

DATA SHEET

BLW78 HF/VHF power transistor

Product specification

August 1986

HF/VHF power transistor**BLW78****DESCRIPTION**

N-P-N silicon planar epitaxial transistor intended for use in class-A, AB or B operated mobile, industrial and military transmitters in the h.f. and v.h.f. bands. It is resistance stabilized and is guaranteed to withstand severe load mismatch conditions.

It has a $\frac{1}{2}$ " flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25^\circ\text{C}$

MODE OF OPERATION	V_{CE} V	I_C $I_{C(ZS)}$ A	f MHz	P_L W	G_p dB	η %	$d_3^{(1)}$ dB
c.w. (class-B)	28	—	150	100	> 6	> 70	—
s.s.b. (class-A)	26	3	28	35 (P.E.P.)	typ. 19,5	—	typ. -40
s.s.b. (class-AB)	28	0,05	28	100 (P.E.P.)	typ. 19,0	typ. 42	typ. -30

Note

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.

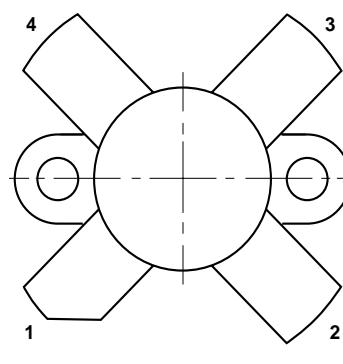
PIN CONFIGURATION

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.

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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. 10 ACollector current (peak value); $f > 1$ MHz I_{CM} max. 25 AR.F. power dissipation ($f > 1$ MHz); $T_{mb} = 25$ °C P_{rf} max. 160 W

Storage temperature

 T_{stg} -65 to +150 °C

Operating junction temperature

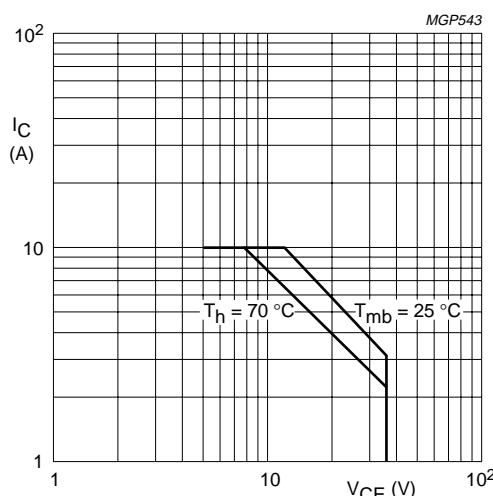
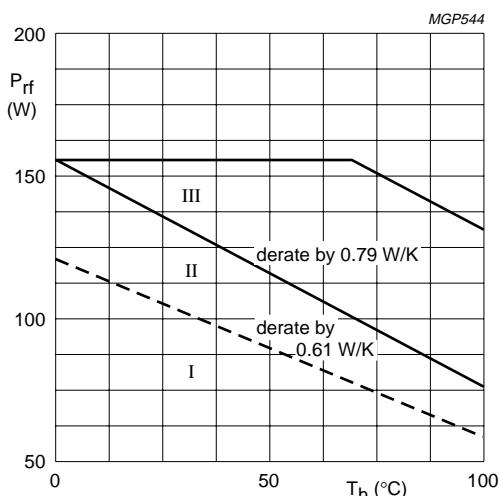
 T_j max. 200 °C

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 = 80 W; $T_{mb} = 86$ °C; i.e. $T_h = 70$ °C)

From junction to mounting base (d.c. dissipation)

 $R_{th\ j-mb(dc)}$ = 1,45 K/W

From junction to mounting base (r.f. dissipation)

 $R_{th\ j-mb(rf)}$ = 1,06 K/W

From mounting base to heatsink

 $R_{th\ mb-h}$ = 0,2 K/W

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CHARACTERISTICS $T_j = 25^\circ\text{C}$

Collector-emitter breakdown voltage

 $V_{BE} = 0; I_C = 50 \text{ mA}$ $V_{(BR)CES} > 70 \text{ V}$

Collector-emitter breakdown voltage

open base; $I_C = 100 \text{ mA}$ $V_{(BR)CEO} > 35 \text{ V}$

Emitter-base breakdown voltage

open collector; $I_E = 5 \text{ mA}$ $V_{(BR)EBO} > 4 \text{ V}$

Collector cut-off current

 $V_{BE} = 0; V_{CE} = 35 \text{ V}$ $I_{CES} < 5 \text{ mA}$ D.C. current gain⁽¹⁾ $I_C = 5 \text{ A}; V_{CE} = 5 \text{ V}$ $h_{FE} \text{ typ. } 20 \text{ to } 85$

