

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

QUICK REFERENCE DATA

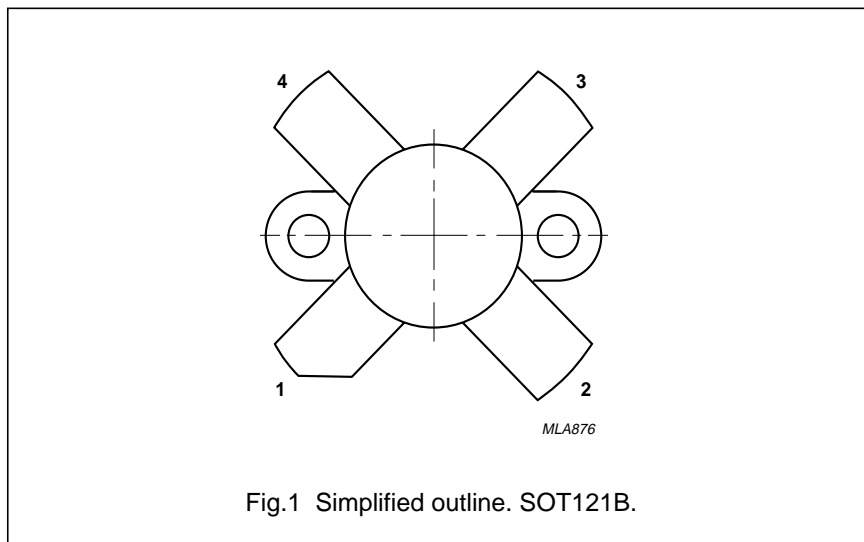
R.F. performance up to $T_h = 25\text{ }^\circ\text{C}$

| MODE OF OPERATION | V_{CE} V | 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



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 A

Collector current (peak value); $f > 1$ MHz

I_{CM} max. 25 A

R.F. power dissipation ($f > 1$ MHz); $T_{mb} = 25$ °C

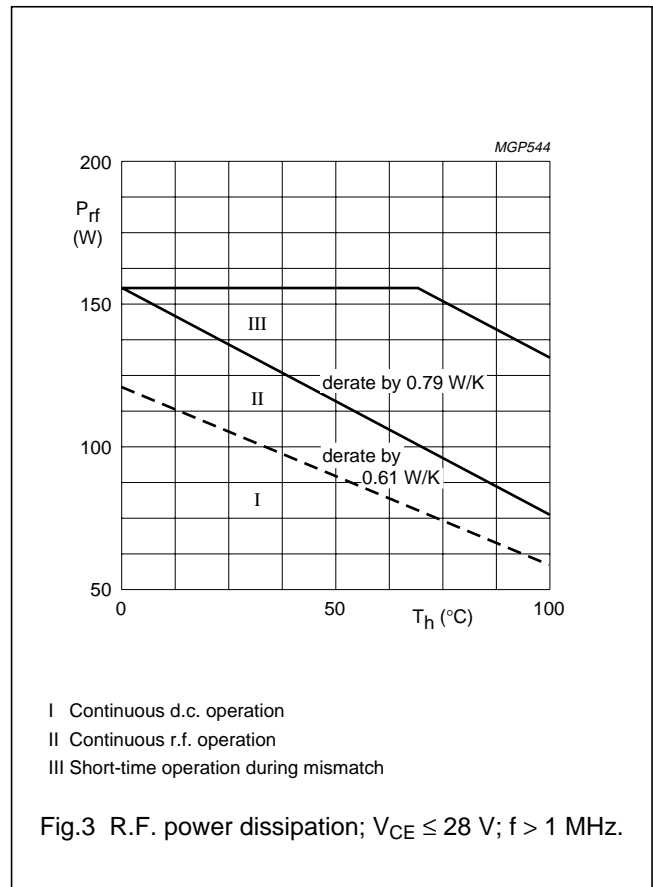
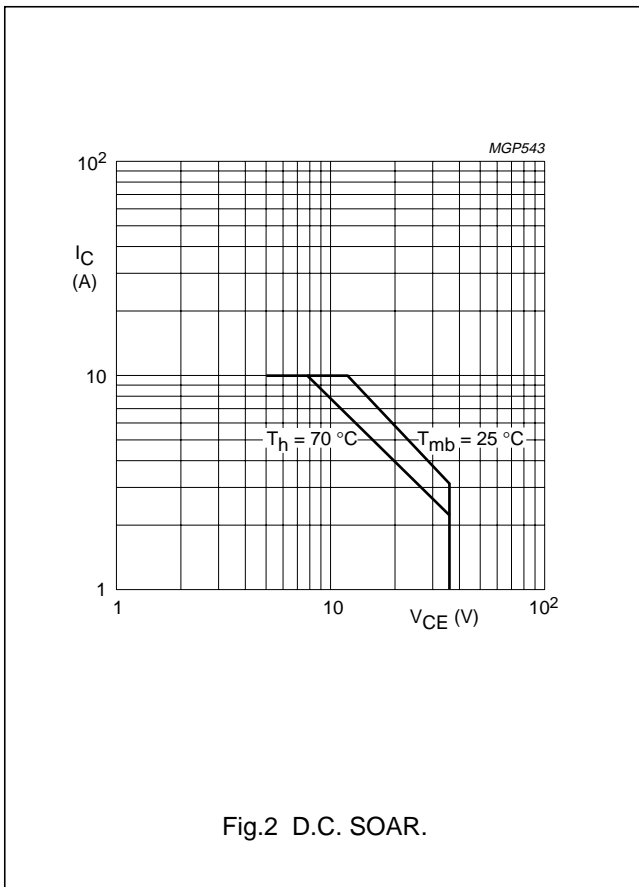
P_{rf} max. 160 W

