DATA SHEET

BLW77
HF/VHF power transistor

Product specification

August 1986

Philips
Semiconductors

PHILIPS

HF/VHF power transistor BLW77

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**	**0,1**	**1,6 – 28**	**15 – 130** (P.E.P.)	> **12**	> **37,5**(1)	< **–30**
c.w. (class-B)	28	–	87,5	130	typ. 7,5	typ. 75	–

Note

1. At 130 W P.E.P.

PIN CONFIGURATION

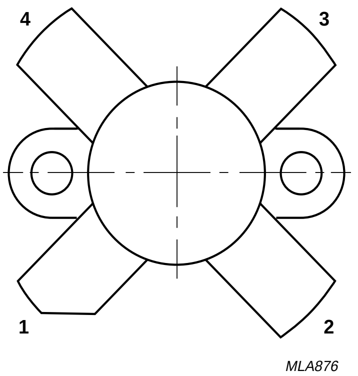


Fig.1 Simplified outline. SOT121B.

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.	12	A
Collector current (peak value); f > 1 MHz	I_{CM}	max.	30	A
R.F. power dissipation (f > 1 MHz;); T_{mb} = 25 °C	P_{rf}	max.	245	W
Storage temperature	T_{stg}		–65 to + 150	°C
Operating junction temperature	T_j	max.	200	°C

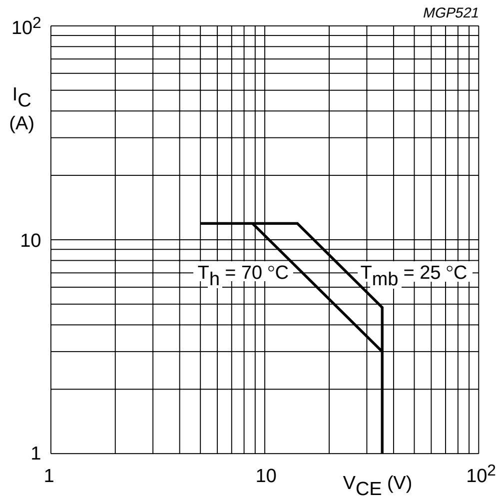
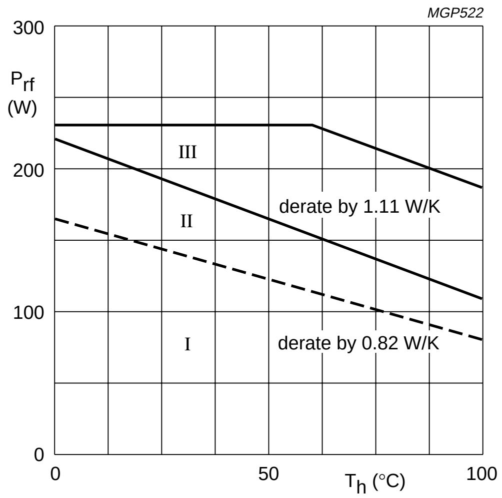


Fig.2 D.C. SOAR.



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

Fig.3 R.F. power dissipation; V_{CE} ≤ 28 V; f ≥ 1 MHz.

THERMAL RESISTANCE

(dissipation = 100 W; T_{mb} = 90 °C, i.e. T_h = 70 °C)

From junction to mounting base (d.c. dissipation)	$R_{th\ j\text{-}mb(dc)}$	=	1,03	K/W
From junction to mounting base (r.f. dissipation)	$R_{th\ j\text{-}mb(rf)}$	=	0,71	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 = 100 mA	$V_{(BR)\ CEO}$	>	35	V
Emitter-base breakdown voltage				
open collector; I_E = 20 mA	$V_{(BR)EBO}$	>	4	V
Collector cut-off current				
V_{BE} = 0; V_{CE} = 35 V	I_{CES}	<	20	mA
D.C. current gain(1)				
I_C = 7 A; V_{CE} = 5 V	h_{FE}		15 to 80	
D.C. current gain ratio of matched devices(1)				
I_C = 7 A; V_{CE} = 5 V	h_{FE1}/h_{FE2}	<	1,2	
Collector-emitter saturation voltage(1)				
I_C = 20 A; I_B = 4 A	V_{CEsat}	typ.	2	V
Transition frequency at f = 100 MHz(2)				
$-I_E$ = 7 A; V_{CB} = 28 V	f_T	typ.	320	MHz
$-I_E$ = 20 A; V_{CB} = 28 V	f_T	typ.	300	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e$ = 0; V_{CB} = 28 V	C_c	typ.	255	pF
Feedback capacitance at f = 1 MHz				
I_C = 100 mA; V_{CE} = 28 V	C_{re}	typ.	175	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: $t_p \leq 50\ \mu s$; $\delta \leq 0,01$.

