

# DATA SHEET

## **BLW96** HF/VHF power transistor

Product specification

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 1/2" flange envelope with a ceramic cap. All leads are isolated from the flange.

### QUICK REFERENCE DATA

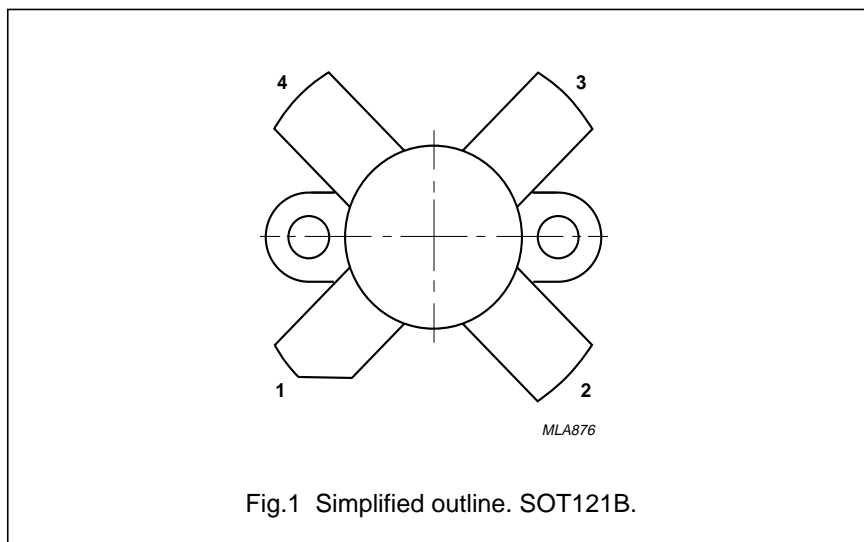
R.F. performance up to  $T_h = 25\text{ }^\circ\text{C}$

MODE OF OPERATION	$V_{CE}$ V	f MHz	$P_L$ W	$G_p$ dB	$\eta$ %	$d_3$ 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 <sup>(1)</sup>	< -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

- $\eta_{dt}$  at 200 W P.E.P.

### PIN CONFIGURATION



### 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

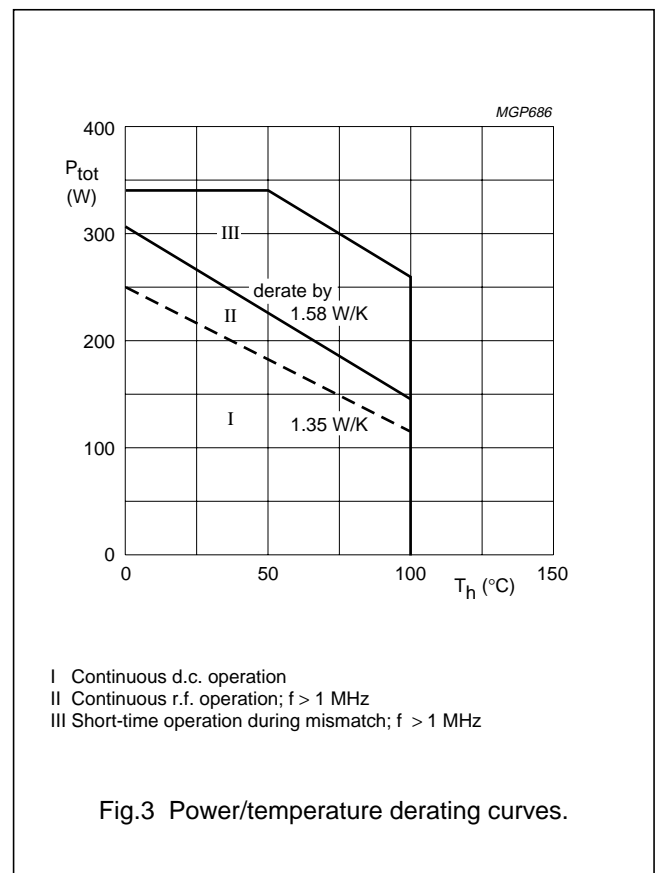
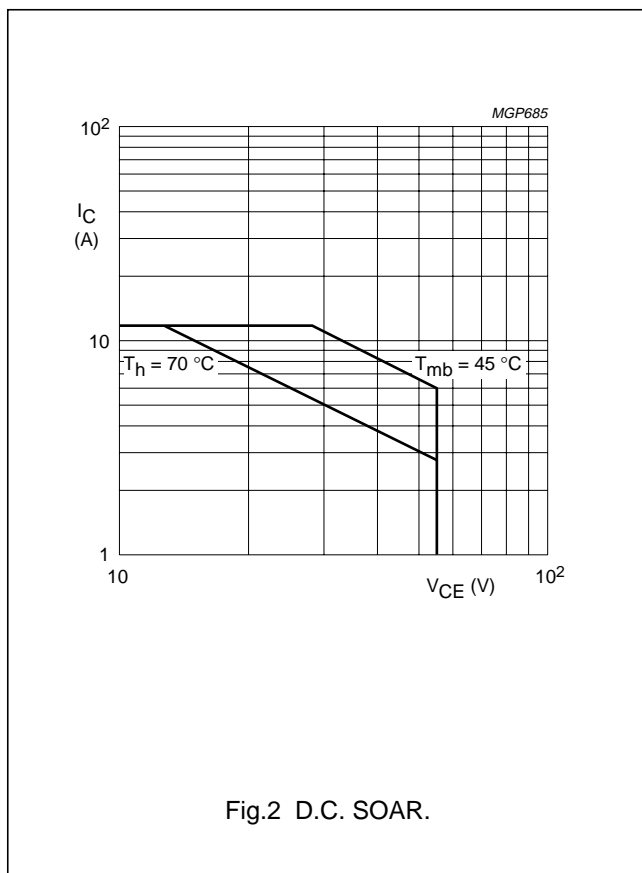
$P_{rf}$  max. 340 W