Storage temperature

T_{stg} -65 to +150 °C

Operating junction temperature

T_j max. 200 °C



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

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⁾ $I_C = 5\text{ A}; V_{CE} = 5\text{ V}$ $h_{FE} 20\text{ to }85$

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 $f = 1\text{ MHz}$ $I_C = 100\text{ mA}; V_{CE} = 28\text{ V}$ $C_{re} \text{ typ. } 102\text{ pF}$

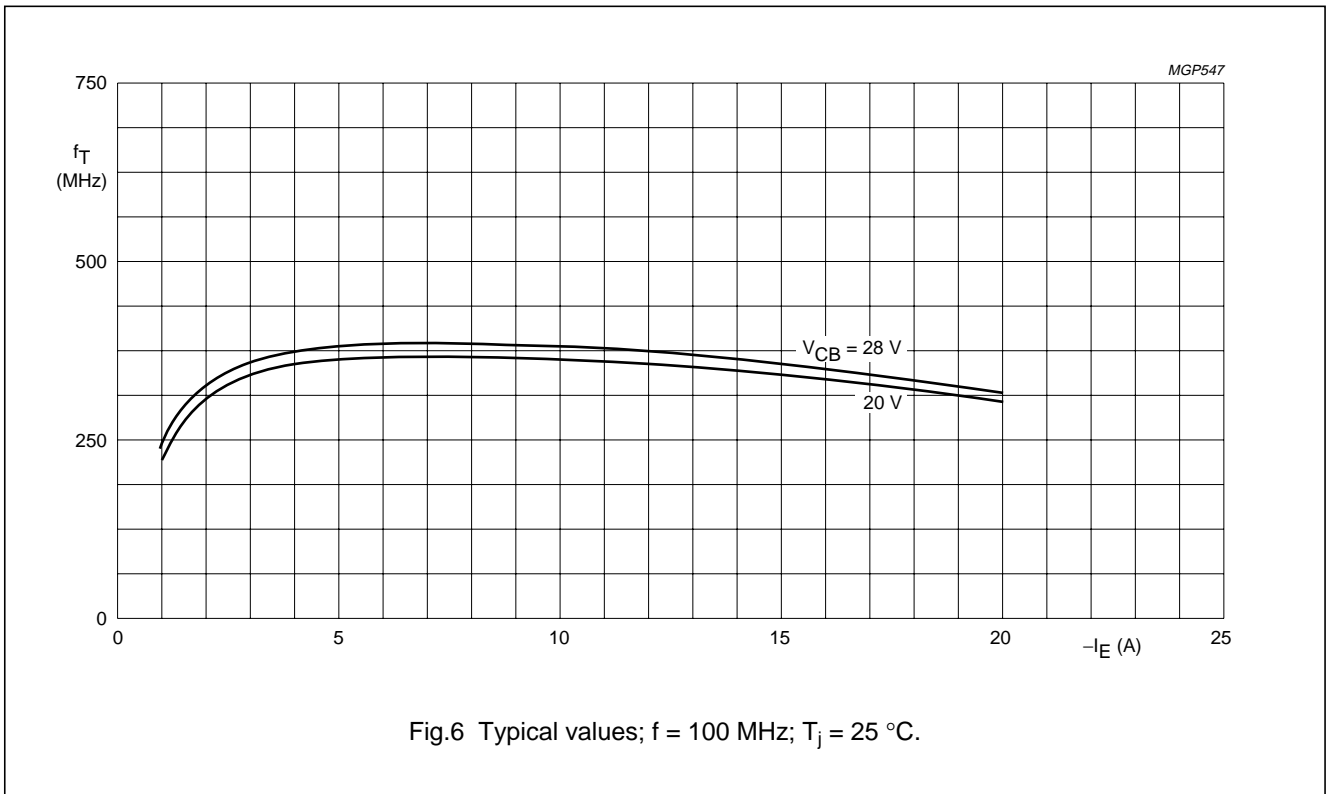
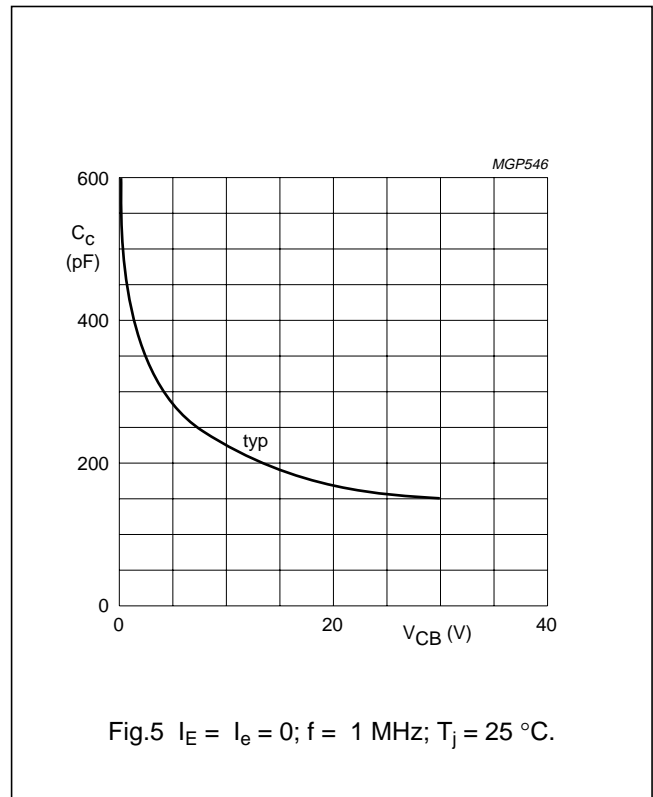
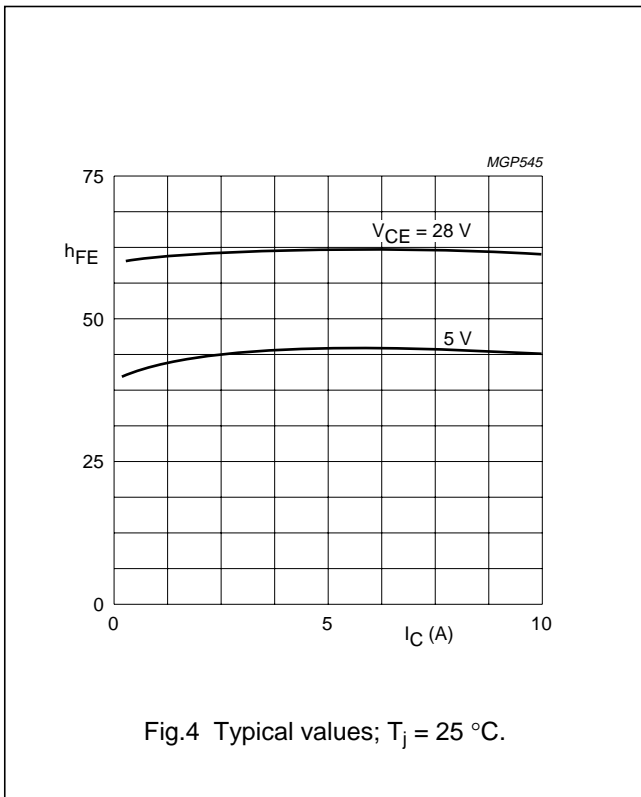
Collector-flange capacitance

