

DATA SHEET

BLW96 HF/VHF power transistor

Product specification
File under Discrete Semiconductors, SC08a

August 1986

HF/VHF power transistor

BLW96

DESCRIPTION
N-P-N silicon planar epitaxial transistor intended for use in class-A, AB and B operated high power industrial and military transmitting equipment in the h.f. and v.h.f. band. The transistor presents excellent performance as a linear amplifier in s.s.b. applications. It is resistance stabilized and is guaranteed to withstand severe load mismatch

conditions. Transistors are supplied in matched h_{FE} groups.
The transistor 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 $T_h = 25\text{ }^{\circ}\text{C}$

MODE OF OPERATION	V_{CE} V	f MHz	P_L W	G_p dB	η %	d_3 dB	d_5 dB	$I_{c(zs)}$ (I_c) A
s.s.b. (class-AB)	50	1,6 – 28	25 – 200 (P.E.P.)	> 13,5	> 40 ⁽¹⁾	< -30	< -30	0,1
c.w. (class-B)	50	108	200	typ. 6,5	typ. 67	–	–	(6)
s.s.b. (class-A)	40	28	50 (P.E.P.)	typ. 19	–	typ. -40	< -40	(4)

Note
1. η_{dt} at 200 W P.E.P.

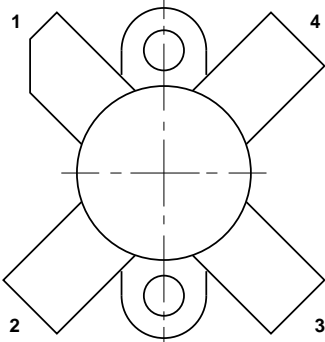
PIN CONFIGURATION


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.

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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. 110 V

Collector-emitter voltage (open base)

V_{CEO} max. 55 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. 40 A

R.F. power dissipation ($f > 1$ MHz); $T_{mb} = 45$ °C

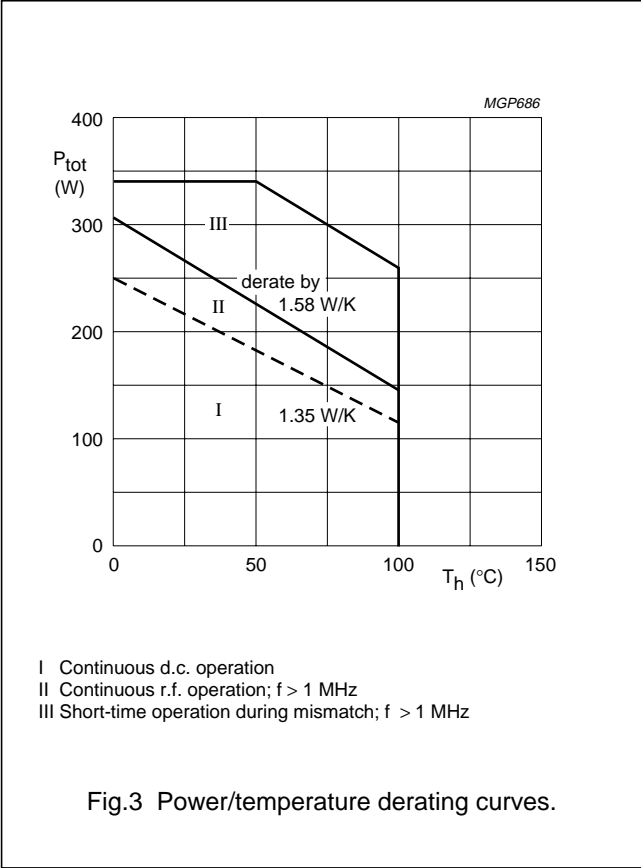
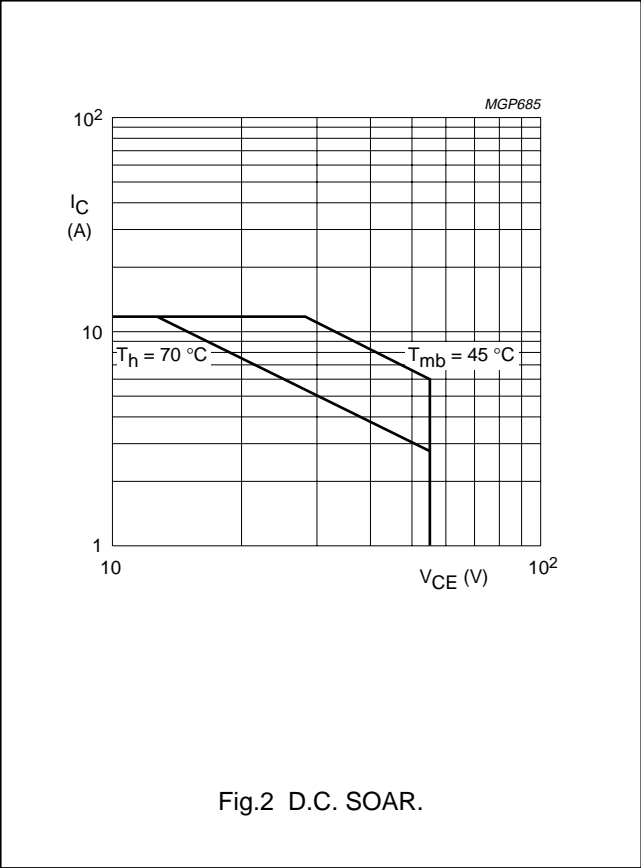
P_{rf} max. 340 W