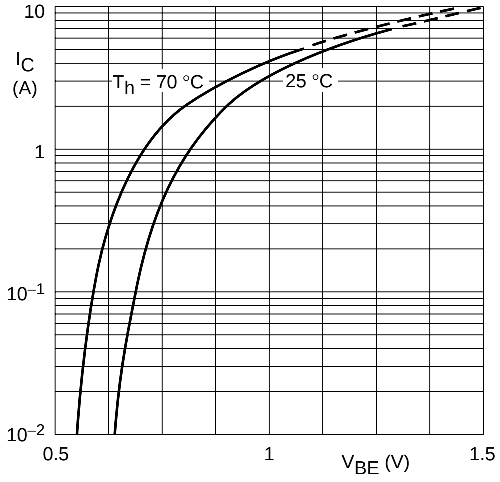


Fig.4 Typical values; V_{CE} = 20 V.

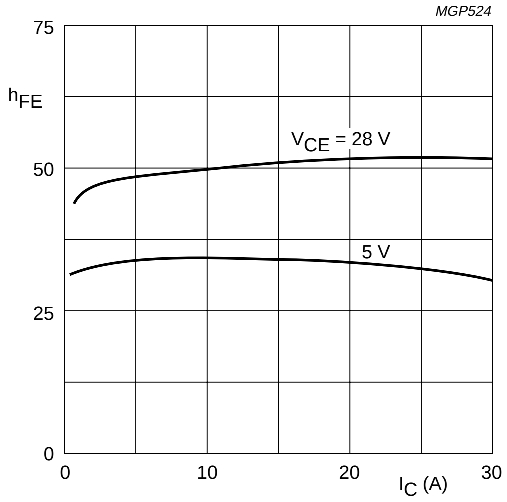


Fig.5 Typical values; T_j = 25 °C.

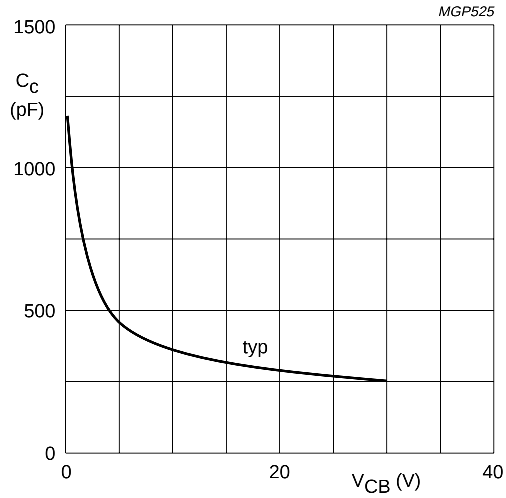


Fig.6 $I_E = I_e = 0$; f = 1 MHz; T_j = 25 °C.

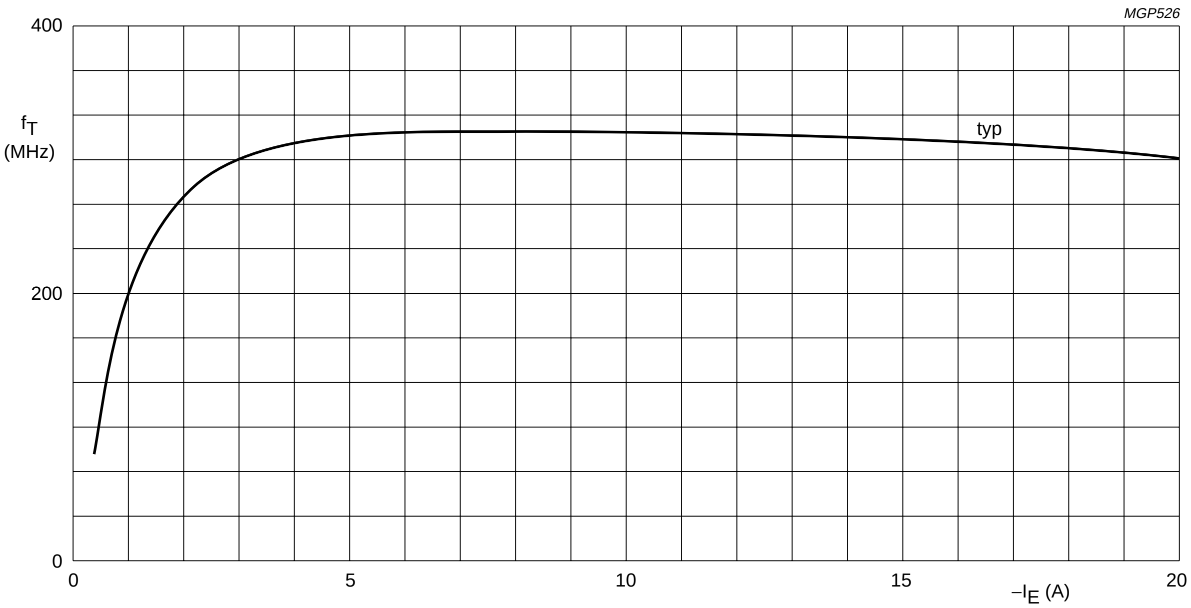


Fig.7 V_{CB} = 28 V; f = 100 MHz; T_j = 25 °C.