Collector-emitter saturation voltage

 $I_C = 15 \text{ A}; I_B = 3 \text{ A}$ $V_{CEsat} \text{ typ. } 2 \text{ V}$ Transition frequency at $f = 100 \text{ MHz}^{(2)}$ $-I_E = 5 \text{ A}; V_{CB} = 28 \text{ V}$ $f_T \text{ typ. } 370 \text{ MHz}$ $-I_E = 15 \text{ A}; V_{CB} = 28 \text{ V}$ $f_T \text{ typ. } 350 \text{ MHz}$ Collector capacitance at $f = 1 \text{ MHz}$ $I_E = I_e = 0; V_{CB} = 28 \text{ V}$ $C_c \text{ typ. } 155 \text{ pF}$ Feedback capacitance at $f = 1 \text{ MHz}$ $I_C = 100 \text{ mA}; V_{CE} = 28 \text{ V}$ $C_{re} \text{ typ. } 102 \text{ pF}$

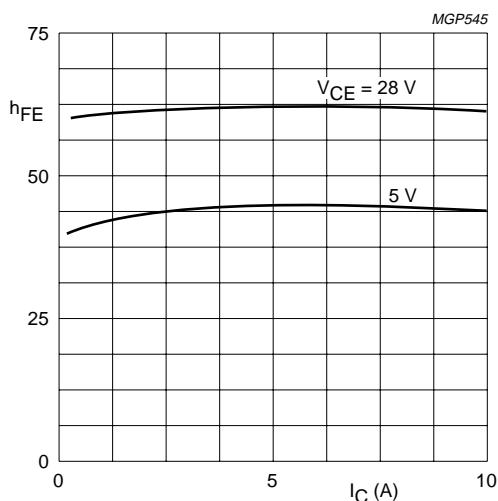
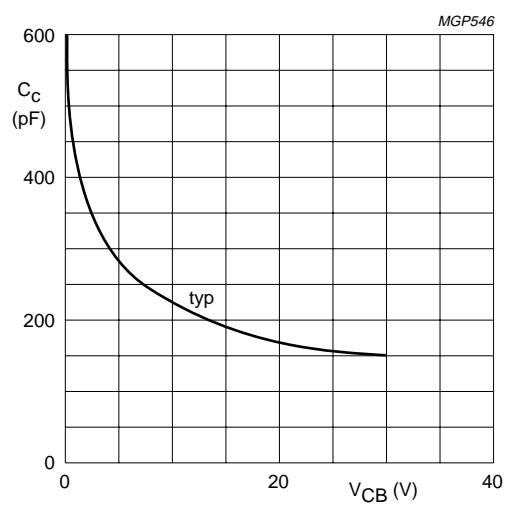
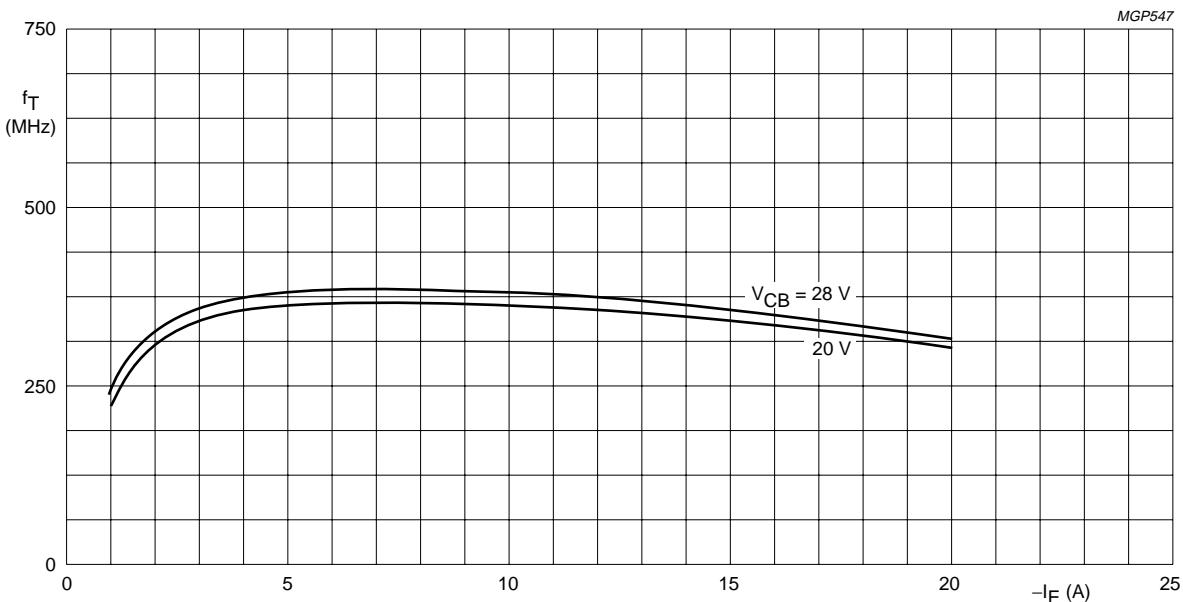
Collector-flange capacitance