Storage temperature

T_{stg} -65 to + 150 °C

Operating junction temperature

T_j max. 200 °C



THERMAL RESISTANCE

(dissipation = 150 W; $T_{mb} = 100$ °C, i.e. $T_h = 70$ °C)

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

$R_{th\ j-mb(dc)}$ = 0,63 K/W

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

$R_{th\ j-mb(rf)}$ = 0,45 K/W

From mounting base to heatsink

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

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

Collector-emitter breakdown voltage

 $V_{BE} = 0; I_C = 50\text{ mA}$ $V_{(BR)CES} > 110\text{ V}$

Collector-emitter breakdown voltage

open base; $I_C = 200\text{ mA}$ $V_{(BR)CEO} > 55\text{ V}$

Emitter-base breakdown voltage

open collector; $I_E = 20\text{ mA}$ $V_{(BR)EBO} > 4\text{ V}$

Collector cut-off current

 $V_{BE} = 0; V_{CE} = 55\text{ V}$ $I_{CES} < 10\text{ mA}$ Second breakdown energy; $L = 25\text{ mH}; f = 50\text{ Hz}$

open base

 $E_{SBO} > 20\text{ mJ}$ $R_{BE} = 10\text{ }\Omega$ $E_{SBR} > 20\text{ mJ}$ D.C. current gain⁽¹⁾ $I_C = 7\text{ A}; V_{CE} = 5\text{ V}$ h_{FE} typ. 30
15 to 50D.C. current gain ratio of matched devices⁽¹⁾ $I_C = 7\text{ A}; V_{CE} = 5\text{ V}$ $h_{FE1}/h_{FE2} \leq 1,2$ Collector-emitter saturation voltage⁽¹⁾ $I_C = 20\text{ A}; I_B = 4\text{ A}$ V_{CEsat} typ. 1,9 VTransition frequency at $f = 100\text{ MHz}$ ⁽²⁾ $-I_E = 7\text{ A}; V_{CB} = 45\text{ V}$ f_T typ. 235 MHz $-I_E = 20\text{ A}; V_{CB} = 45\text{ V}$ f_T typ. 245 MHzCollector capacitance at $f = 1\text{ MHz}$ $I_E = I_e = 0; V_{CB} = 50\text{ V}$ Feedback capacitance at $f = 1\text{ MHz}$ $I_C = 150\text{ mA}; V_{CE} = 50\text{ V}$ C_c typ. 280 pF C_{re} typ. 170 pF

Collecting-flange capacitance

 C_{cf} typ. 4,4 pF**Notes**

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

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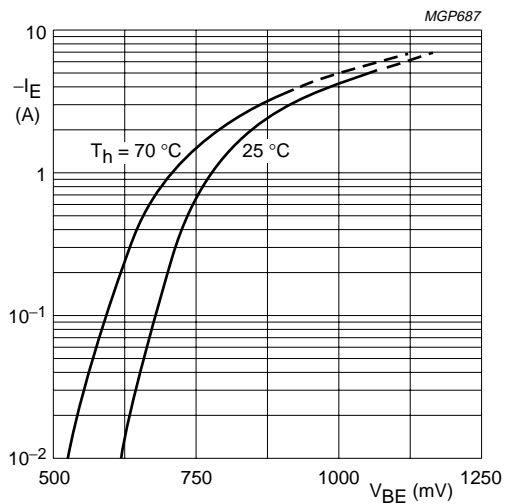


Fig.4 Typical values; $V_{CE} = 40\text{ V}$.

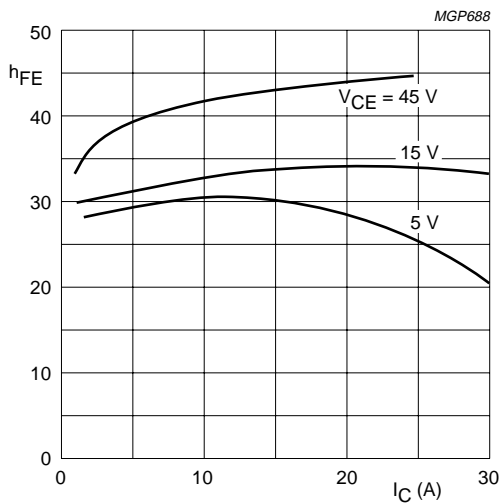


Fig.5 Typical values; $T_j = 25\text{ }^{\circ}\text{C}$.

