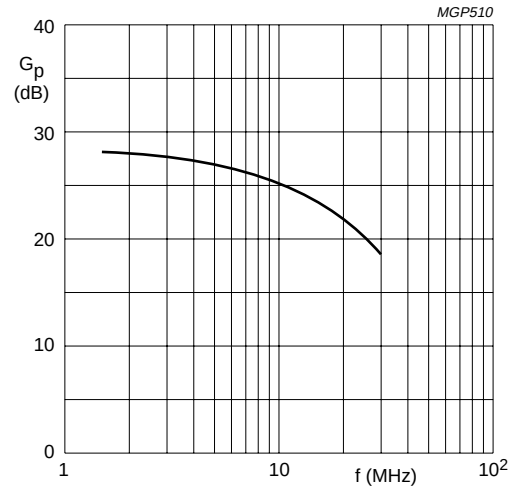
Fig.11 Power gain as a function of frequency.



V_{CE} = 28 V; $I_{C(ZS)}$ = 50 mA; P_L = 80 W;
T_h 25 °C; Z_L = 3,9 Ω.

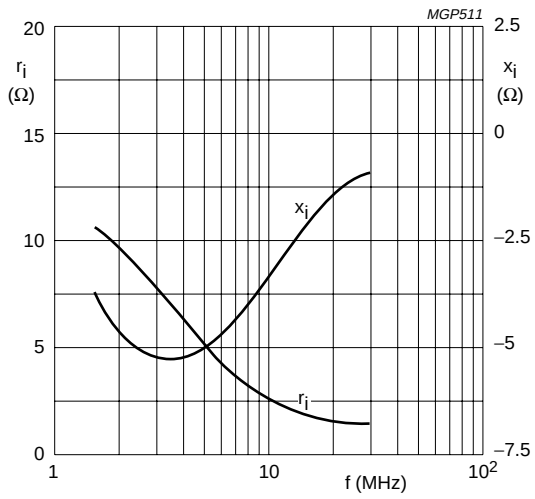
Fig.12 Input impedance (series components) as a function of frequency.

Figs 11 and 12 are typical curves and hold for an unneutralized amplifier in s.s.b. class-AB operation.



V_{CE} = 28 V; $I_{C(ZS)}$ = 50 mA; P_L = 80 W; T_h = 25 °C;
Z_L = 3,9 Ω; neutralizing capacitor: 68 pF.

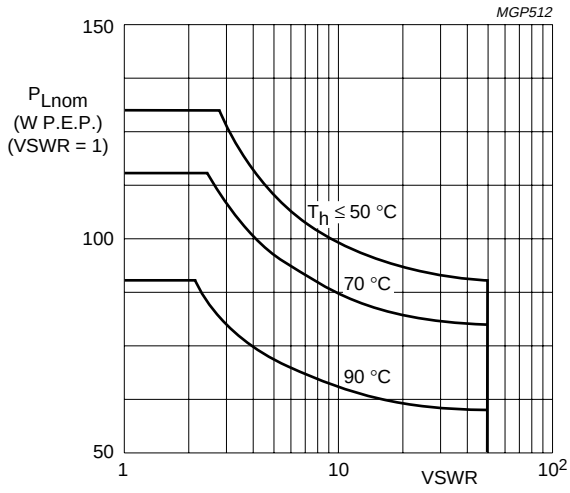
Fig.13 Power gain as a function of frequency.



V_{CE} = 28 V; $I_{C(ZS)}$ = 50 mA; P_L = 80 W; T_h = 25 °C;
Z_L = 3,9 Ω; neutralizing capacitor: 68 pF.

Fig.14 Input impedance (series components) as a function of frequency.

Figs 13 and 14 are typical curves and hold for a push-pull amplifier with cross-neutralization in s.s.b. class-AB operation.



The graph shows the permissible output power under nominal conditions (VSWR = 1) as a function of the expected VSWR during short-time mismatch conditions with heatsink temperatures as parameter.

Fig.15 R.F. SOAR; s.s.b. class-AB operation; f_1 = 28,000 MHz; f_2 = 28,001 MHz; V_{CE} = 28 V; $R_{th\ mb\text{-}h}$ = 0,2 K/W.