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

 $E_{SBO} > 20\text{ mJ}$  $R_{BE} = 10\ \Omega$  $E_{SBR} > 20\text{ mJ}$ D.C. current gain<sup>(1)</sup> $I_C = 7\text{ A}; V_{CE} = 5\text{ V}$  $h_{FE}$  typ. 30  
15 to 50D.C. current gain ratio of matched devices<sup>(1)</sup> $I_C = 7\text{ A}; V_{CE} = 5\text{ V}$  $h_{FE1}/h_{FE2} \leq 1,2$ Collector-emitter saturation voltage<sup>(1)</sup> $I_C = 20\text{ A}; I_B = 4\text{ A}$  $V_{CEsat}$  typ. 1,9 VTransition frequency at  $f = 100\text{ MHz}$ <sup>(2)</sup> $-I_E = 7\text{ A}; V_{CB} = 45\text{ V}$  $f_T$  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:  $t_p \leq 300\ \mu\text{s}; \delta \leq 0,02$ .
2. Measured under pulse conditions:  $t_p \leq 50\ \mu\text{s}; \delta \leq 0,01$ .

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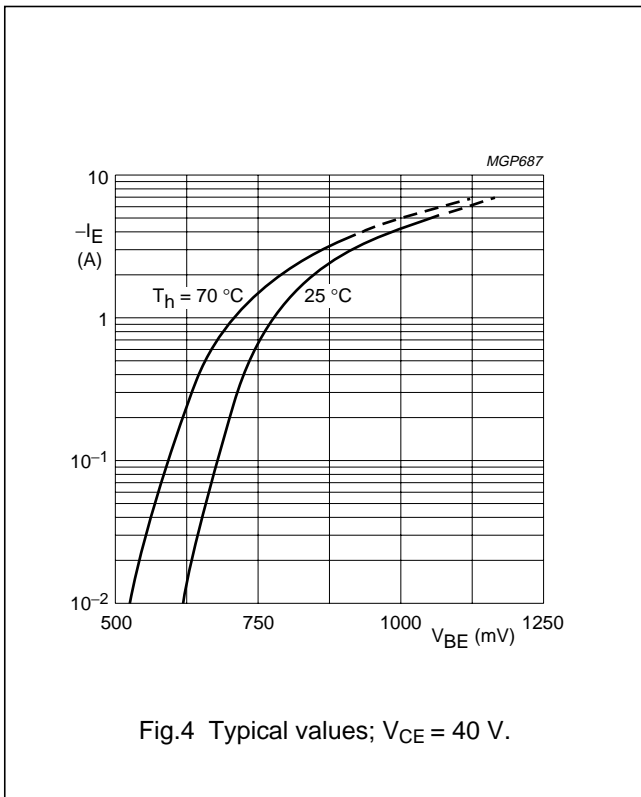


Fig.4 Typical values;  $V_{CE} = 40\text{ V}$ .

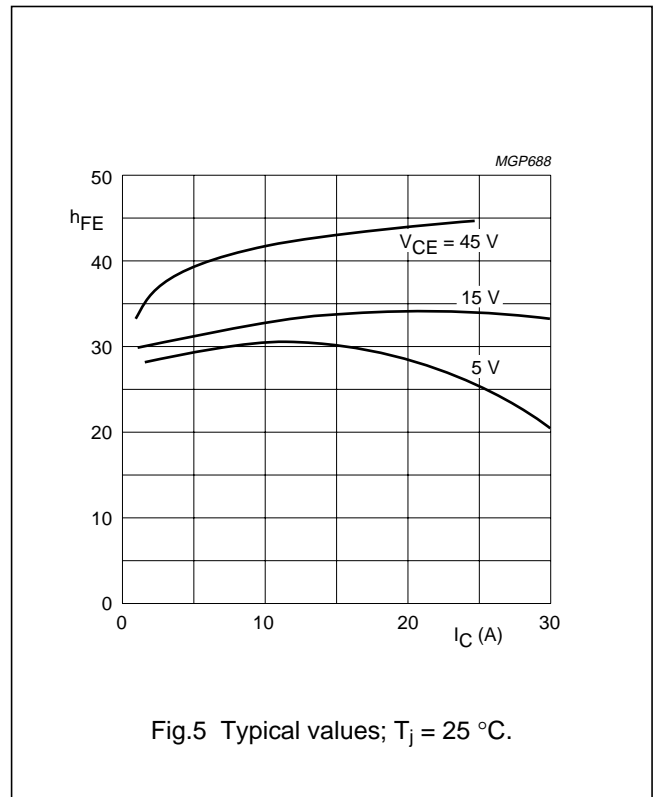


Fig.5 Typical values;  $T_j = 25^\circ\text{C}$ .