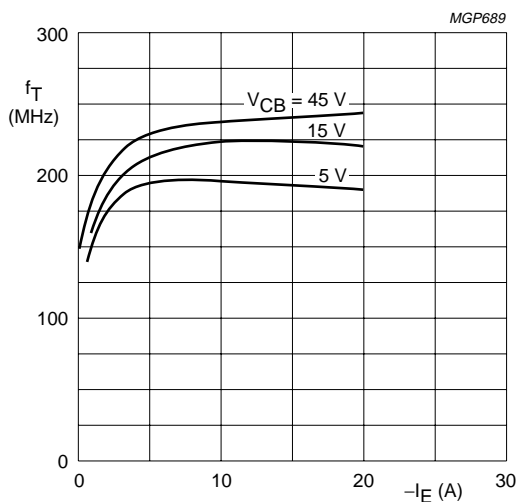


Fig.6 Typical values; $f = 100\text{ MHz}$; $T_j = 25\text{ }^{\circ}\text{C}$.

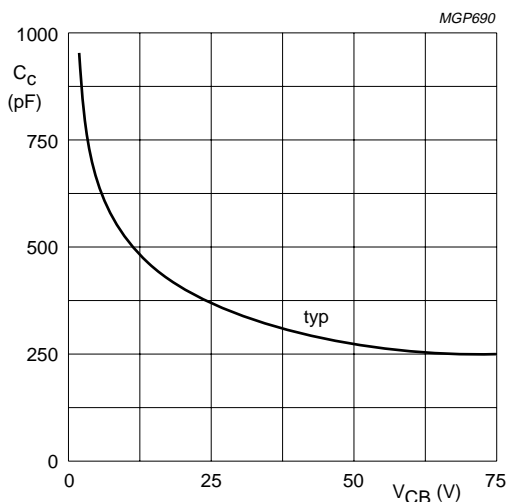


Fig.7 $I_E = I_e = 0$; $f = 1\text{ MHz}$; $T_j = 25\text{ }^{\circ}\text{C}$.

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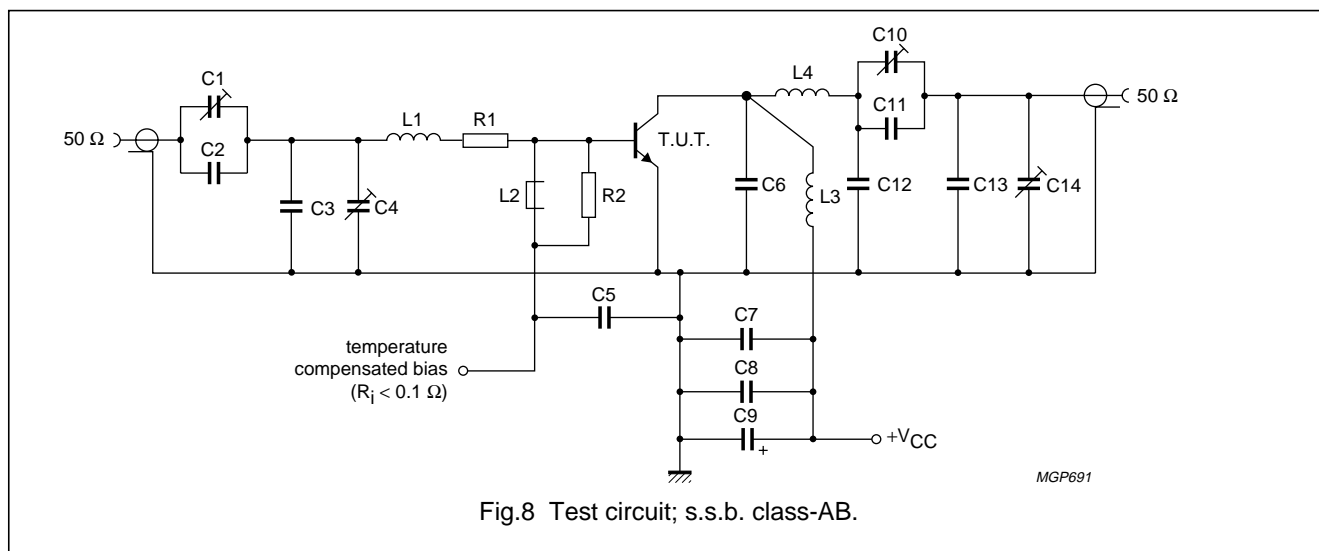
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APPLICATION INFORMATION

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

 $V_{CE} = 50 \text{ V}$; $T_h = 25 \text{ }^\circ\text{C}$; $f_1 = 28,000 \text{ MHz}$; $f_2 = 28,001 \text{ MHz}$