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

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

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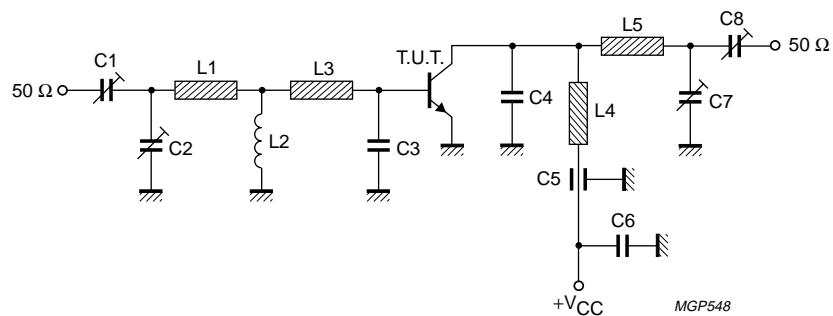
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APPLICATION INFORMATION

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_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; $f = 150\text{ MHz}$.

List of components:

C1 = C2 = C7 = C8 = 5 to 100 pF film dielectric trimmer

C3 = 203 pF; $2 \times 82\text{ pF}$ and 39 pF multilayer ceramic chip capacitors (500 V, ATC⁽¹⁾) in parallelC4 = 39 pF multilayer ceramic chip capacitor (500 V, ATC⁽¹⁾)

C5 = 1 nF feed-through capacitor

C6 = 100 nF polyester capacitor

L1 = strip (30 mm \times 8 mm); bent to form inverted 'U' shape with top 15 mm above heatsink, and bottom 5 mm above heatsinkL2 = 1 μH r.f. choke

L3 = strip; shape as shown in Fig.8; 5 mm above heatsink

L4 = strip (40 mm \times 8 mm); bent in form $\text{┌} \text{┐}$, 25 mm at 15 mm above heatsink, 5 mm at 5 mm above heatsink

L5 = strip (75 mm long; width 8 mm); 5 mm above base

L1, L3, L4, and L5 are copper strips with a thickness of 0,6 mm.

Heatsink: aluminium; 0,9 K/W

At $P_L = 100\text{ W}$ and $V_{CE} = 28\text{ V}$, the output power at heatsink temperatures between $25\text{ }^\circ\text{C}$ and $90\text{ }^\circ\text{C}$ relative to that at $25\text{ }^\circ\text{C}$ is diminished by typ. 0,12 W/K.

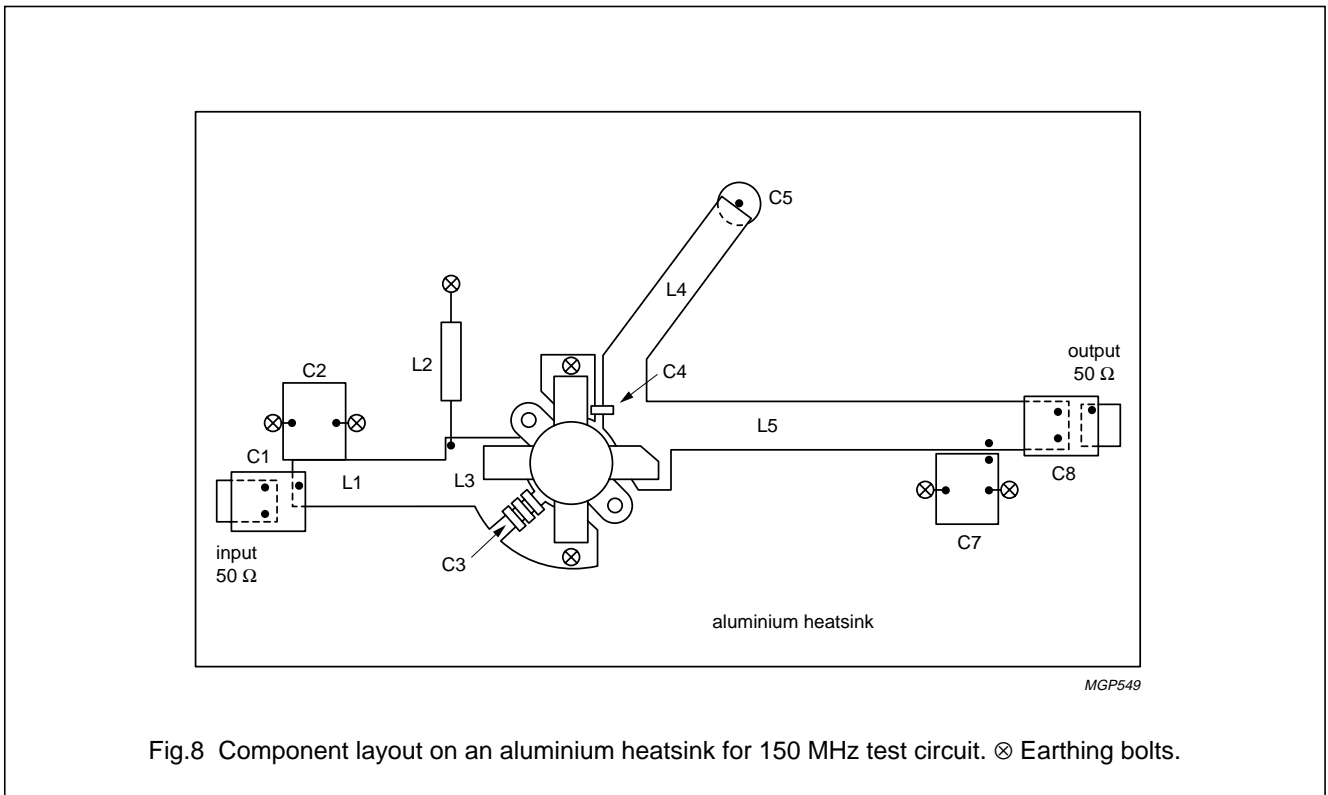
Component layout on an aluminium heatsink for 150 MHz test circuit is shown in Fig.8.