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 W	G_p dB	η_{dt} (%) at 130 W P.E.P.	I_C (A) at 130 W P.E.P.	d_3 dB	d_5 dB	$I_{C(ZS)}$ A
15 to 130 (P.E.P.)	> **12**	> **37,5**	< **6,2**	< **–30**	< **–30**	**0,1**

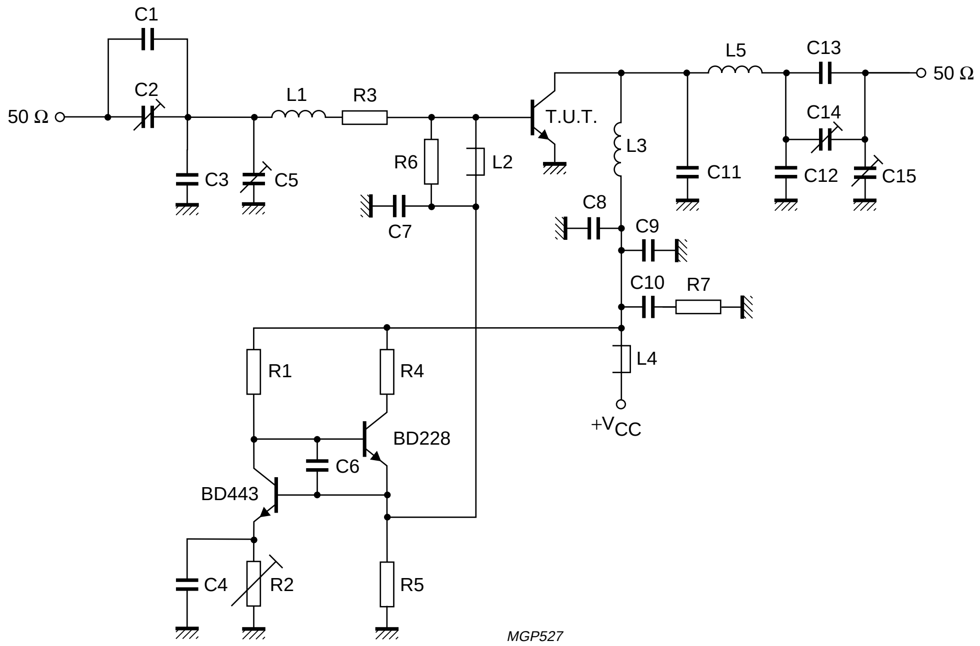
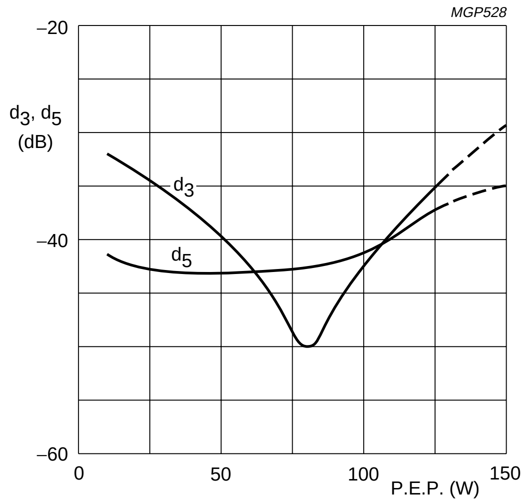


Fig.8 Test circuit; s.s.b. class-AB.

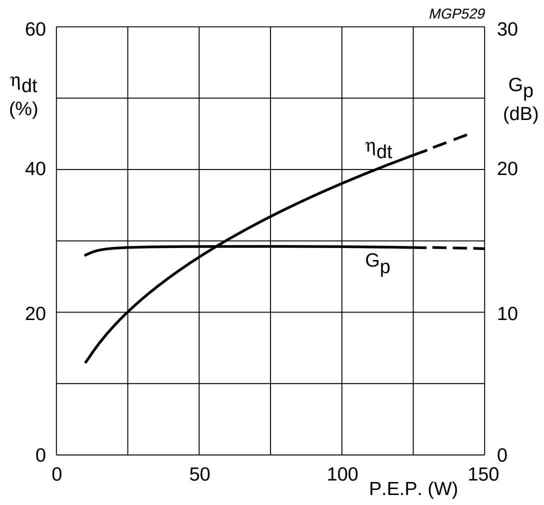
List of components:

C1	=	27 pF ceramic capacitor (500 V)
C2	=	100 pF air dielectric trimmer (single insulated rotor type)
C3	=	180 pF polystyrene capacitor
C4	=	C6 = C9 = 100 nF polyester capacitor
C5	=	100 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	=	2 × 180 pF polysterene capacitors in parallel
C12	=	3 × 56 pF and 33 pF ceramic capacitors in parallel (500 V)
C13	=	4 × 56 pF and 68 pF ceramic capacitors in parallel (500 V)
C14	=	360 pF air dielectric trimmer (single insulated rotor type)
C15	=	360 pF air dielectric trimmer (single non-insulated rotor type)
L1	=	88 nH; 3 turns Cu wire (1,0 mm); int. dia. 9,0 mm; length 6,1 mm; leads 2 × 7 mm
L2	=	L4 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L3	=	L5 = 80 nH; 2,5 turns closely wound enamelled Cu wire (1,6 mm); int. dia. 10,0 mm; leads 2 × 7 mm
R1	=	470 Ω wirewound resistor (5,5 W)
R2	=	4,7 Ω wirewound potentiometer (3 W)
R3	=	0,55 Ω; parallel connection of 4 × 2,2 Ω carbon resistors (± 5%; 0,5 W each)
R4	=	45 Ω; parallel connection of 4 × 180 Ω wirewound resistors (5,5 W each)
R5	=	56 Ω (± 5%) carbon resistor (0,5 W)
R6	=	27 Ω (± 5%) carbon resistor (0,5 W)
R7	=	4,7 Ω (± 5%) carbon resistor (0,5 W)



V_{CE} = 28 V; $I_{C(ZS)}$ = 100 mA; f_1 = 28,000 MHz;
f_2 = 28,001 MHz; T_h = 25 °C; typical values.

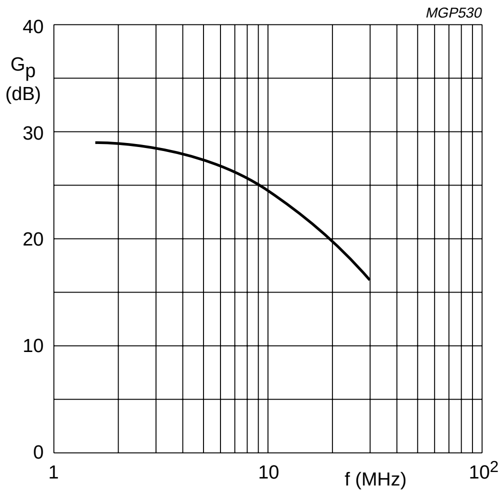
Fig.9 Intermodulation distortion as a function of output power.(1.)



V_{CE} = 28 V; $I_{C(ZS)}$ = 100 mA; f_1 = 28,000 MHz;
f_2 = 28,001 MHz; T_h = 25 °C; typical values.

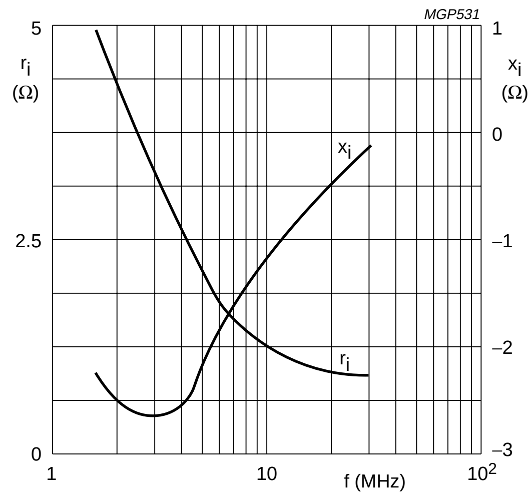
Fig.10 Double-tone efficiency and power gain as a function of output power.

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; $I_{C(ZS)}$ = 100 mA; P_L = 130 W;
T_h = 25 °C; Z_L = 2,5 Ω.

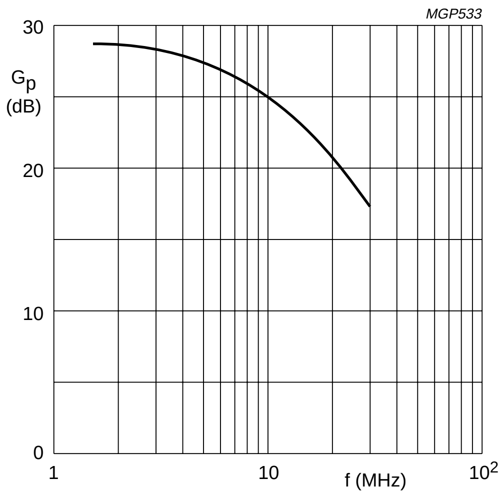
Fig.11 Power gain as a function of frequency.