OUTPUT POWER W	G_p dB	η_{dt} (%) at 200 W (P.E.P.)	I_c (A)	$d_3^{(1)}$ dB	$d_5^{(1)}$ dB	$I_{C(zs)}$ A
25 to 200 (P.E.P.)	> 13,5	> 40	< 5,0	< -30	< -30	0,1



List of components:

C1 = C4 = C10 = C14 = 100 pF film dielectric trimmer

C2 = 27 pF ceramic capacitor (500 V)

C3 = 270 pF polystyrene capacitor (630 V)

C5 = C7 = C8 = 220 nF multilayer ceramic chip capacitor

C6 = 27 pF multilayer ceramic chip capacitor (500 V; ATC⁽²⁾)C9 = 47 μ F/63 V electrolytic capacitorC11 = 2 \times 36 pF multilayer ceramic chip capacitors (500 V; ATC⁽²⁾) in parallelC12 = 2 \times 43 pF multilayer ceramic chip capacitors (500 V; ATC⁽²⁾) in parallelC13 = 43 pF multilayer ceramic chip capacitor (500 V; ATC⁽²⁾)L1 = 88 nH; 3 turns Cu wire (1,0 mm); int. dia. 9,0 mm; length 6,1 mm; leads 2 \times 5 mm

L2 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)

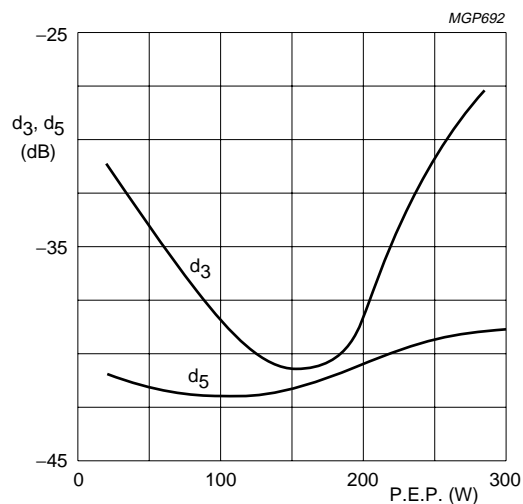
L3 = 150 nH; 5 turns Cu wire (2,0 mm); int. dia. 10,0 mm; length 18,7 mm; leads 2 \times 5 mmL4 = 197 nH; 5 turns Cu wire (2,0 mm); int. dia. 12,0 mm; length 18,6 mm; leads 2 \times 5 mmR1 = 0,66 Ω ; parallel connection of 5 \times 3,3 Ω metal film resistors (PR37; \pm 5%; 1,6 W each)R2 = 27 Ω carbon resistor (\pm 5%; 0,5 W)

Notes

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.
2. ATC means American Technical Ceramics.

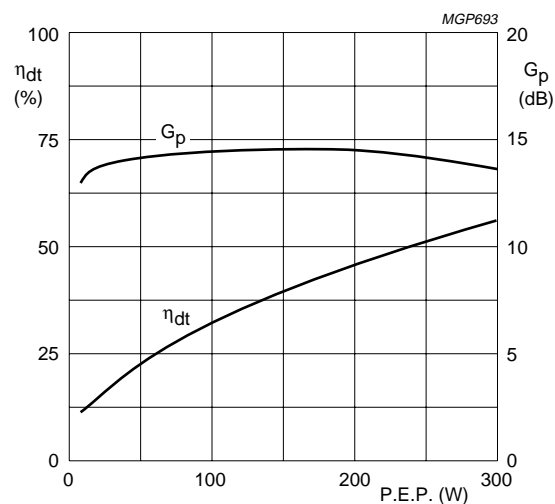
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$V_{CE} = 50 \text{ V}$; $I_{C(ZS)} = 0,1 \text{ A}$; $f_1 = 28,000 \text{ MHz}$;
 $f_2 = 28,001 \text{ MHz}$; $T_h = 25 \text{ }^\circ\text{C}$; typical values.

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



$V_{CE} = 50 \text{ V}$; $I_{C(ZS)} = 0,1 \text{ A}$; $f_1 = 28,000 \text{ MHz}$;
 $f_2 = 28,001 \text{ MHz}$; $T_h = 25 \text{ }^\circ\text{C}$; typical values.