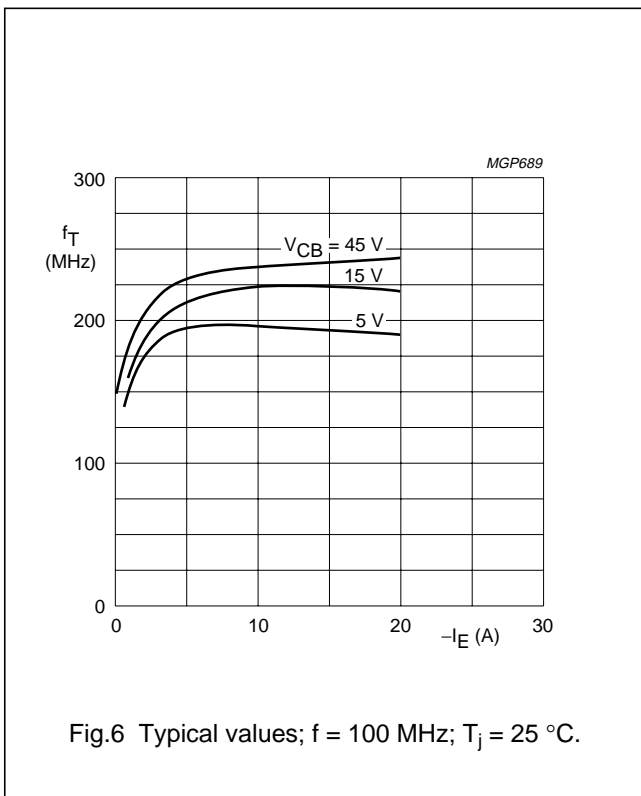


Fig.6 Typical values;  $f = 100\text{ MHz}$ ;  $T_j = 25^\circ\text{C}$ .

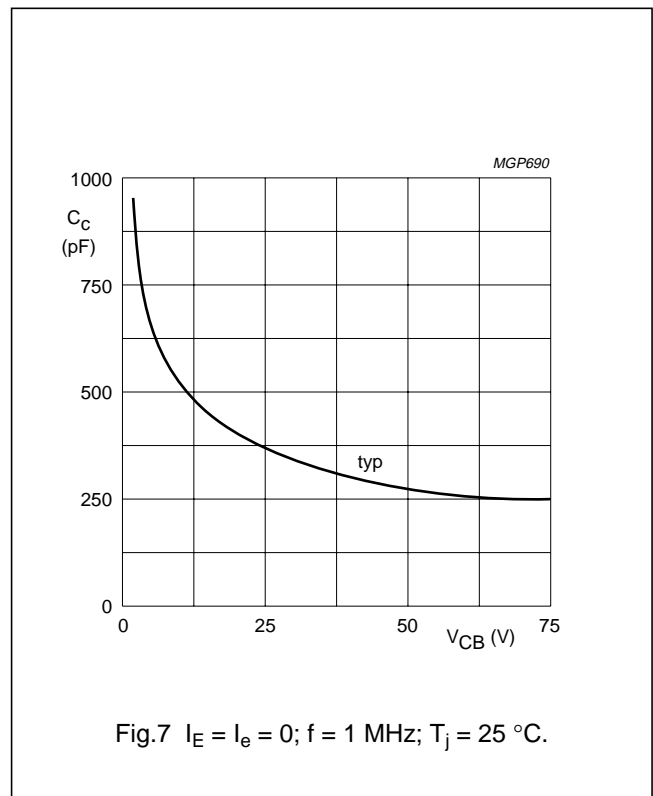


Fig.7  $I_E = I_e = 0$ ;  $f = 1\text{ MHz}$ ;  $T_j = 25^\circ\text{C}$ .

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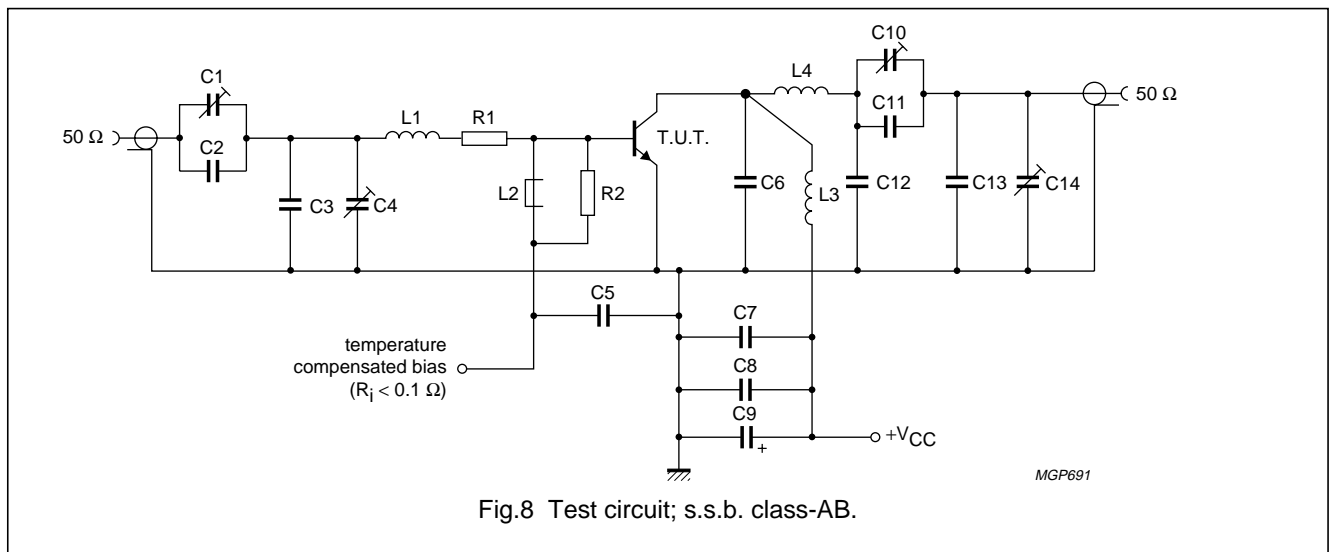
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## APPLICATION INFORMATION