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit); T_h = 25 °C

f (MHz)	V_{CE} (V)	P_L (W)	P_S (W)	G_p (dB)	I_C (A)	η (%)	$\bar{z}_i$ (Ω)	$\bar{Y}_L$ (mS)
108	28	80	typ. 13	typ. 7,9	typ. 4,1	typ. 70	0,85 + j1,0	174 − j40

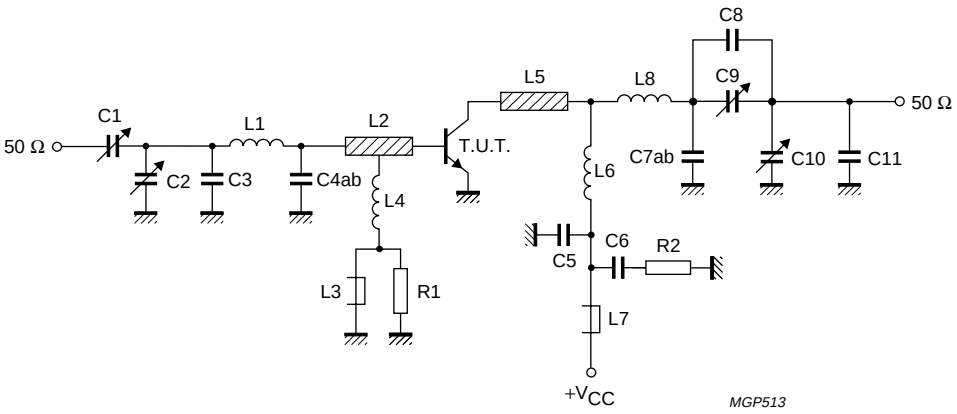


Fig.16 Test circuit; c.w. class-B.

List of components:

C1 = C9 = C10 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
C2 = 5 to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
C3 = 22 pF ceramic capacitor (500 V)
C4ab = 2 × 82 pF ceramic capacitors in parallel (500 V)
C5 = 270 pF polystyrene capacitor
C6 = 100 nF polyester capacitor
C7a = 8,2 pF ceramic capacitor (500 V)
C7b = 10 pF ceramic capacitor (500 V)
C 8 = 5,6 pF ceramic capacitor (500 V)
C11 = 10 pF ceramic capacitor (500 V)
L1 = 21 nH; 2 turns Cu wire (1,0 mm); int. dia. 4,0 mm; length 3,5 mm; leads 2 × 5 mm
L2 = L5 = 2,4 nH; strip (12 mm × 6 mm); tap for L4 at 6 mm from transistor
L3 = L7 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L4 = 100 nH; 7 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 3 mm; leads 2 × 5 mm
L6 = 49 nH; 2 turns Cu wire (1,6 mm); int. dia. 9,0 mm; length 4,7 mm; leads 2 × 5 mm
L8 = 56 nH; 2 turns Cu wire (1,6 mm); int. dia. 10,0 mm; length 4,5 mm; leads 2 × 5 mm
L2 and L5 are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric.
R1 = R2 = 10 Ω (± 10%) carbon resistor

Component layout and printed-circuit board for 108 MHz test circuit are shown in Fig.17.