V_{CE} = 28 V; $I_{C(ZS)}$ = 100 mA; P_L = 130 W;
T_h = 25 °C; Z_L = 2,5 Ω.

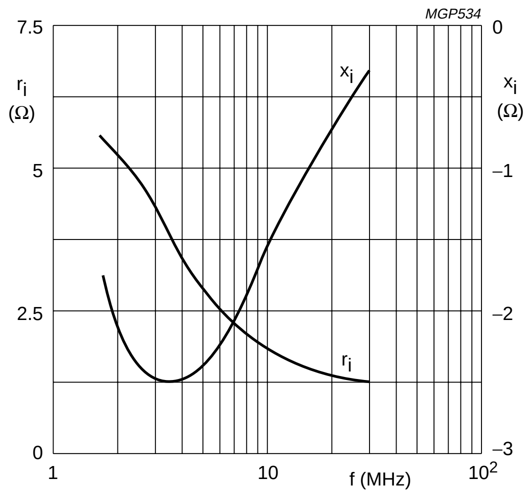
Fig.12 Input impedance (series components) as a function of frequency.

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



V_{CE} = 28 V; $I_{C(ZS)}$ = 100 mA; P_L = 130 W; T_h = 25 °C;
Z_L = 2,5 Ω; neutralizing capacitor: 150 pF.

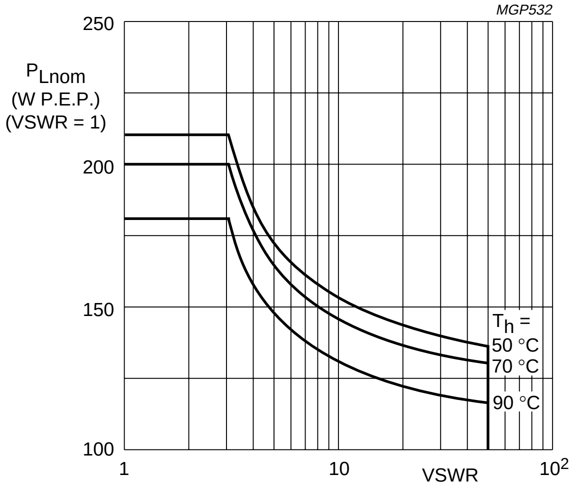
Fig.13 Power gain as a function of frequency.



V_{CE} = 28 V; $I_{C(ZS)}$ = 100 mA; P_L = 130 W; T_h = 25 °C;
Z_L = 2,5 Ω; neutralizing capacitor: 150 pF.

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

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)
87,5	**28**	**130**	typ. **23,2**	typ. **7,5**	typ. **6,2**	typ. **75**	**0,62 + j0,73**	**273 − j42**

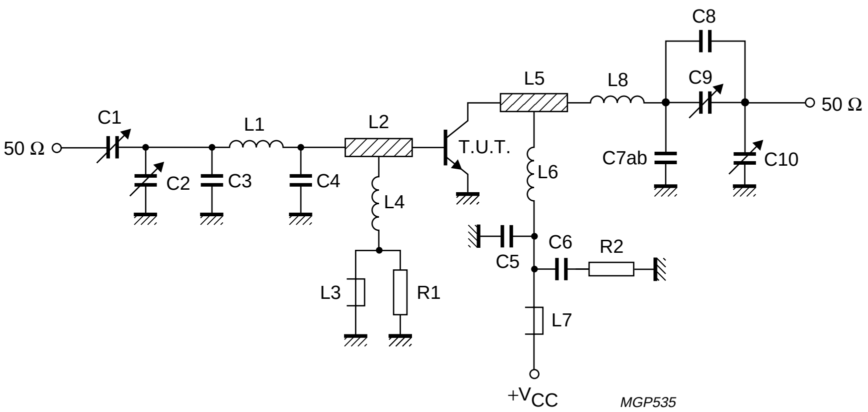


Fig.16 Test circuit; c.w. class-B.

List of components:

C1	=	4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
C2	=	C9 = C10 = 7 to 100 pF film dielectric trimmer (cat. no. 2222 809 07015)
C3	=	C8 = 22 pF ceramic capacitor (500 V)
C4	=	4 × 82 pF ceramic capacitors in parallel (500 V)
C5	=	390 pF polystyrene capacitor
C6	=	220 nF polyester capacitor
C7a	=	2 × 10 pF ceramic capacitors in parallel (500 V)
C7b	=	2 × 8,2 pF ceramic capacitors in parallel (500 V)
L1	=	25 nH; 2 turns Cu wire (1,6 mm); int. dia. 5,0 mm; length 4,6 mm; leads 2 × 5 mm
L2	=	L5 = 2,4 nH; strip (12 mm × 6 mm); tap for L4 and L6 at 5 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	=	46 nH; 2 turns Cu wire (2,0 mm); int. dia. 9,0 mm; length 6,0 mm; leads 2 × 5 mm
L8	=	44 nH; 2 turns Cu wire (2,0 mm); int. dia. 9,0 mm; length 6,7 mm; leads 2 × 5 mm

L2 and L5 are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric.