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

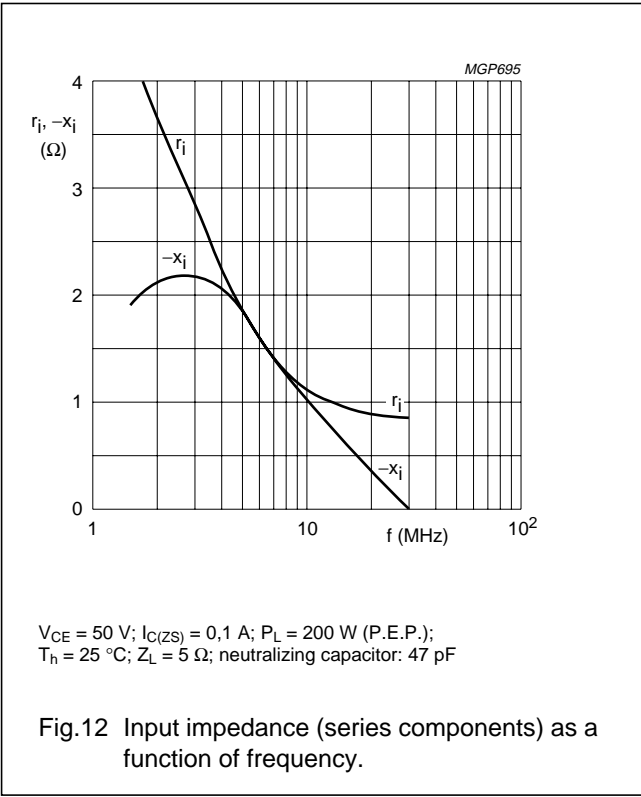
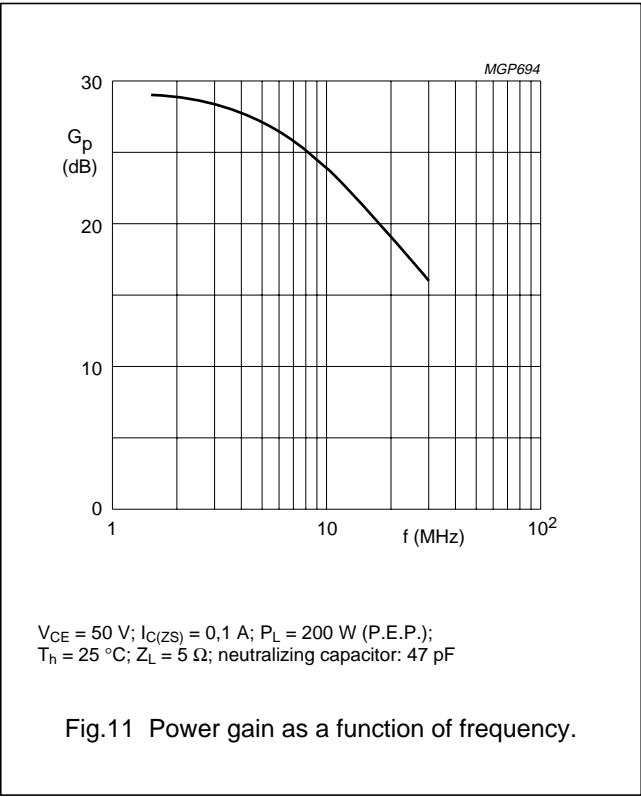
Ruggedness

The BLW96 is capable of withstanding full load mismatch (VSWR = 50 through all phases) up to 150 W (P.E.P.) or a load mismatch (VSWR = 5 through all phases) up to 200 W (P.E.P.) under the following conditions:

$V_{CE} = 45 \text{ V}$; $f = 28 \text{ MHz}$; $T_h = 70 \text{ }^\circ\text{C}$; $R_{th\text{ mb-h}} = 0,2 \text{ K/W}$.

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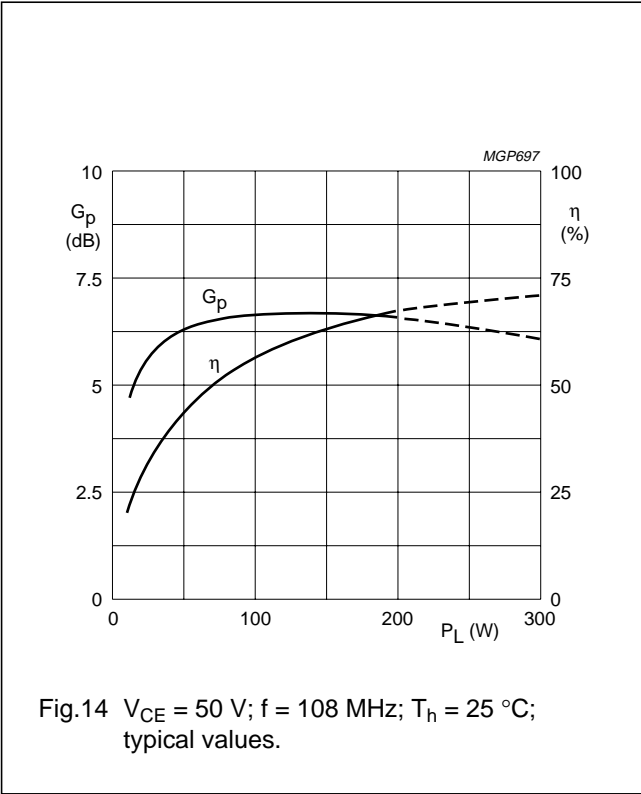
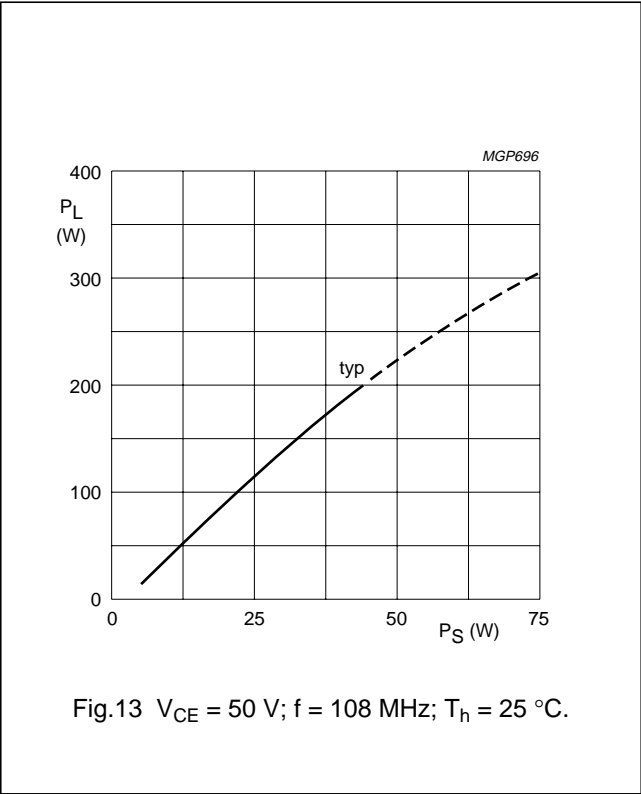
Figs 11 and 12 are typical curves and hold for one transistor of a push-pull amplifier with cross-neutralization in s.s.b. class-AB operation.