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	$\eta_{dt}$ (%) at 200 W (P.E.P.)	$I_c$ (A) < 5,0	$d_3^{(1)}$ dB < -30	$d_5^{(1)}$ dB < -30	$I_{c(zs)}$ A 0,1
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 polysterene capacitor (630 V)

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

C6 = 27 pF multilayer ceramic chip capacitor (500 V; ATC<sup>(2)</sup>)C9 = 47  $\mu\text{F}$ /63 V electrolytic capacitorC11 = 2  $\times$  36 pF multilayer ceramic chip capacitors (500 V; ATC<sup>(2)</sup>) in parallelC12 = 2  $\times$  43 pF multilayer ceramic chip capacitors (500 V; ATC<sup>(2)</sup>) in parallelC13 = 43 pF multilayer ceramic chip capacitor (500 V; ATC<sup>(2)</sup>)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)

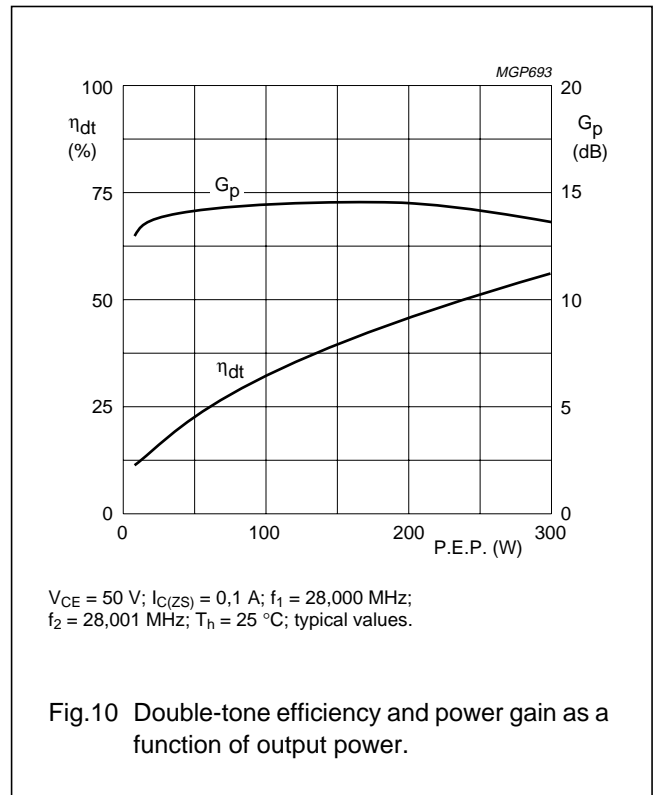
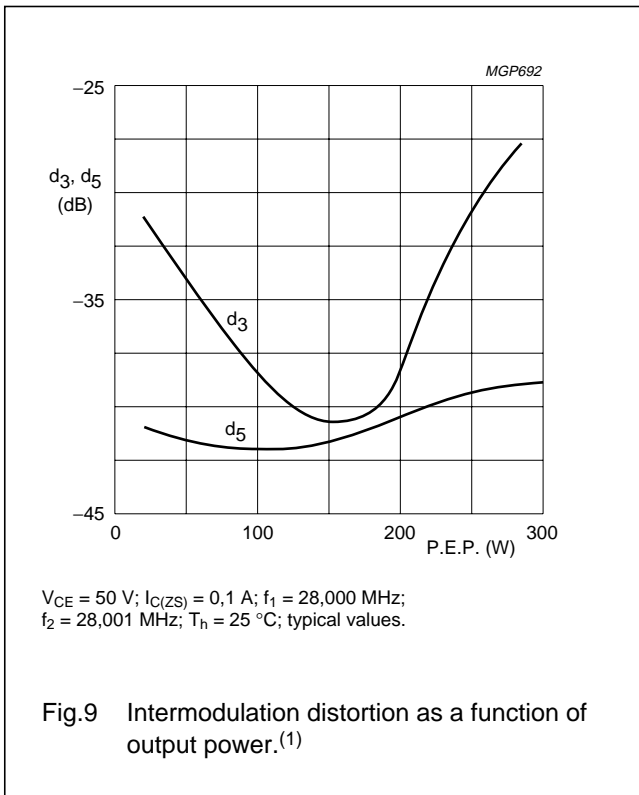
L3 = 150 nH; 5 turns Cu wire (2,0 mm); int. dia. 10,0 mm; length 18,7 mm; leads 2  $\times$  5 mmL4 = 197 nH; 5 turns Cu wire (2,0 mm); int. dia. 12,0 mm; length 18,6 mm; leads 2  $\times$  5 mmR1 = 0,66  $\Omega$ ; parallel connection of 5  $\times$  3,3  $\Omega$  metal film resistors (PR37;  $\pm$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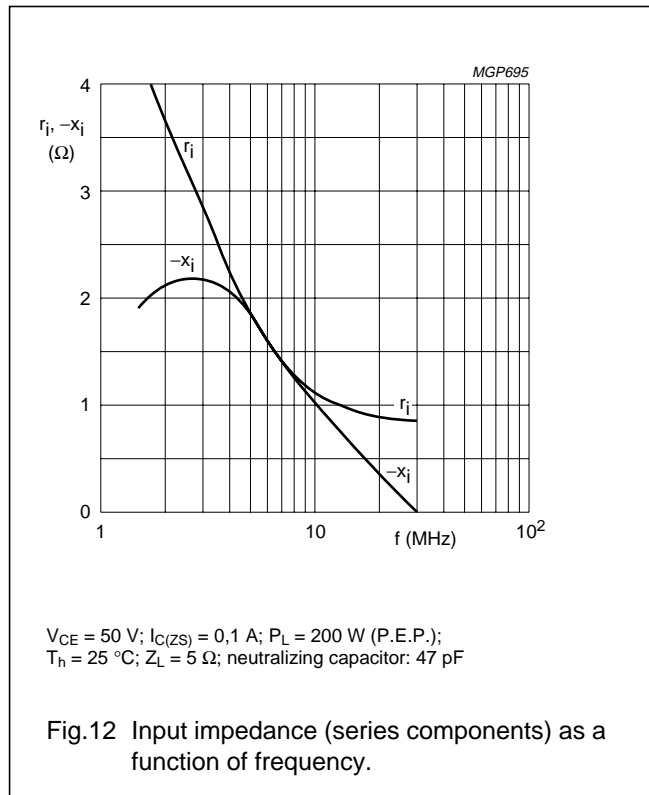
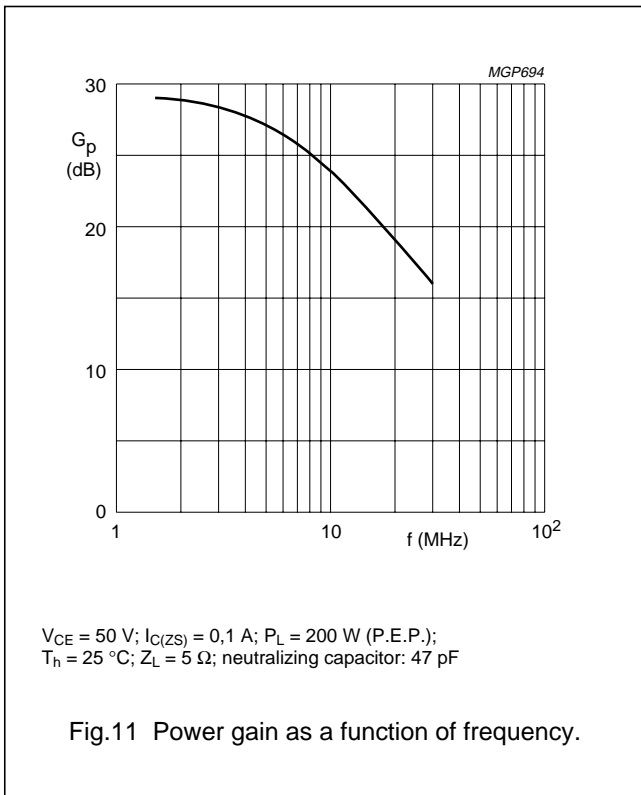
**Ruggedness**