R1	=	10 Ω (± 10%) carbon resistor
R2	=	10 Ω (± 10%) carbon resistor

Component layout and printed-circuit board for 87,5 MHz test circuit are shown in Fig.17.

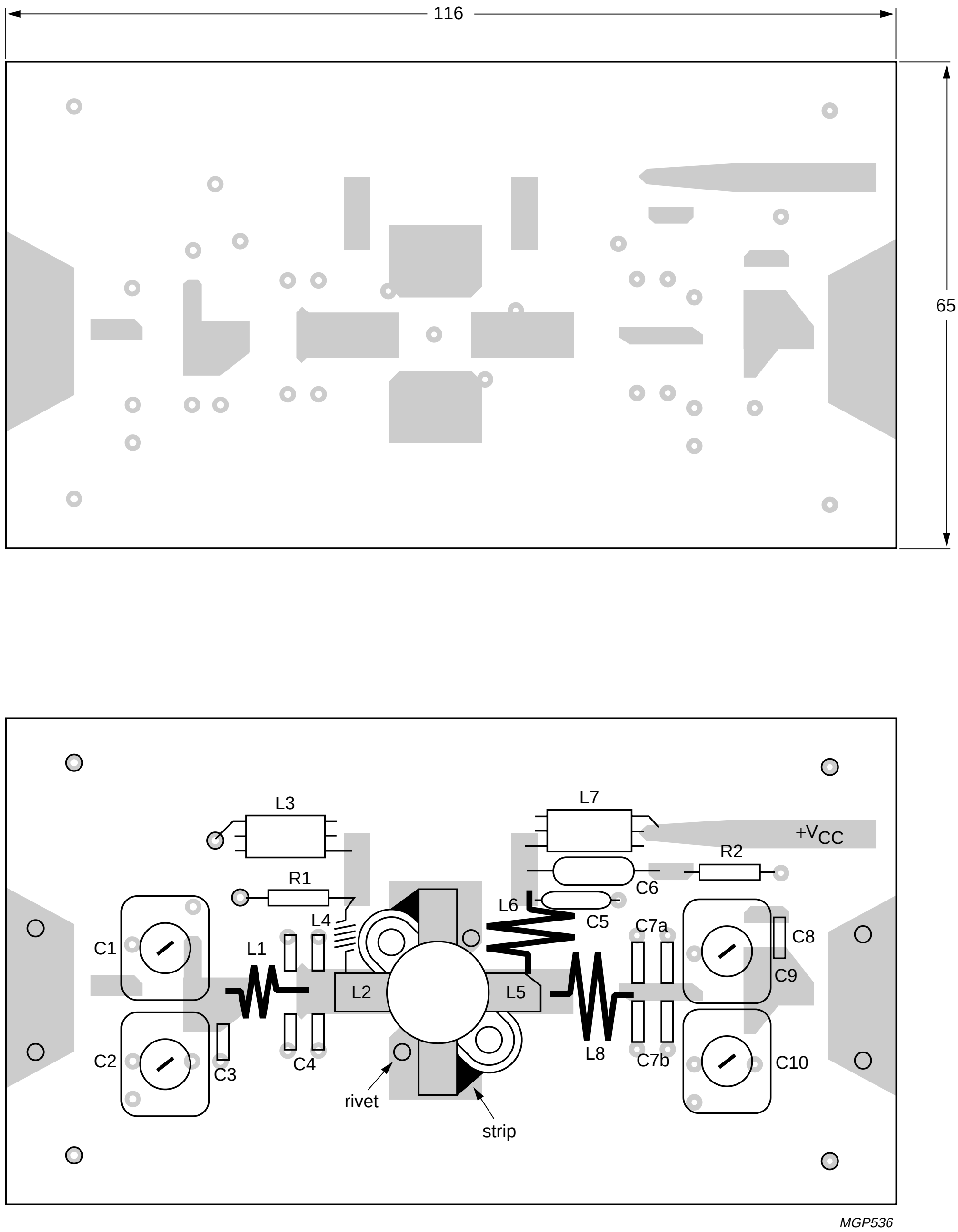


Fig.17 Component layout and printed-circuit board for 87,5 MHz test circuit.

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.

