

# DATA SHEET

## **BLW85** HF/VHF power transistor

Product specification

March 1993

# HF/VHF power transistor

# BLW85

### DESCRIPTION

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated mobile h.f. and v.h.f. transmitters with a nominal supply voltage of 12,5 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions with a supply over-voltage to 16,5 V.

Matched  $h_{FE}$  groups are available on request.

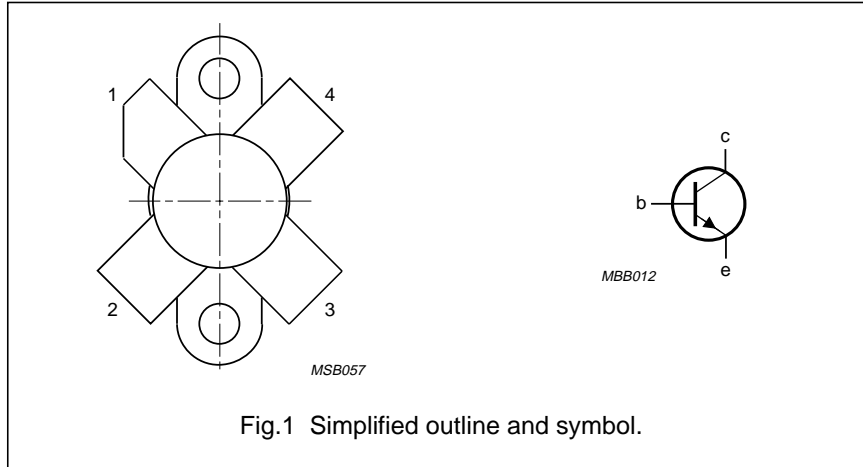
It has a 3/8" flange envelope with a ceramic cap. All leads are isolated from the flange.

### QUICK REFERENCE DATA

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

| MODE OF OPERATION | $V_{CE}$<br>V | f<br>MHz | $P_L$<br>W    | $G_p$<br>dB | $\eta$<br>% | $\bar{z}_i$<br>$\Omega$ | $\bar{Z}_L$<br>$\Omega$ | $d_3$<br>dB |
|-------------------|---------------|----------|---------------|-------------|-------------|-------------------------|-------------------------|-------------|
| c.w. (class-B)    | 12,5          | 175      | 45            | > 4,5       | > 75        | $1,4 + j1,5$            | $2,7 - j1,3$            | -           |
| s.s.b. (class-AB) | 12,5          | 1,6-28   | 3-30 (P.E.P.) | typ. 19,5   | typ. 35     | -                       | -                       | typ. -33    |

### PIN CONFIGURATION



### PINNING - SOT123

| 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. 36 V

Collector-emitter voltage (open base)

$V_{CEO}$  max. 16 V

Emitter-base voltage (open-collector)

$V_{EBO}$  max. 4 V

Collector current (average)