 $C_{cf} \text{ typ. } 3 \text{ pF}$ **Notes**

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

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Fig.4 Typical values; $T_j = 25 \text{ }^\circ\text{C}$.Fig.5 $I_E = I_e = 0$; $f = 1 \text{ MHz}$; $T_j = 25 \text{ }^\circ\text{C}$.Fig.6 Typical values; $f = 100 \text{ MHz}$; $T_j = 25 \text{ }^\circ\text{C}$.

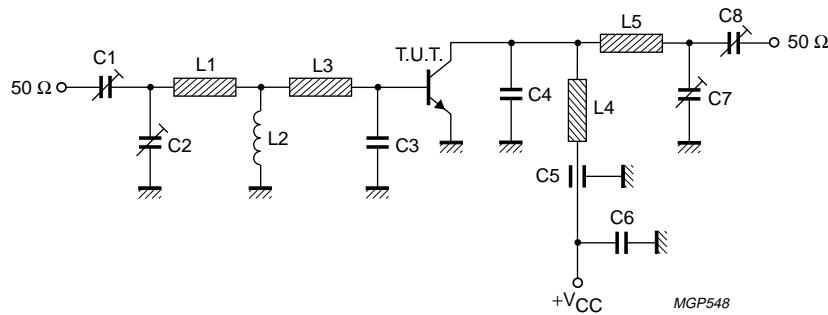
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APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit); $T_h = 25^\circ\text{C}$

f (MHz)	V_{CE} (V)	P_L (W)	P_D (W)	η (%)	\bar{z}_i (Ω)	\bar{z}_L (Ω)
150	28	100	≤ 25	≥ 70	$0,74 + j1,35$	$4,30 + j0,60$

Fig.7 Test circuit; c.w. class-B; $f = 150$ MHz.

List of components:

 $C_1 = C_2 = C_7 = C_8 = 5$ to 100 pF film dielectric trimmer $C_3 = 203$ pF; 2×82 pF and 39 pF multilayer ceramic chip capacitors (500 V, ATC⁽¹⁾) in parallel $C_4 = 39$ pF multilayer ceramic chip capacitor (500 V, ATC⁽¹⁾) $C_5 = 1$ nF feed-through capacitor $C_6 = 100$ nF polyester capacitor L_1 = strip (30 mm \times 8 mm); bent to form inverted 'U' shape with top 15 mm above heatsink, and bottom 5 mm above heatsink $L_2 = 1$ μ H r.f. choke L_3 = strip; shape as shown in Fig.8; 5 mm above heatsink L_4 = strip (40 mm \times 8 mm); bent in form \square , 25 mm at 15 mm above heatsink, 5 mm at 5 mm above heatsink L_5 = strip (75 mm long; width 8 mm); 5 mm above base L_1 , L_3 , L_4 , and L_5 are copper strips with a thickness of $0,6$ mm.Heatsink: aluminium; $0,9$ K/WAt $P_L = 100$ W and $V_{CE} = 28$ V, the output power at heatsink temperatures between 25°C and 90°C relative to that at 25°C is diminished by typ. $0,12$ W/K.

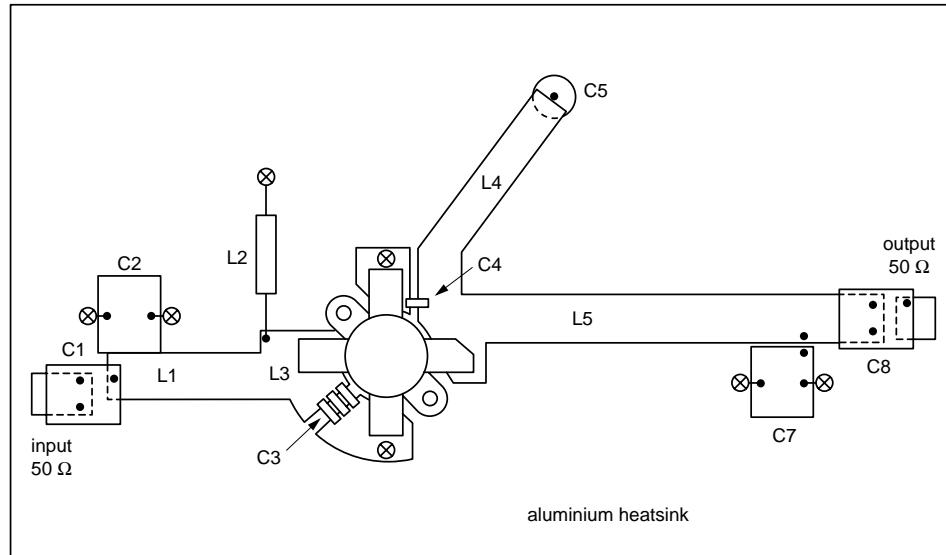
Component layout on an aluminium heatsink for 150 MHz test circuit is shown in Fig.8.