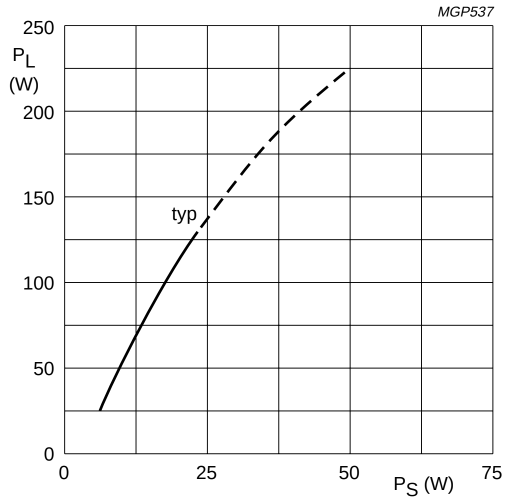


Fig.18 V_{CE} = 28 V; f = 87,5 MHz; T_h = 25 °C.

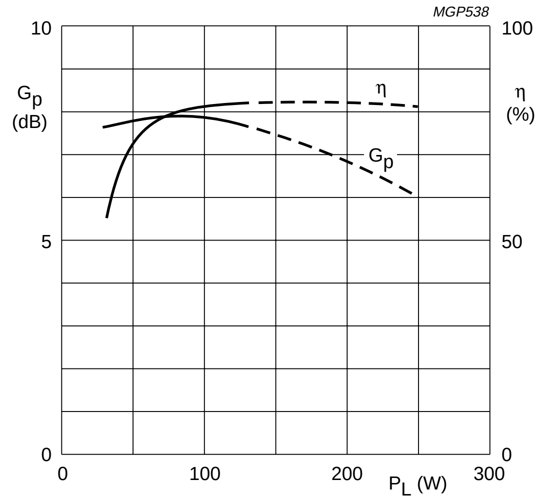
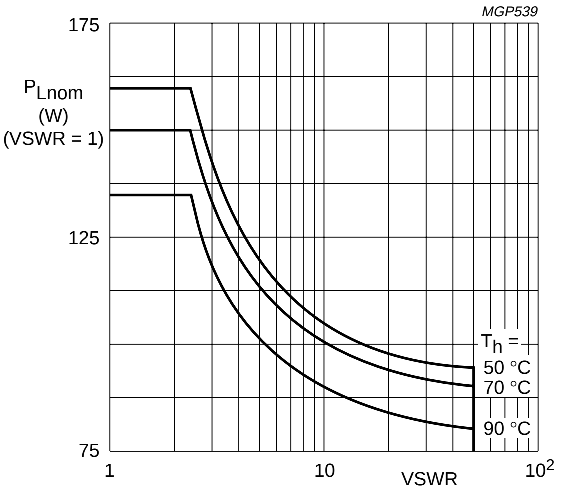


Fig.19 V_{CE} = 28 V; f = 87,5 MHz; T_h = 25 °C; typical values.



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 = 87,5 MHz; V_{CE} = 28 V; $R_{th\ mb\text{-}h}$ = 0,2 K/W.

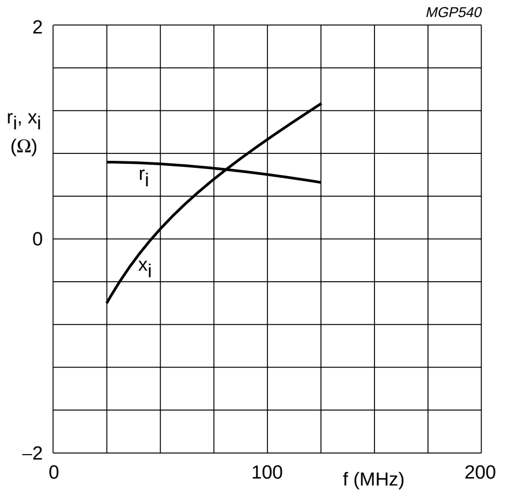


Fig.21 V_{CE} = 28 V; P_L =130 W; T_h = 25 °C; typical values.

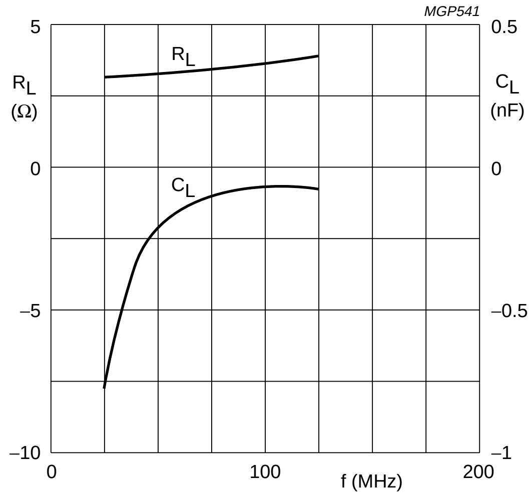


Fig.22 V_{CE} = 28 V; P_L =130 W; T_h = 25 °C; typical values.