Note

1. ATC means American Technical Ceramics.

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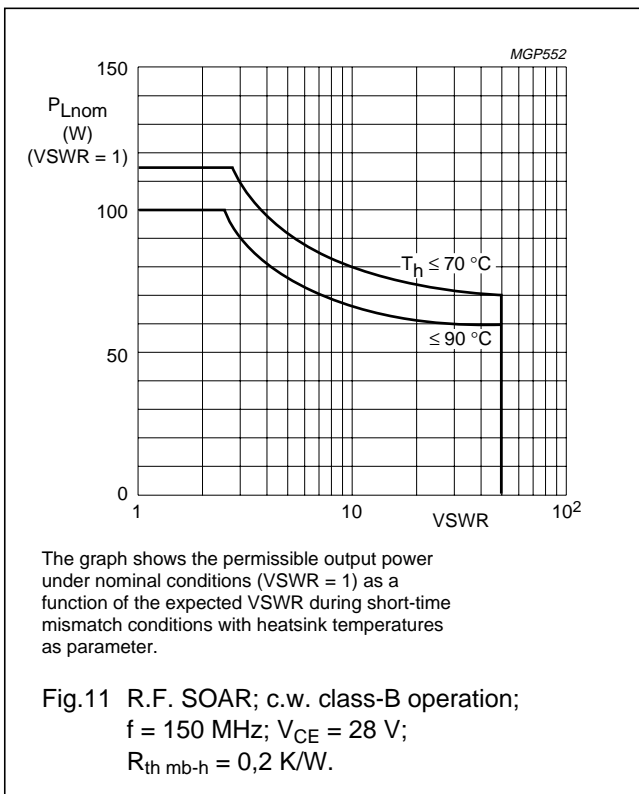
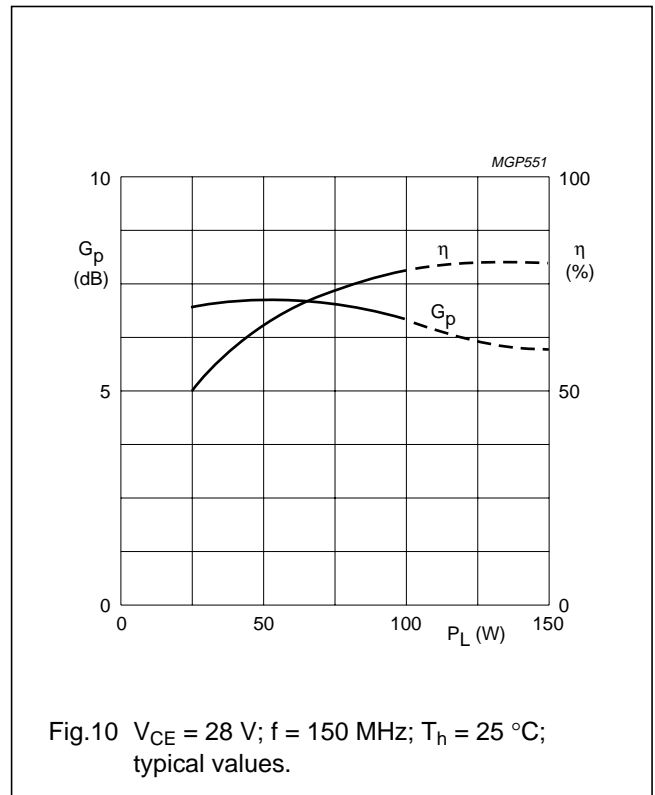
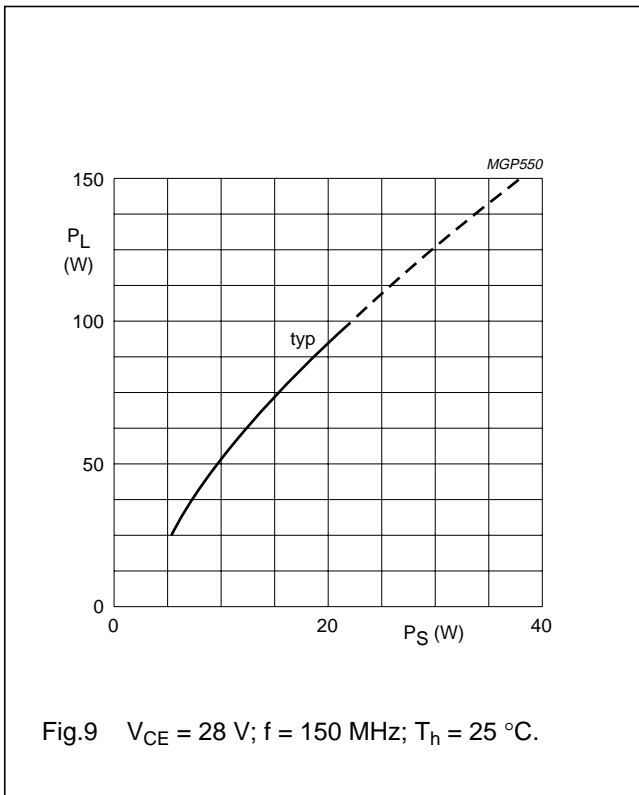
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MGP549