Note

- ATC means American Technical Ceramics.

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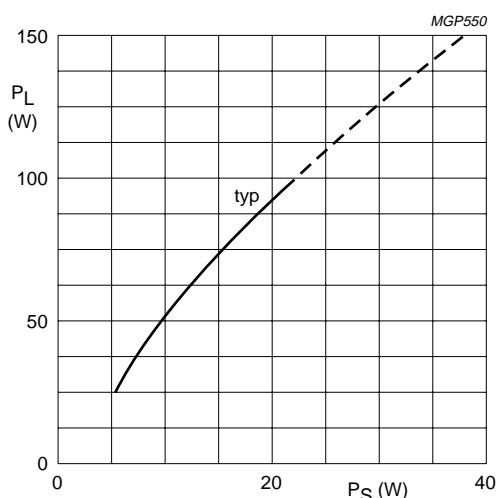
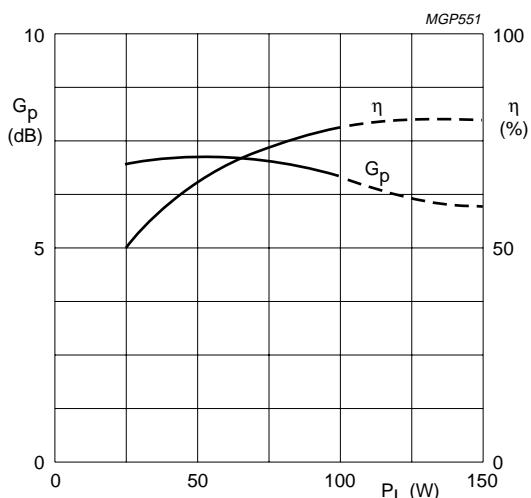
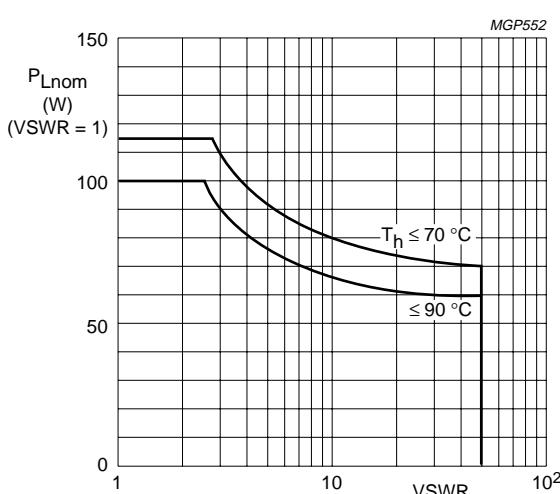


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Fig.8 Component layout on an aluminium heatsink for 150 MHz test circuit. ⊗ Earthing bolts.

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Fig.9 $V_{CE} = 28$ V; $f = 150$ MHz; $T_h = 25$ °C.Fig.10 $V_{CE} = 28$ V; $f = 150$ 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.

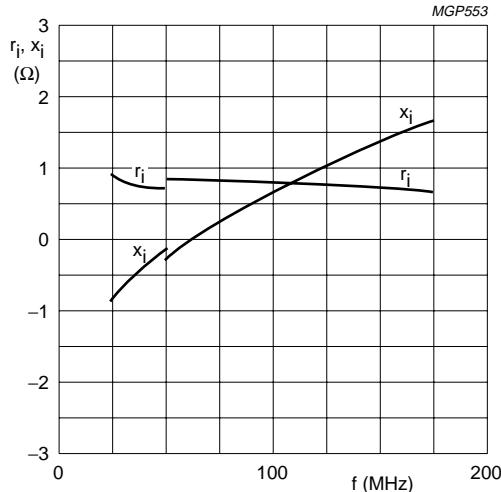
Fig.11 R.F. SOAR; c.w. class-B operation;
 $f = 150$ MHz; $V_{CE} = 28$ V;
 $R_{th\ mb-h} = 0,2$ K/W.