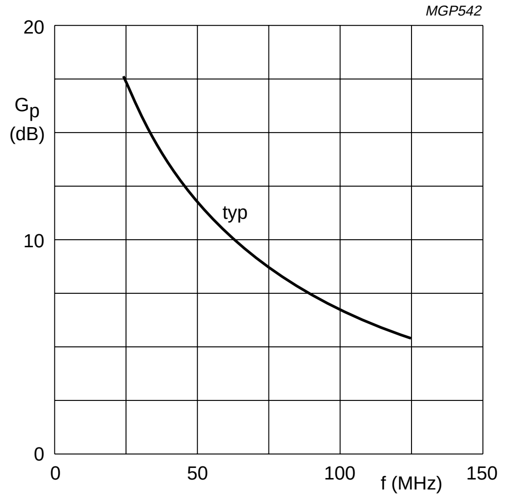
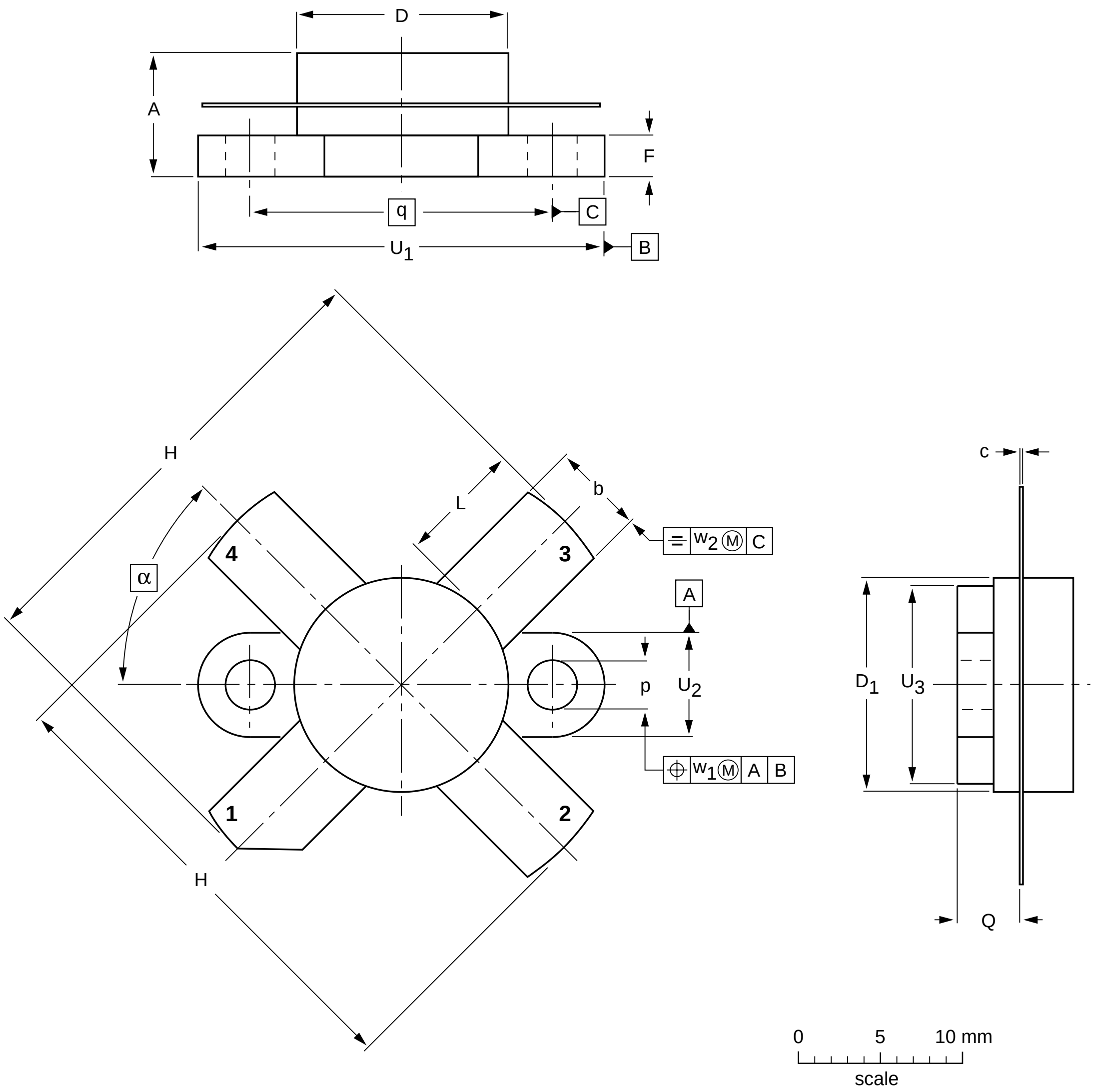


Fig.23 V_{CE} = 28 V; P_L =130 W; T_h = 25 °C.

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.