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.



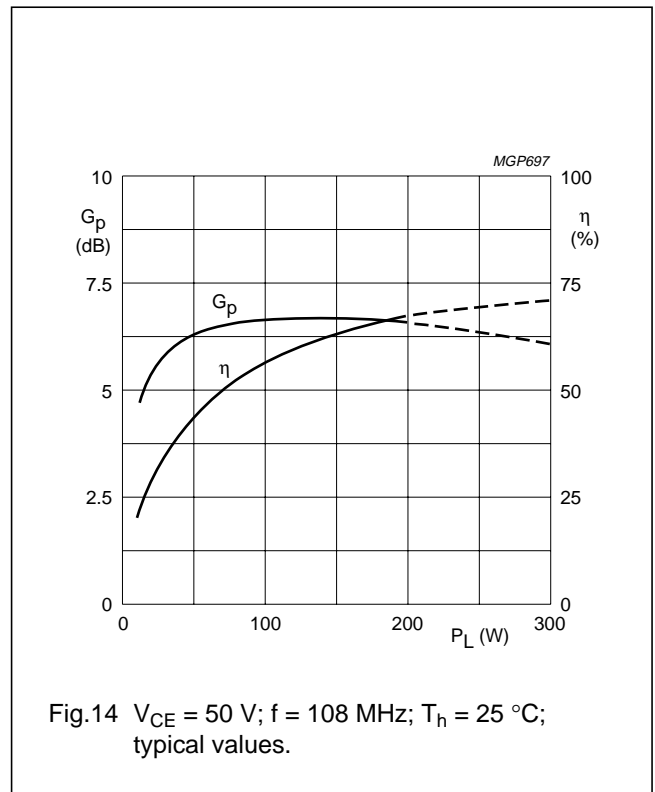
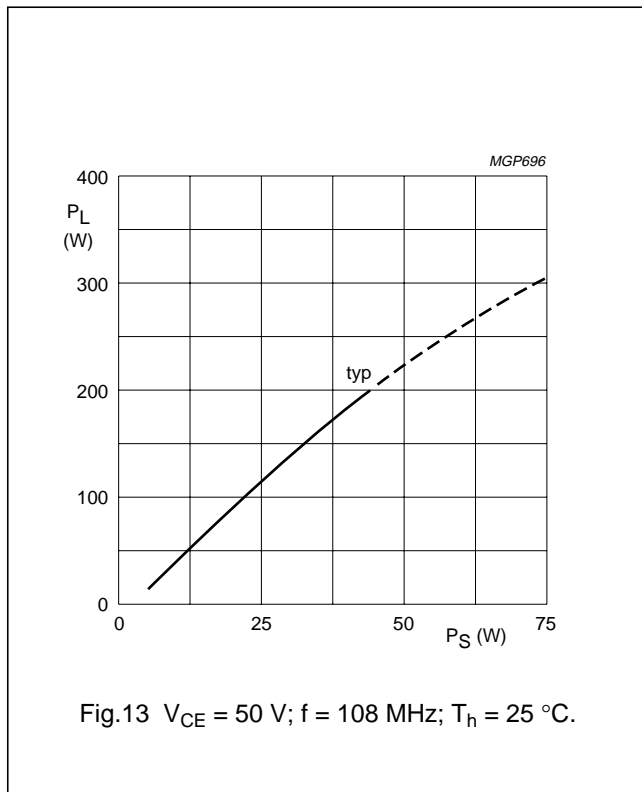
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R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