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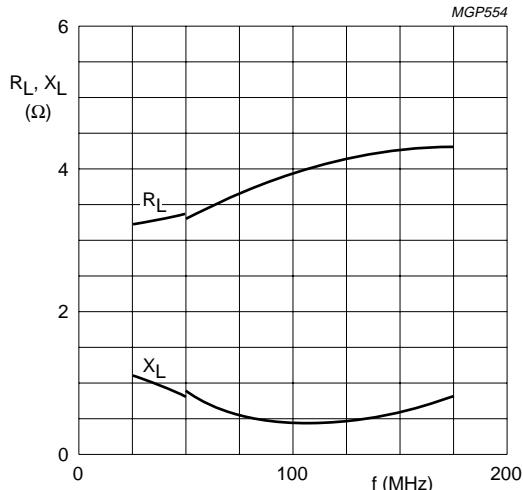
OPERATING NOTE

Below 50 MHz a base-emitter resistor of $4,7 \Omega$ is recommended to avoid oscillation. This resistor must be effective for r.f. only.



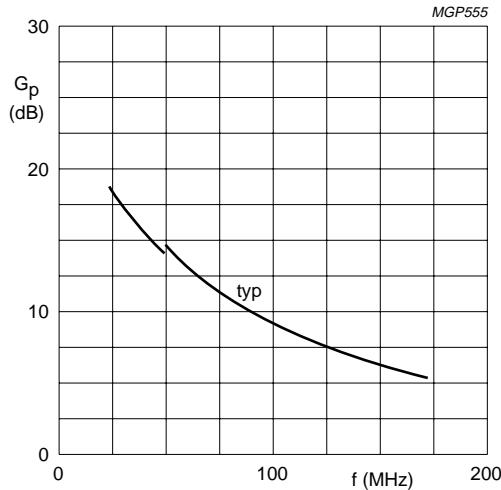
$V_{CE} = 28$ V; $P_L = 100$ W; $T_h = 25$ °C;
typical values; class-B operation.

Fig.12 Input impedance (series components).



$V_{CE} = 28$ V; $P_L = 100$ W; $T_h = 25$ °C;
typical values; class-B operation.

Fig.13 Load impedance (series components).



$V_{CE} = 28$ V; $P_L = 100$ W; $T_h = 25$ °C;
typical values; class-B operation.

Fig.14

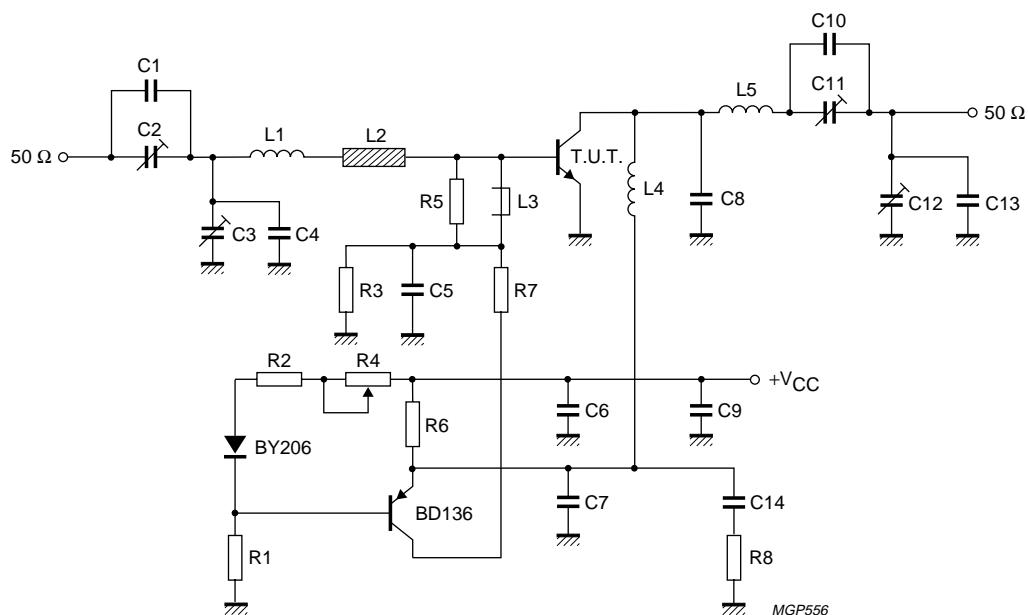
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R.F. performance in s.s.b. class-A operation

 $V_{CE} = 26$ V; $T_h = 40$ °C; $f_1 = 28,000$ MHz; $f_2 = 28,001$ MHz

OUTPUT POWER W	G_p dB	I_C A	d_3 dB
35 (P.E.P.)	typ. 19,5	3	typ. -40

Fig.15 Test circuit; s.s.b. class-A; $f = 28$ MHz.