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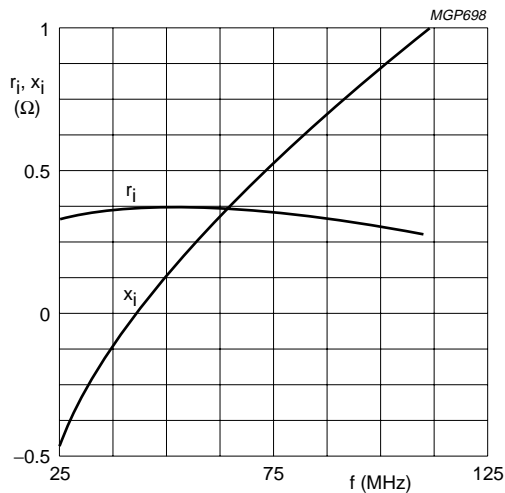
R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)
 $T_h = 25\text{ }^{\circ}\text{C}$

f (MHz)	V_{CE} (V)	P_L (W)	P_S (W)	G_p (dB)	I_c (A)	η (%)
108	50	200	typ. 45	typ. 6,5	typ. 6	typ. 67



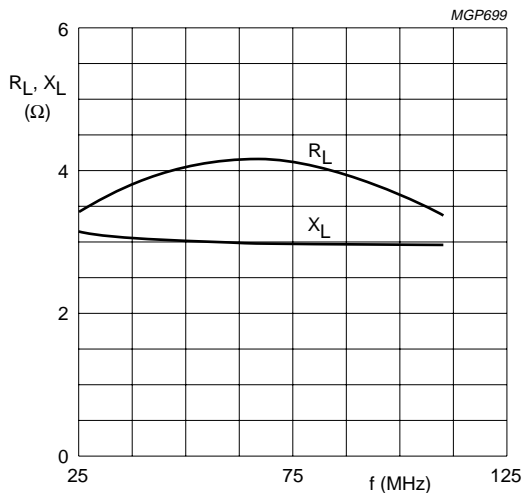
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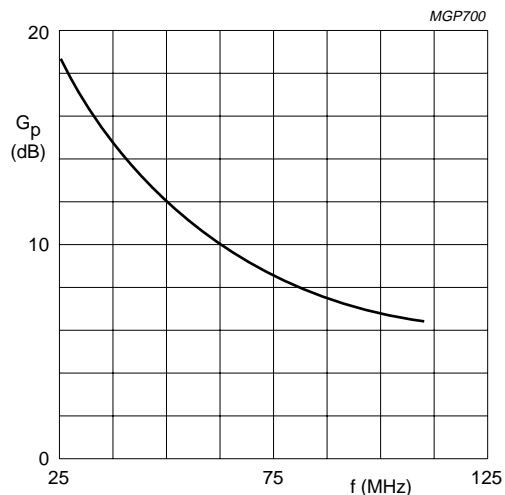
Typical values; $V_{CE} = 50\text{ V}$; $P_L = 200\text{ W}$; $T_h = 25\text{ }^\circ\text{C}$; class-B operation

Fig.15 Input impedance (series components).



Typical values; $V_{CE} = 50\text{ V}$; $P_L = 200\text{ W}$; $T_h = 25\text{ }^\circ\text{C}$; class-B operation

Fig.16 Load impedance (series components).