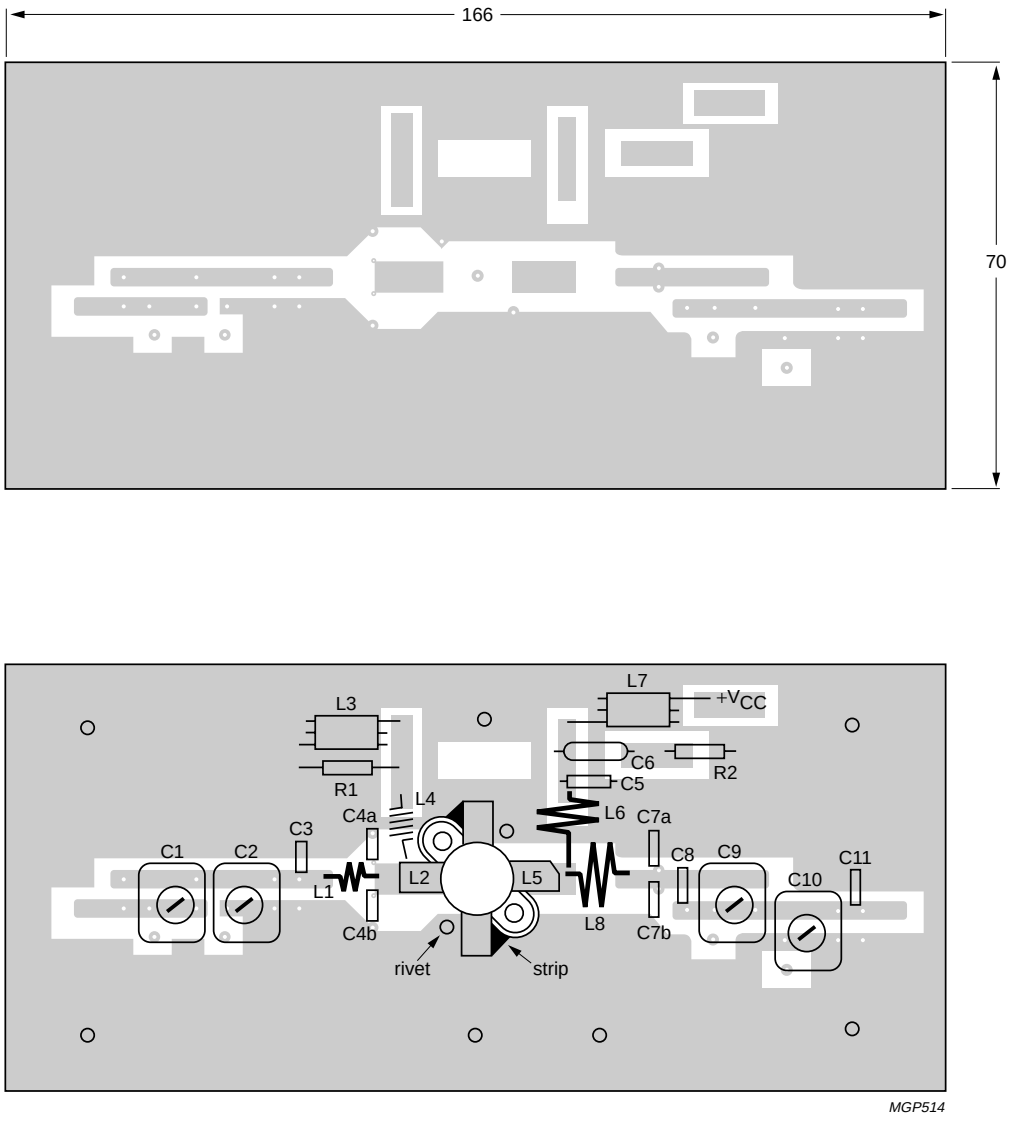


Fig.17 Component layout and printed-circuit board for 108 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.

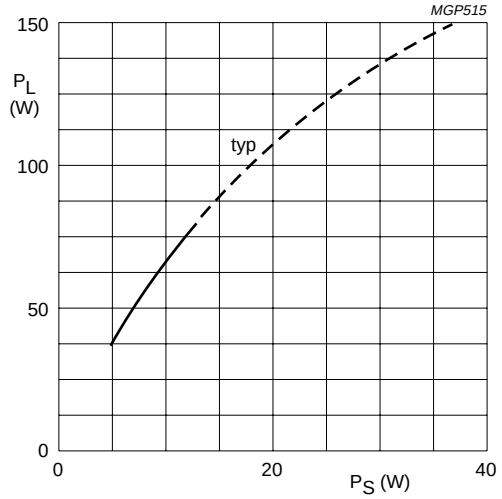


Fig.18 V_{CE} = 28 V; f = 108 MHz; T_h = 25 °C.

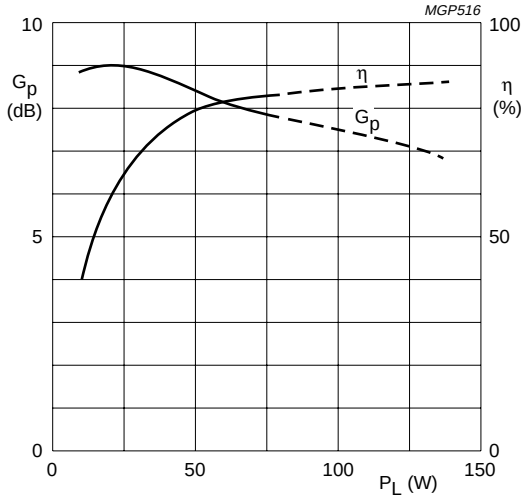
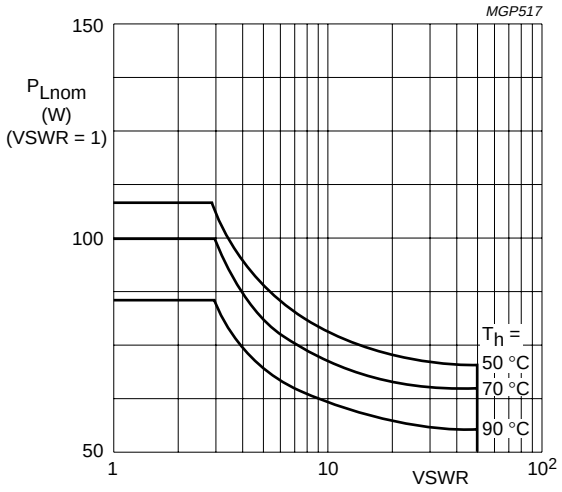