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List of components:

C1 = 33 pF ceramic capacitor (500 V)
C2 = 100 pF air dielectric trimmer (single insulated rotor type)
C3 = 280 pF air dielectric trimmer (single non-insulated rotor type)
C4 = 180 pF polystyrene capacitor
C5 = C6 = C7 = 3,9 nF ceramic capacitor
C8 = 2 × 33 pF ceramic capacitors in parallel (500 V)
C9 = 330 nF polyester capacitor
C10 = 82 pF ceramic capacitor (500 V)
C11 = 100 pF air dielectric trimmer (single insulated rotor type)
C12 = 180 pF air dielectric trimmer (single non-insulated rotor type)
C13 = 150 pF polystyrene capacitor
C14 = 390 nF polyester capacitor
L1 = 72 nH; 3 turns Cu wire (1,0 mm); int. dia. 7 mm; length 4,8 mm; leads 2 × 5 mm
L2 = Cu strip (28 mm × 5 mm × 0,2 mm); 18 mm at 3 mm above printed-circuit board
L3 = Ferroxcube choke coil (cat. no. 4312 020 36640)
L4 = 300 nH; 6 turns Cu wire (1,5 mm); int. dia. 12 mm; length 16 mm; leads 2 × 5 mm
L5 = 330 nH; 7 turns Cu wire (1,5 mm); int. dia. 12 mm; length 20,8 mm; leads 2 × 5 mm
R1 = 1,5 kΩ (± 5%) carbon resistor (0,5 W)
R2 = 100 Ω (± 5%) carbon resistor (0,5 W)
R3 = 68 Ω (± 5%) carbon resistor (0,5 W)
R4 = 100 Ω wirewound potentiometer
R5 = 33 Ω (± 5%) carbon resistor (0,5 W)
R6 = 0,68 Ω (± 10%) wirewound resistor (7 W)
R7 = 120 Ω wirewound resistor (8 W)
R8 = 10 Ω (± 10%) carbon resistor (0,5 W)

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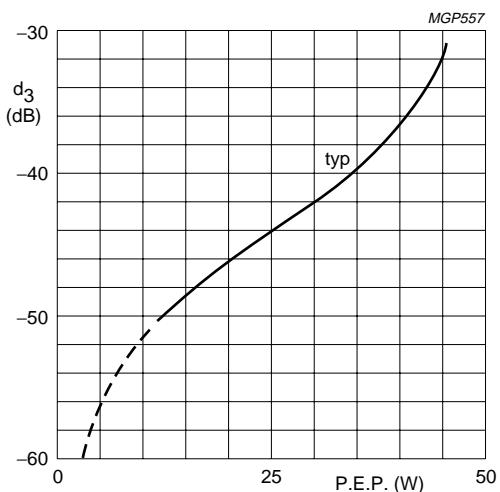


Fig.16 Intermodulation distortion as a function of output power; $V_{CE} = 26$ V; $I_C = 3$ A;
 $f_1 = 28,000$ MHz; $f_2 = 28,001$ MHz;
 $T_h = 40$ °C.

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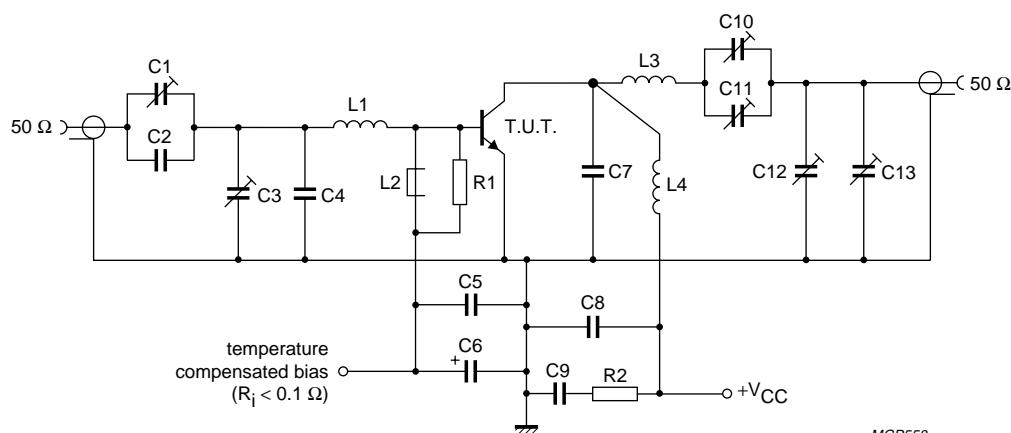
R.F. performance in s.s.b. class-AB operation (linear power amplifier)

 $V_{CE} = 28 \text{ V}$; $T_h = 25^\circ\text{C}$; $f_1 = 28,000 \text{ MHz}$; $f_2 = 28,001 \text{ MHz}$

OUTPUT POWER W	G_p dB	η_{dt} %	I_c A	$d_3^{(1)}$ dB	$d_5^{(1)}$ dB	$I_{c(zs)}$ mA
100 (P.E.P.)	typ. 19	typ. 42	typ. 4,3	typ. -30	typ. -37	50

Note

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.