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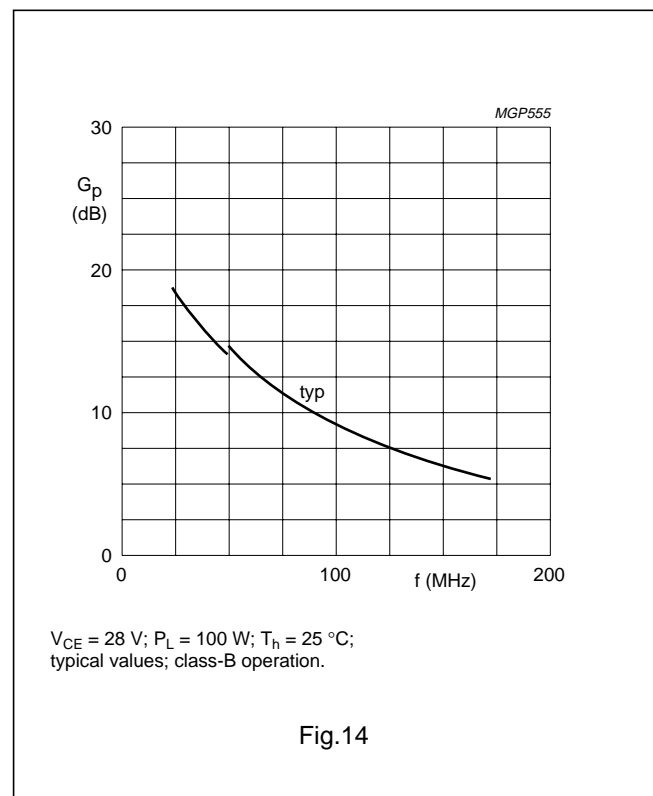
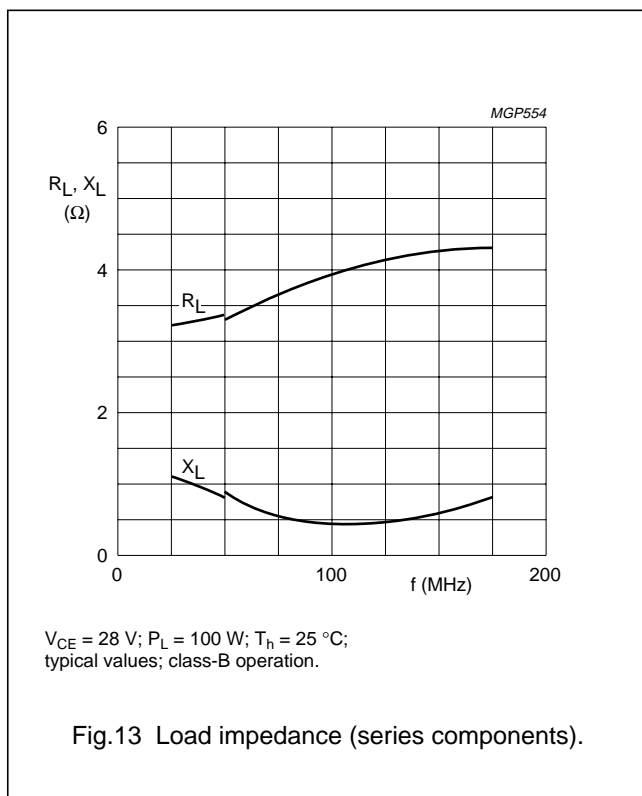
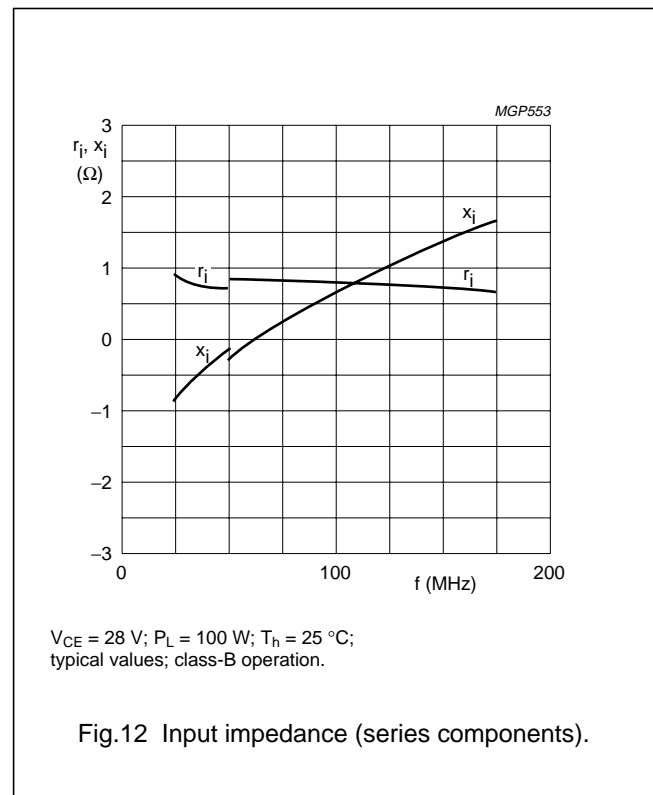