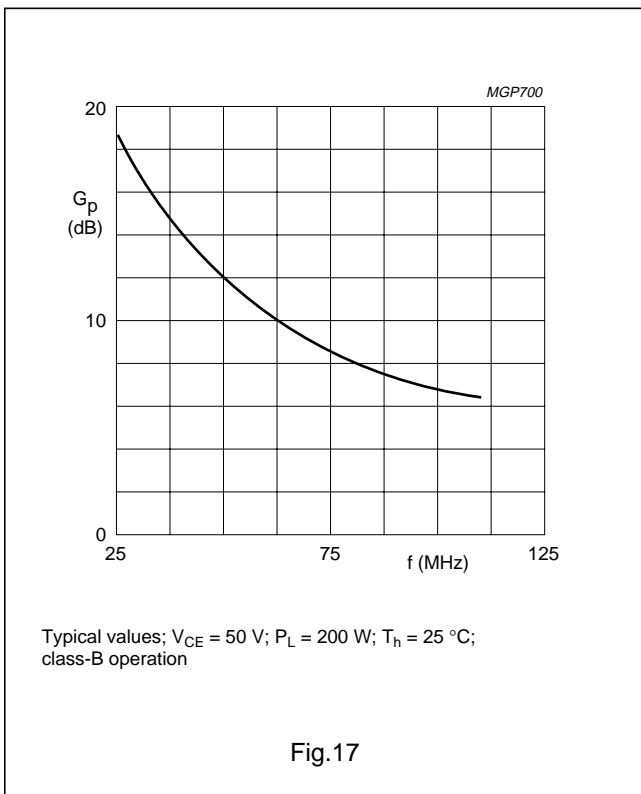
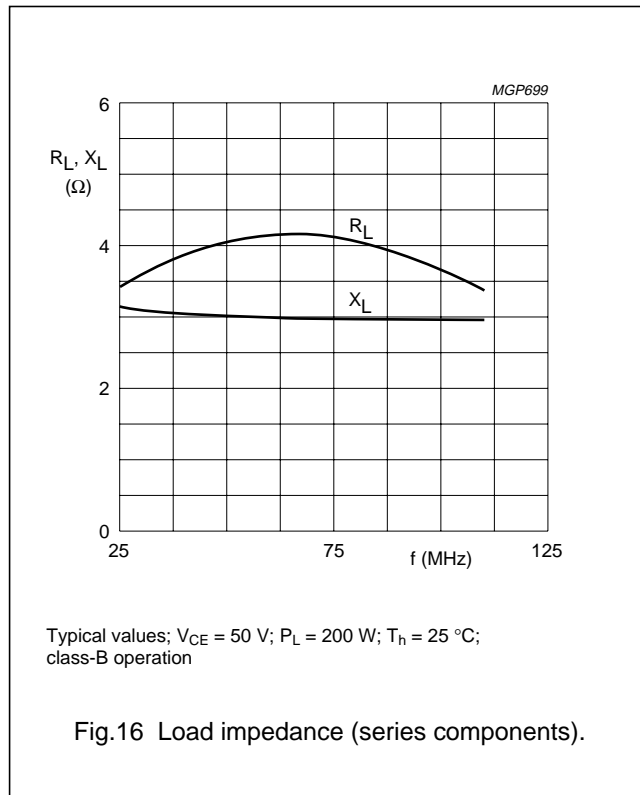
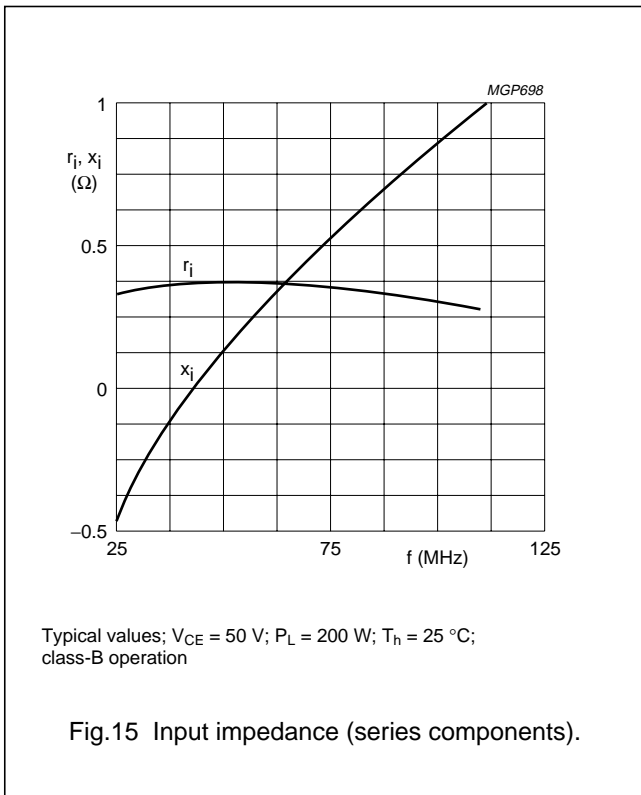
$T_h = 25\text{ }^\circ\text{C}$