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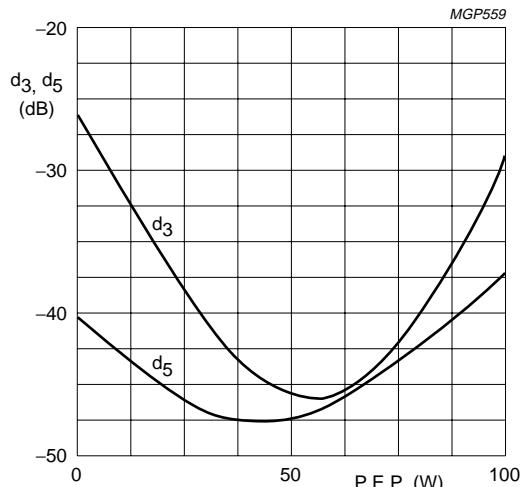
Fig.17 Test circuit; s.s.b. class-AB; $f = 28 \text{ MHz}$.

List of components:

- C1 = C11 = 150 pF air dielectric trimmer (single insulated rotor type)
- C2 = 27 pF ceramic capacitor (500 V)
- C3 = C12 = 150 pF air dielectric trimmer (single non-insulated rotor type)
- C4 = 180 pF ceramic capacitor (500 V)
- C5 = C8 = 3,9 nF ceramic capacitor
- C6 = 150 µF/6 V solid tantalum capacitor
- C7 = 150 pF ceramic capacitor (500 V)
- C9 = 100 nF polyester capacitor
- C10 = 750 pF mica dielectric trimmer (single insulated rotor type)
- C13 = 750 pF mica dielectric trimmer (single non-insulated rotor type)
- L1 = 3 turns enamelled Cu wire (1,0 mm); int. dia. 12 mm; length 12 mm
- L2 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- L3 = 3 turns enamelled Cu wire (2,0 mm); int. dia. 12 mm; length 12 mm
- L4 = 2 turns enamelled Cu wire (2,0 mm); int. dia. 12 mm; length 8 mm
- R1 = 27 Ω ($\pm 10\%$) carbon resistor (0,5 W)
- R2 = 4,7 Ω ($\pm 10\%$) carbon resistor (0,5 W)

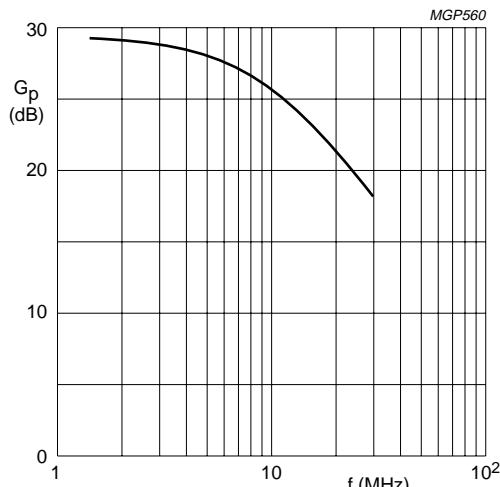
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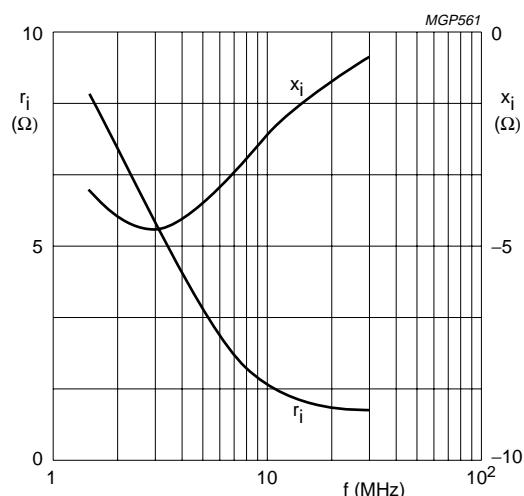
Typical values; $V_{CE} = 28$ V; $I_{C(ZS)} = 50$ mA;
 $f_1 = 28,000$ MHz; $f_2 = 28,001$ MHz;
 $T_h = 25$ °C.