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OPERATING NOTE

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

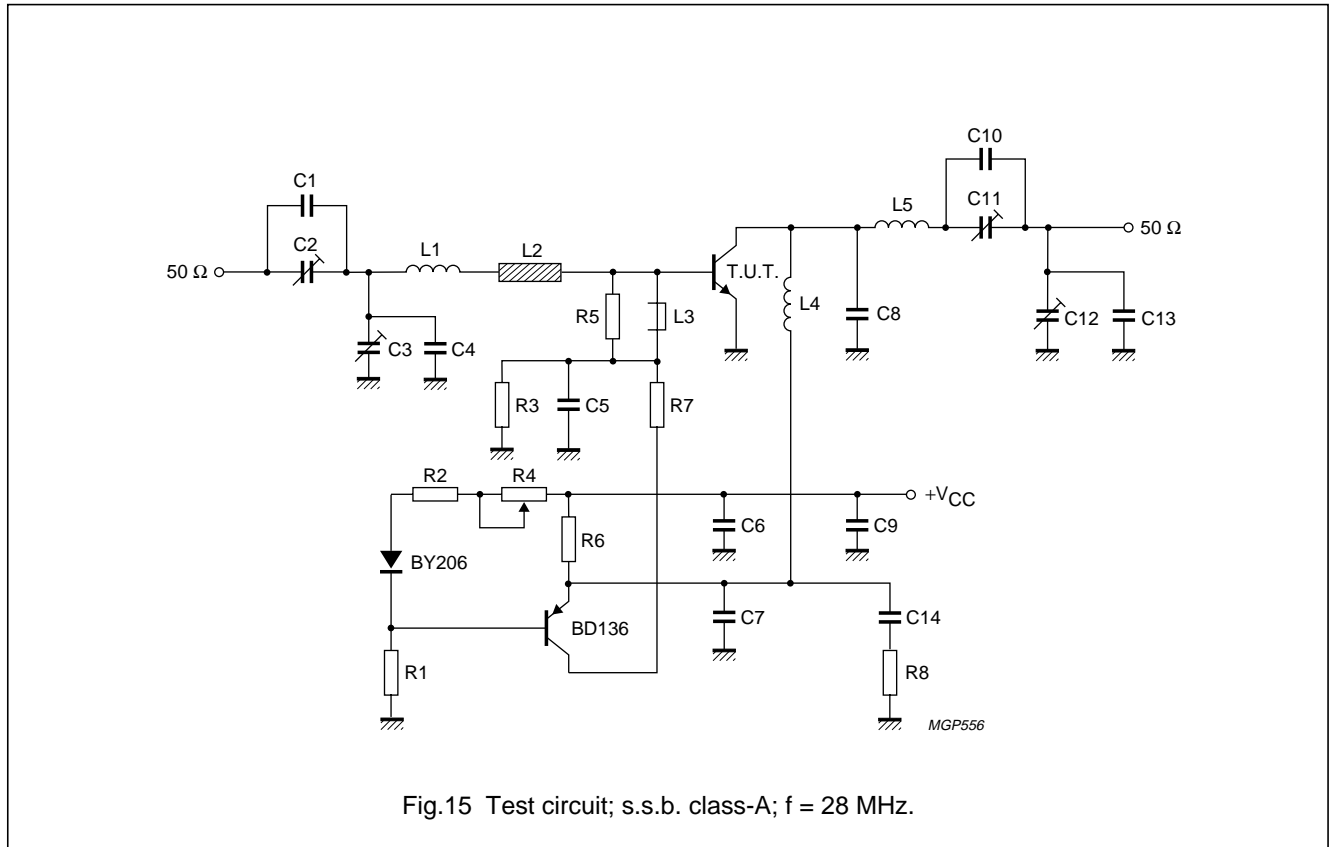


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R.F. performance in s.s.b. class-A operation
 $V_{CE} = 26 \text{ V}$; $T_h = 40 \text{ }^\circ\text{C}$; $f_1 = 28,000 \text{ MHz}$; $f_2 = 28,001 \text{ MHz}$

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



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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 k Ω (\pm 5%) carbon resistor (0,5 W)
- R2 = 100 Ω (\pm 5%) carbon resistor (0,5 W)
- R3 = 68 Ω (\pm 5%) carbon resistor (0,5 W)
- R4 = 100 Ω wirewound potentiometer
- R5 = 33 Ω (\pm 5%) carbon resistor (0,5 W)
- R6 = 0,68 Ω (\pm 10%) wirewound resistor (7 W)
- R7 = 120 Ω wirewound resistor (8 W)
- R8 = 10 Ω (\pm 10%) carbon resistor (0,5 W)

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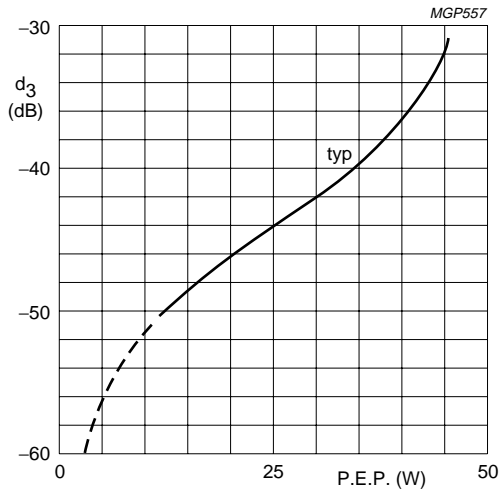


Fig. 16 Intermodulation distortion as a function of output power; $V_{CE} = 26$ V; $I_C = 3$ A; $f_1 = 28,000$ MHz; $f_2 = 28,001$ MHz; $T_h = 40$ °C.