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



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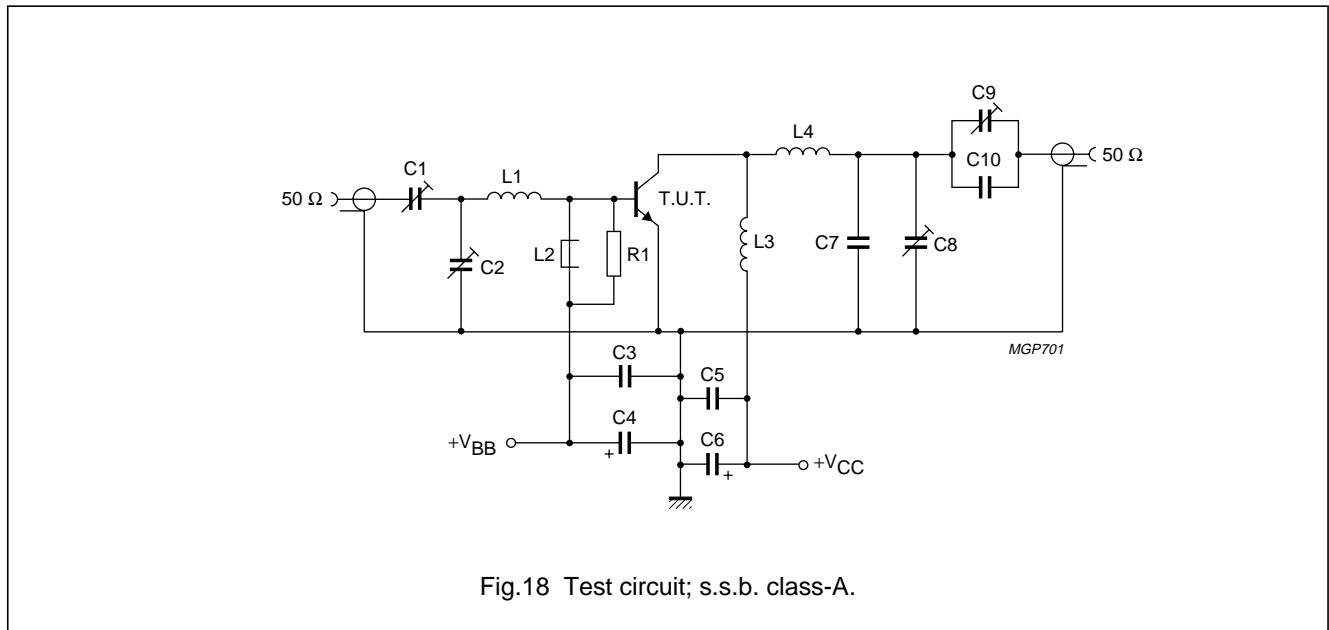
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R.F. performance in s.s.b. class-A operation (linear power amplifier)

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

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



## List of components:

C1 = C2 = 10 to 780 pF film dielectric trimmer

C3 = 220 nF polyester capacitor (100 V)

C4 = 100  $\mu\text{F}$ /4 V electrolytic capacitorC5 = 2  $\times$  330 nF polyester capacitors (100 V) in parallelC6 = 47  $\mu\text{F}$ /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  $\Omega$  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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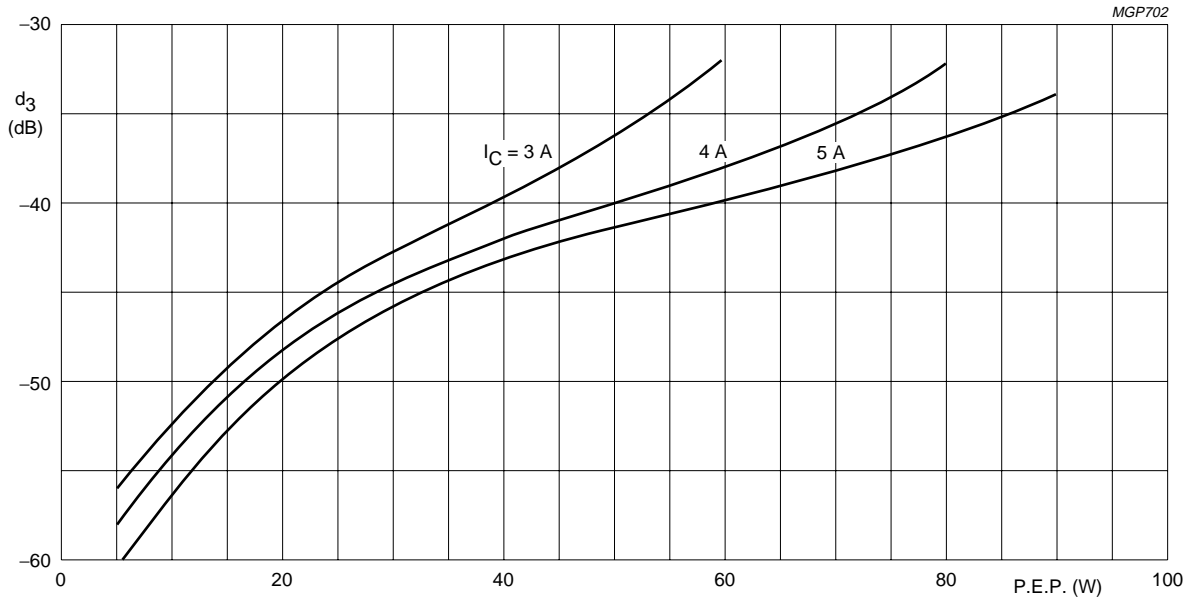