Fig.19 V_{CE} = 28 V; f = 108 MHz; T_h = 25 °C; typical values.



The graph shows the permissible output power under nominal conditions (VSWR = 1) as a function of the expected VSWR during short-time mismatch conditions with heatsink temperatures as parameter.

Fig.20 R.F. SOAR; c.w. class-B operation; f = 108 MHz; V_{CE} = 28 V; $R_{th\ mb\text{-}h}$ = 0,2 K/W.

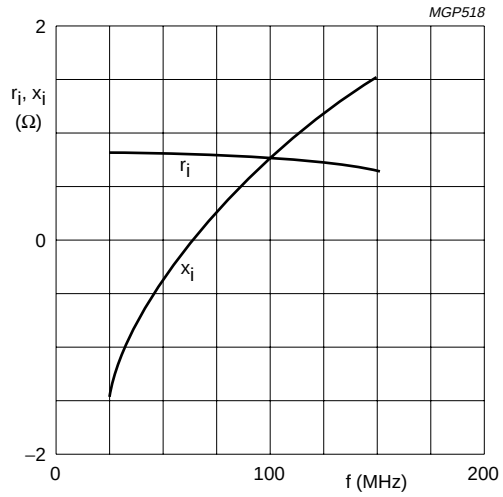


Fig.21 V_{CE} = 28 V; P_L = 80 W; T_h = 25 °C; typical values.

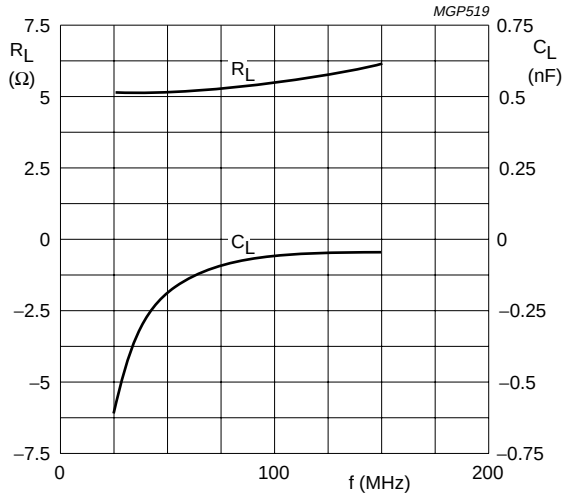


Fig.22 V_{CE} = 28 V; P_L = 80 W; T_h = 25 °C; typical values.