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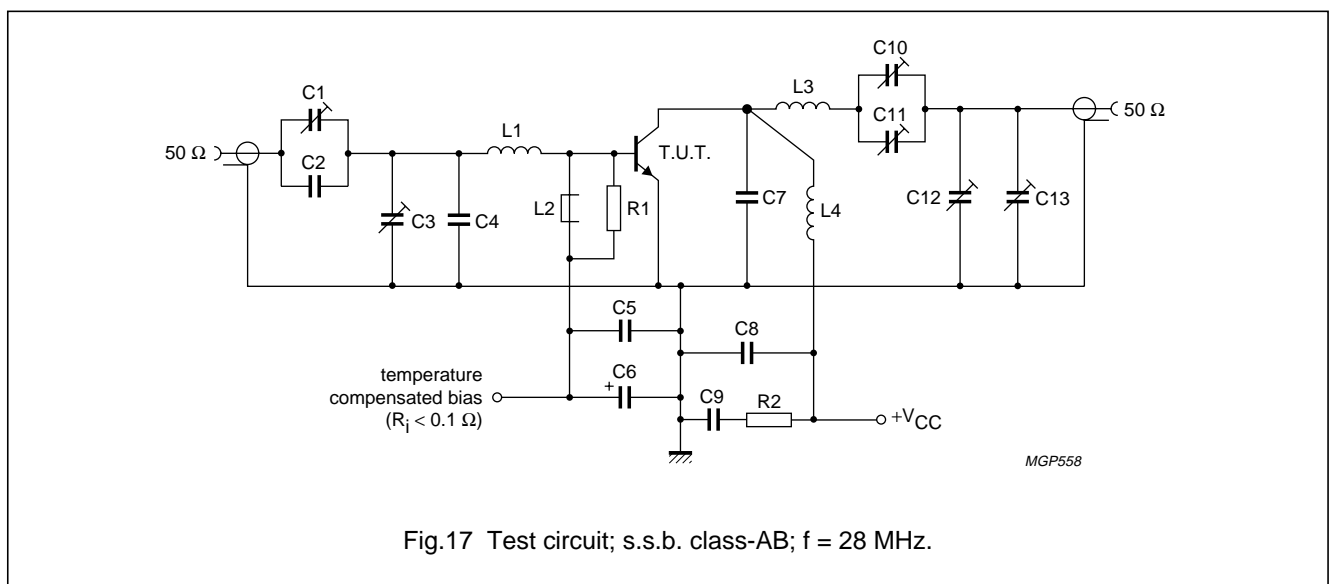
R.F. performance in s.s.b. class-AB operation (linear power amplifier)

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

| 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.

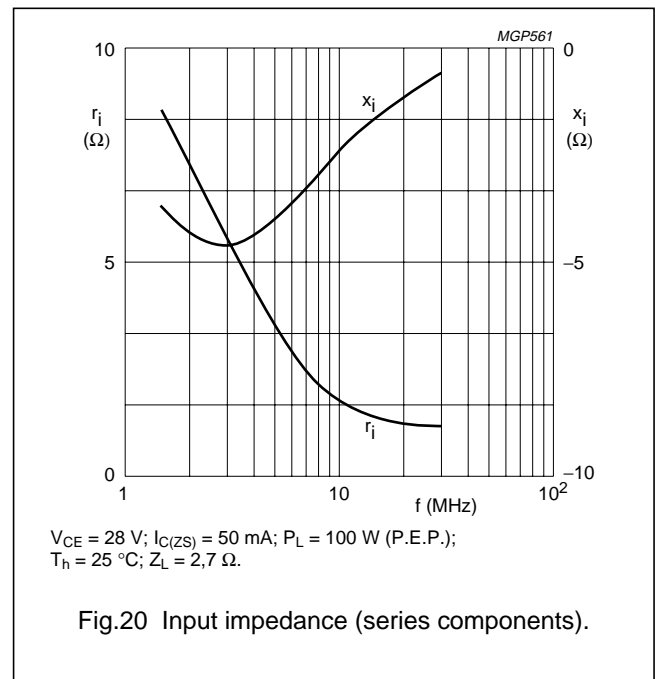
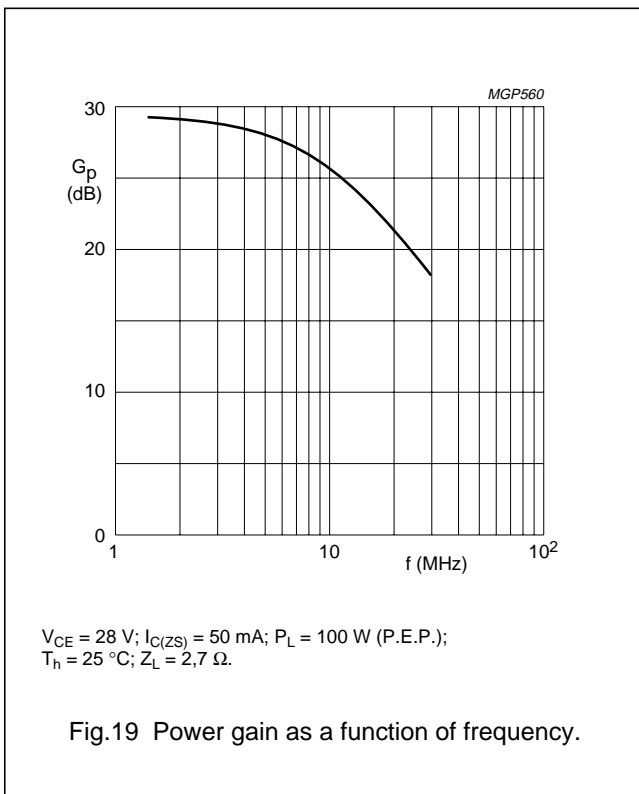
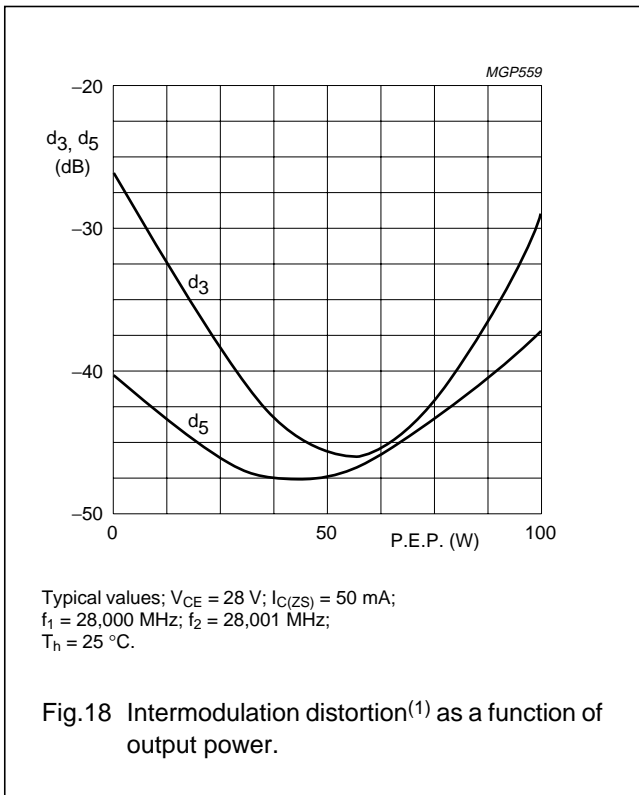