Typical values; $V_{CE} = 50\text{ V}$; $P_L = 200\text{ W}$; $T_h = 25\text{ }^\circ\text{C}$; class-B operation

Fig.17

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

 $V_{CE} = 40\text{ V}$; $T_h = 25\text{ }^{\circ}\text{C}$; $f_1 = 28,000\text{ MHz}$; $f_2 = 28,001\text{ MHz}$

OUTPUT POWER W	G_p dB	I_C A	$d_3^{(1)}$ dB	$d_5^{(1)}$ dB
typ. 50 (P.E.P.)	typ. 19	4	typ. -40	< -40

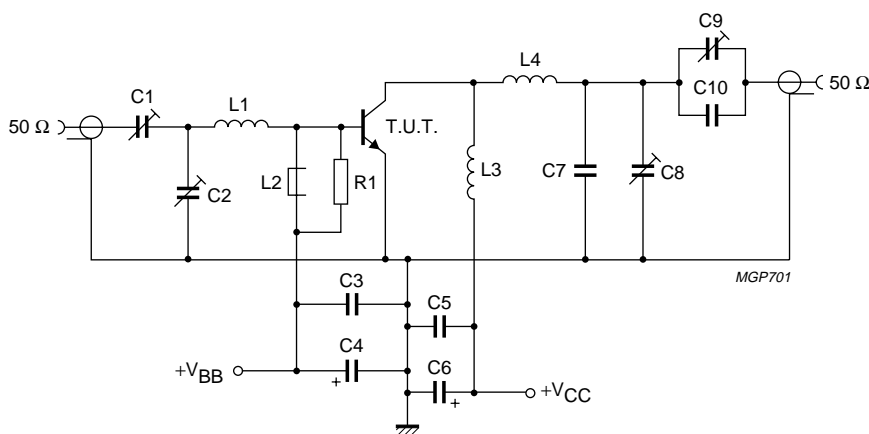


Fig.18 Test circuit; s.s.b. class-A.

List of components:

C1 = C2 = 10 to 780 pF film dielectric trimmer

C3 = 220 nF polyester capacitor (100 V)

C4 = 100 μF /4 V electrolytic capacitorC5 = 2 \times 330 nF polyester capacitors (100 V) in parallelC6 = 47 μF /63 V electrolytic capacitorC7 = C10 = 2 \times 82 pF ceramic capacitors (500 V) in parallel

C8 = C9 = 10 to 150 pF air dielectric trimmer

L1 = 45 nH; 2 turns enamelled Cu wire (1,6 mm); int. dia. 8,0 mm; length 4,0 mm; leads 2 \times 3 mm

L2 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)

L3 = 110 nH; 4 turns enamelled Cu wire (2,0 mm); int. dia. 10,0 mm; length 8,0 mm; leads 2 \times 2 mmL4 = 210 nH; 5 turns enamelled Cu wire (2,0 mm); int. dia. 12,0 mm; length 10,0 mm; leads 2 \times 2 mmR1 = 27 Ω carbon resistor ($\pm 5\%$; 0,5 W)

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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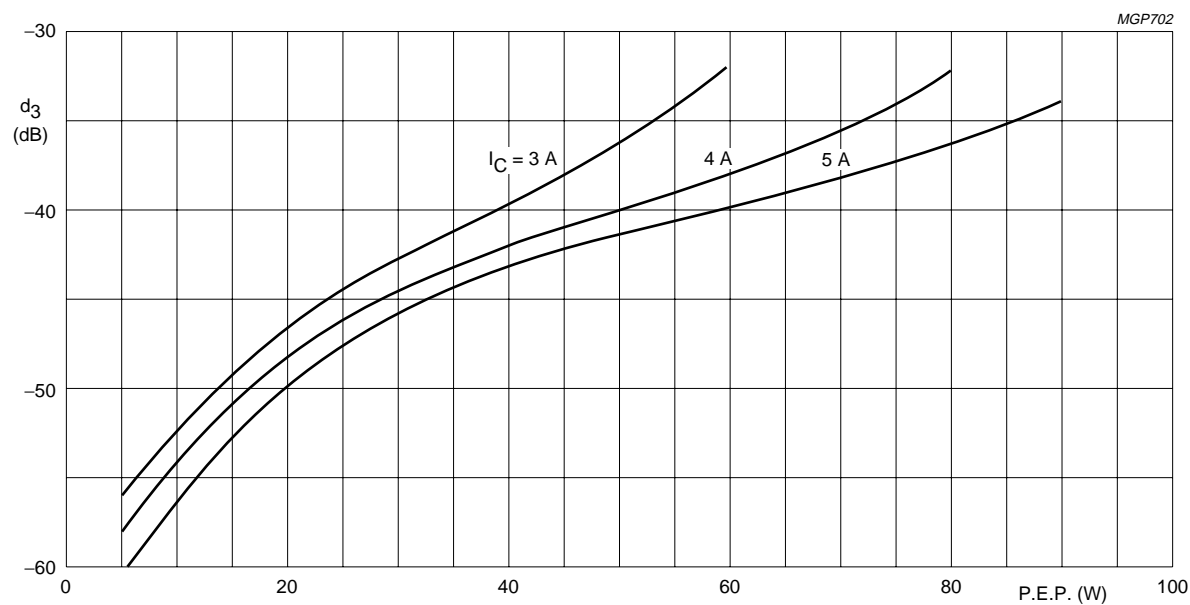