Fig.18 Intermodulation distortion⁽¹⁾ as a function of output power.



$V_{CE} = 28$ V; $I_{C(ZS)} = 50$ mA; $P_L = 100$ W (P.E.P.);
 $T_h = 25$ °C; $Z_L = 2,7 \Omega$.

Fig.19 Power gain as a function of frequency.



$V_{CE} = 28$ V; $I_{C(ZS)} = 50$ mA; $P_L = 100$ W (P.E.P.);
 $T_h = 25$ °C; $Z_L = 2,7 \Omega$.

Fig.20 Input impedance (series components).

Figs 19 and 20 are typical curves and hold for an unneutralized amplifier in s.s.b. class-AB operation.

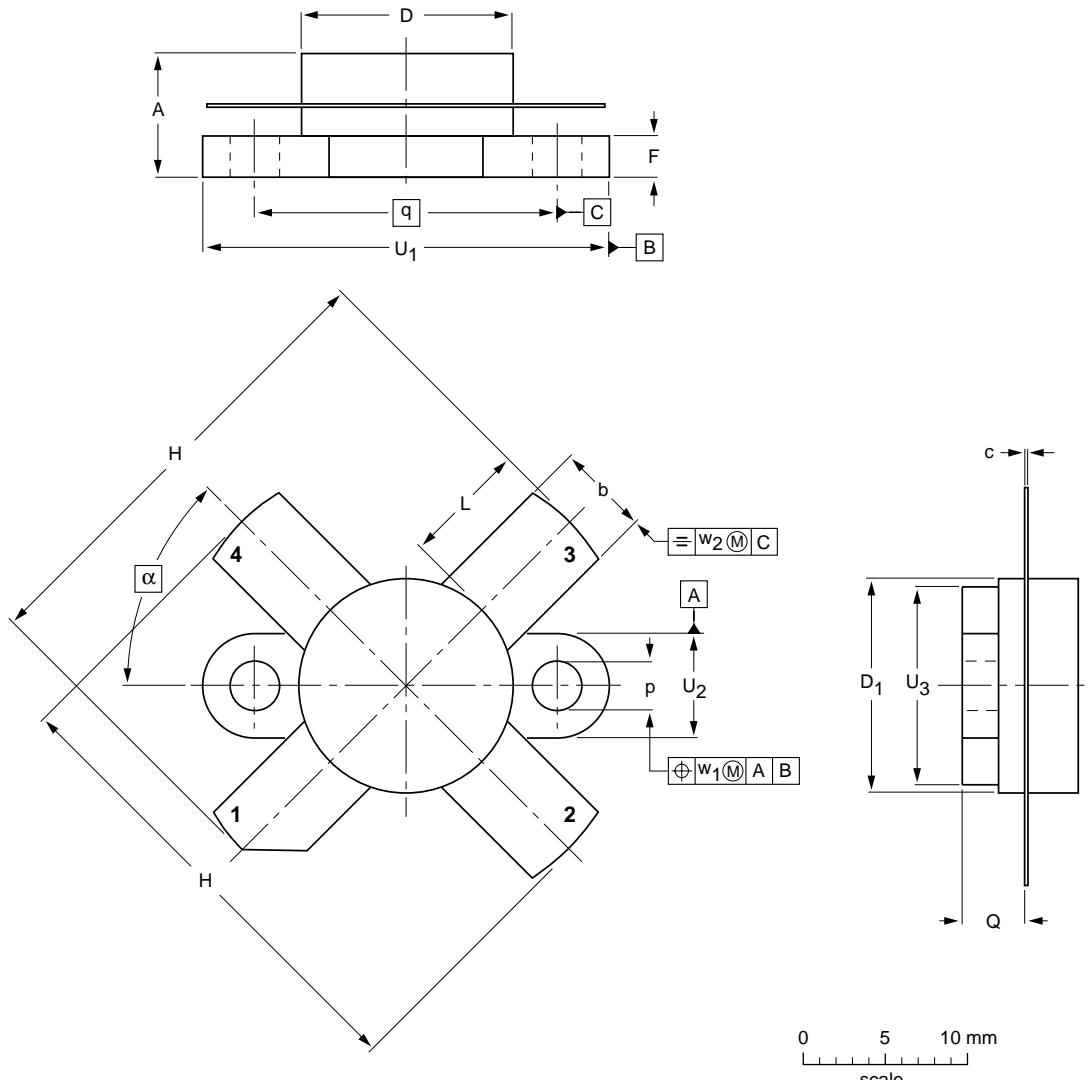
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PACKAGE OUTLINE

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

HF/VHF power transistor**BLW78****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

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