List of components:

- 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 $\mu\text{F}/6 \text{ V}$ 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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Figs 19 and 20 are typical curves and hold for an unneutralized amplifier in s.s.b. class-AB operation.

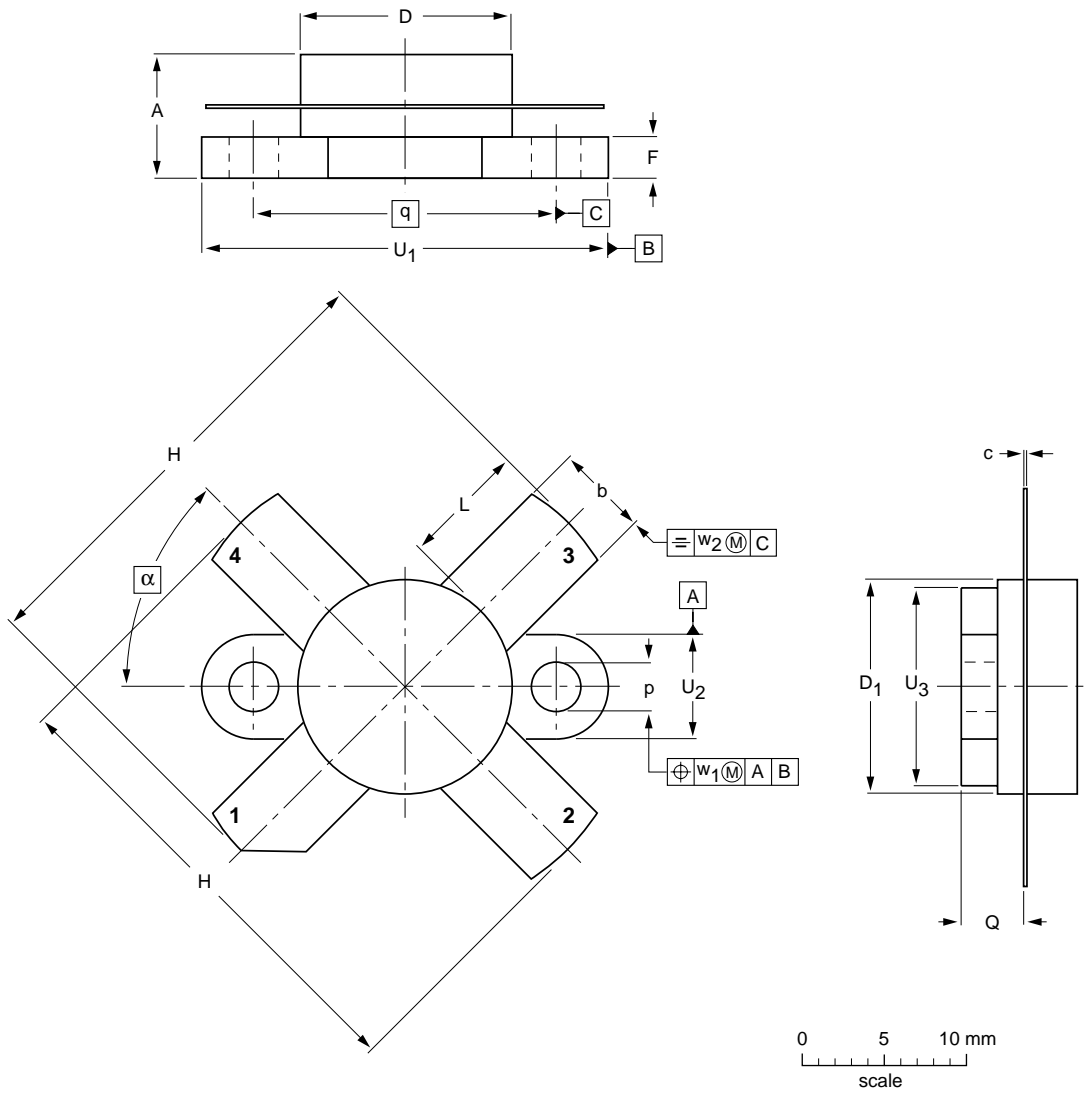
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PACKAGE OUTLINE

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 |

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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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