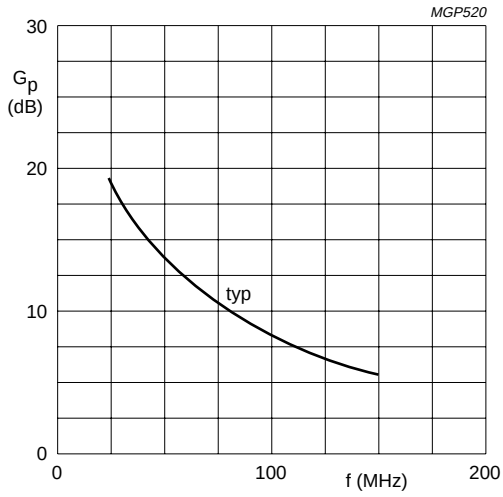
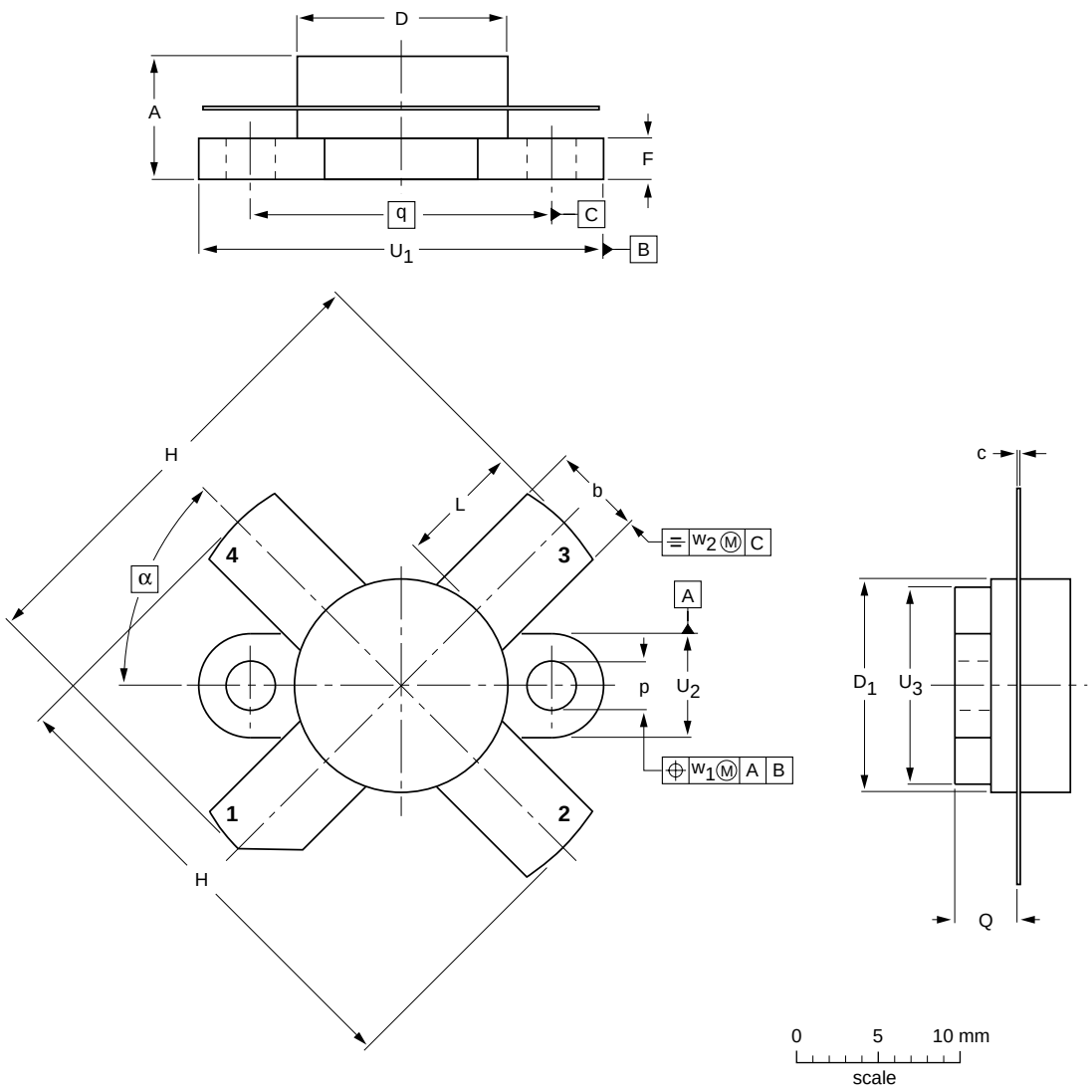


Fig.23 V_{CE} = 28 V; P_L = 80 W; T_h = 25 °C.

PACKAGE OUTLINE

Flanged ceramic package; 2 mounting holes; 4 leads **SOT121B**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	b	c	D	D_1	F	H	L	p	Q	q	U_1	U_2	U_3	w_1	w_2	α
mm	7.27 6.17	5.82 5.56	0.16 0.10	12.86 12.59	12.83 12.57	2.67 2.41	28.45 25.52	7.93 6.32	3.30 3.05	4.45 3.91	18.42	24.90 24.63	6.48 6.22	12.32 12.06	0.51	1.02	45°
inches	0.286 0.243	0.229 0.219	0.006 0.004	0.506 0.496	0.505 0.495	0.105 0.095	1.120 1.005	0.312 0.249	0.130 0.120	0.175 0.154	0.725	0.98 0.97	0.255 0.245	0.485 0.475	0.02	0.04	

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT121B						97-06-28

DEFINITIONS

Data Sheet Status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.