Fig.19 Third order intermodulation distortion as a function of output power.<sup>(1)</sup> Typical values;  $V_{CE} = 40 V$ ;  $T_h = 25 \text{ }^\circ\text{C}$ ;  $f_1 = 28,000 \text{ MHz}$ ;  $f_2 = 28,001 \text{ MHz}$ .

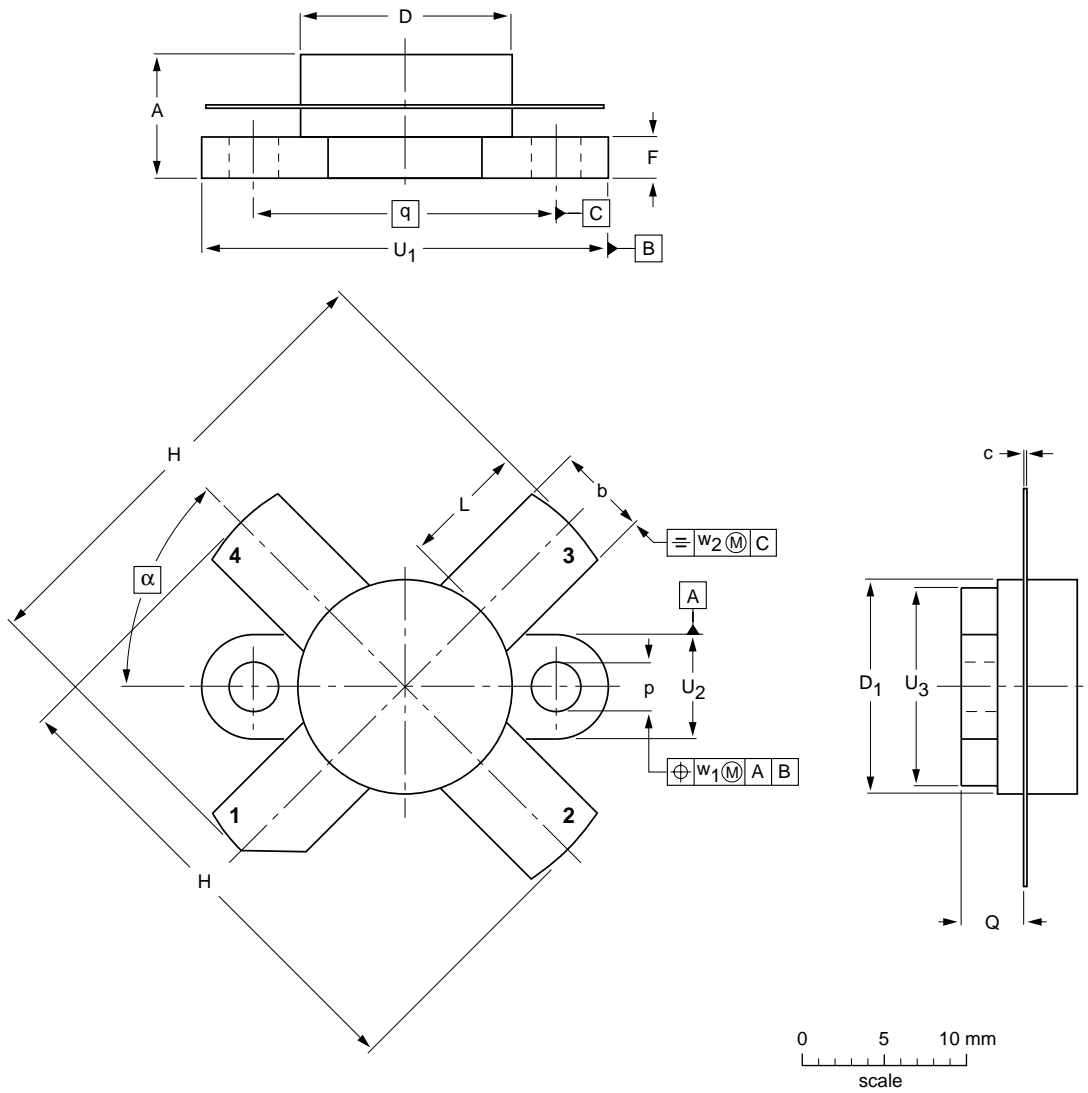
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PACKAGE OUTLINE

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 <sub>1</sub>	F	H	L	p	Q	q	U <sub>1</sub>	U <sub>2</sub>	U <sub>3</sub>	w <sub>1</sub>	w <sub>2</sub>	$\alpha$
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**

<b>Data Sheet Status</b>	
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.
<b>Limiting values</b>	
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.	
<b>Application information</b>	
Where application information is given, it is advisory and does not form part of the specification.	

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