Fig.19 Third order intermodulation distortion as a function of output power.⁽¹⁾ Typical values; $V_{CE} = 40 \text{ V}$; $T_h = 25 \text{ }^\circ\text{C}$; $f_1 = 28,000 \text{ MHz}$; $f_2 = 28,001 \text{ MHz}$.

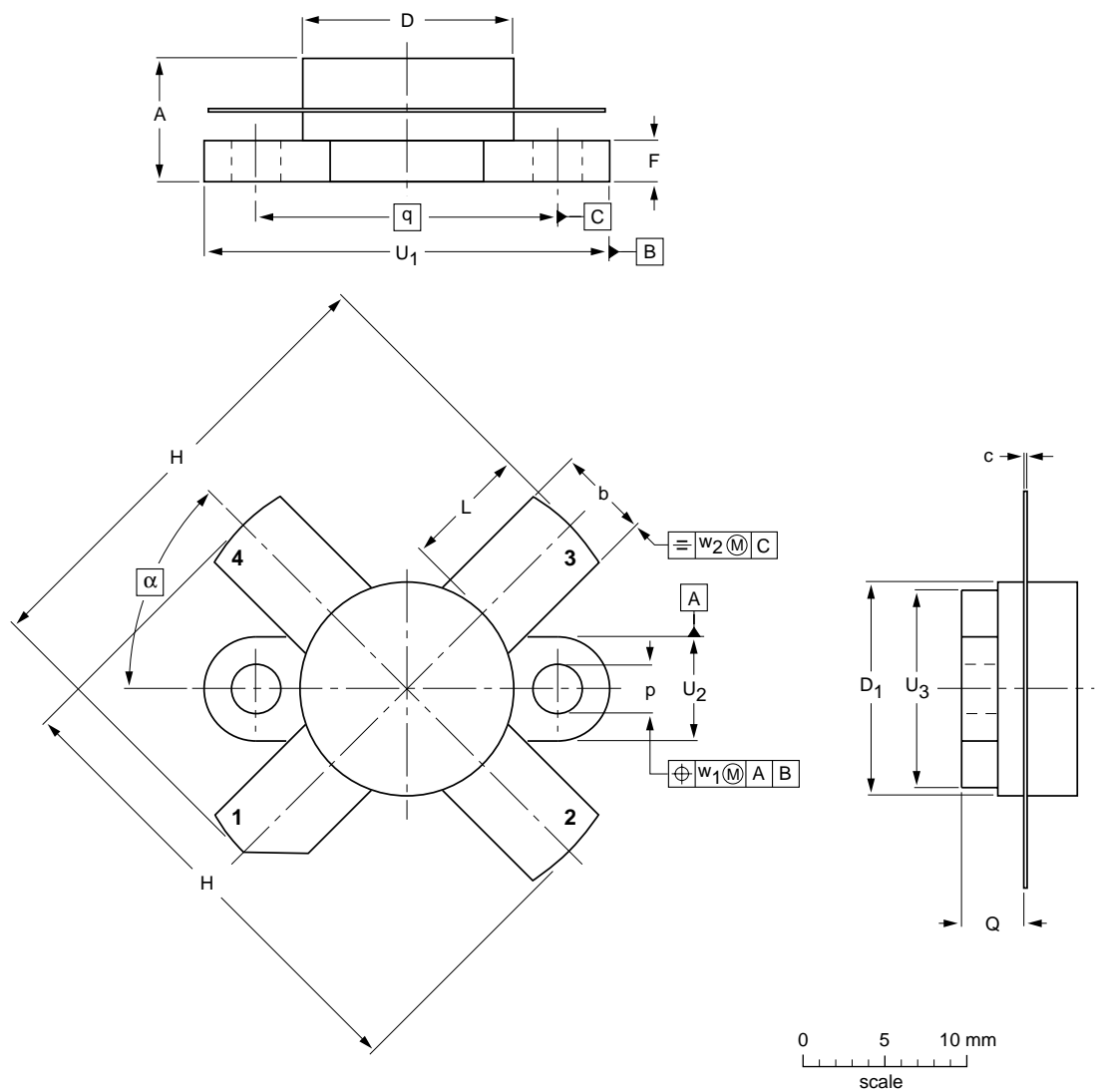
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PACKAGE OUTLINE

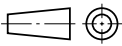
Flanged ceramic package; 2 mounting holes; 4 leads

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

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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.	

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