$I_{C(AV)}$  max. 9 A

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

$I_{CM}$  max. 22 A

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

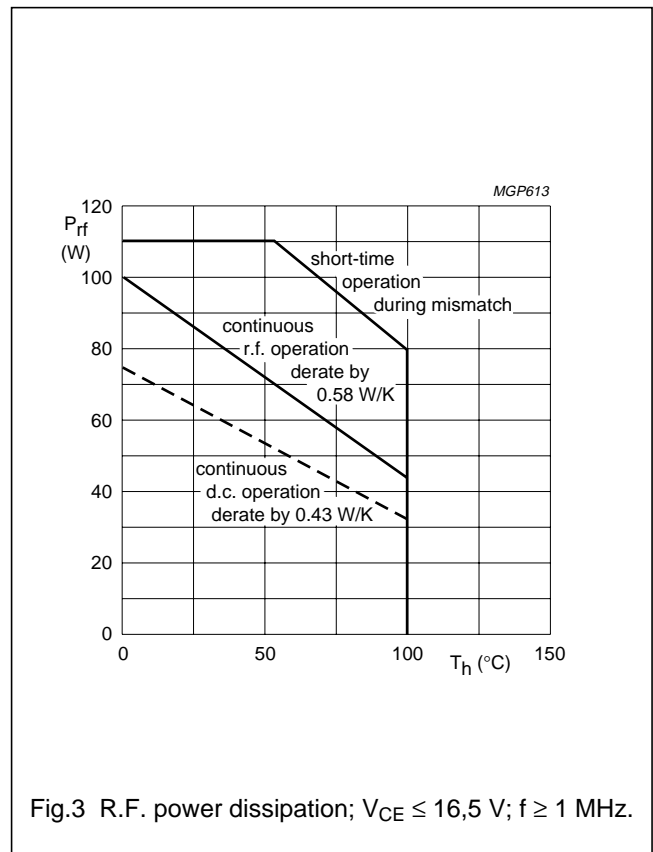
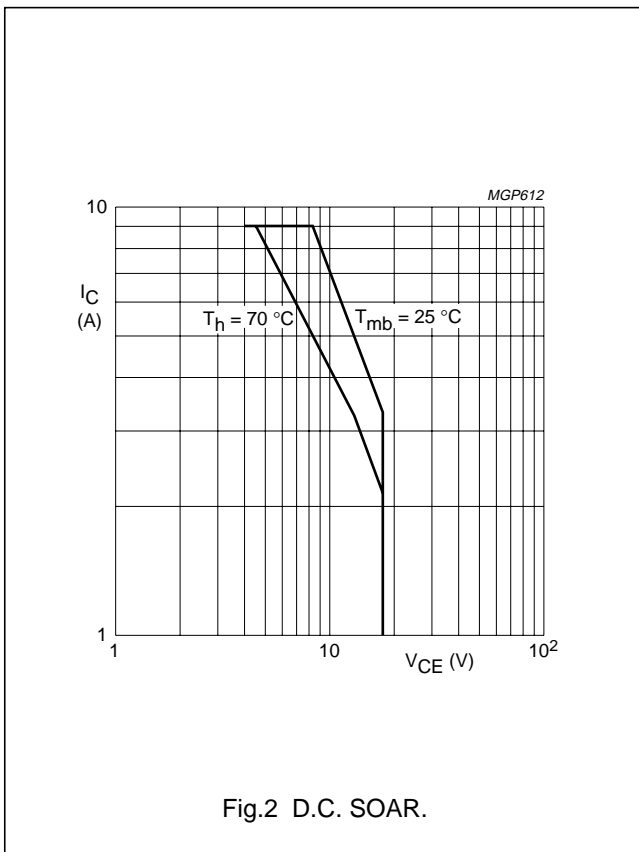
$P_{rf}$  max. 105 W

Storage temperature

$T_{stg}$  -65 to + 150 °C

Operating junction temperature

$T_j$  max. 200 °C



**THERMAL RESISTANCE**

(dissipation = 30 W;  $T_{mb} = 79$  °C, i.e.  $T_h = 70$  °C)

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

$R_{th\ j-mb(dc)}$  = 2,5 K/W

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

$R_{th\ j-mb(rf)}$  = 1,8 K/W

From mounting base to heatsink

$R_{th\ mb-h}$  = 0,3 K/W

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

Collector-emitter breakdown voltage

 $V_{BE} = 0; I_C = 50\text{ mA}$  $V_{(BR)CES} > 36\text{ V}$ 

Collector-emitter breakdown voltage

open base;  $I_C = 100\text{ mA}$  $V_{(BR)CEO} > 16\text{ V}$ 

Emitter-base breakdown voltage

open collector;  $I_E = 25\text{ mA}$  $V_{(BR)EBO} > 4\text{ V}$ 

Collector cut-off current

 $V_{BE} = 0; V_{CE} = 18\text{ V}$  $I_{CES} < 25\text{ mA}$ Second breakdown energy;  $L = 25\text{ mH}; f = 50\text{ Hz}$ 

open base

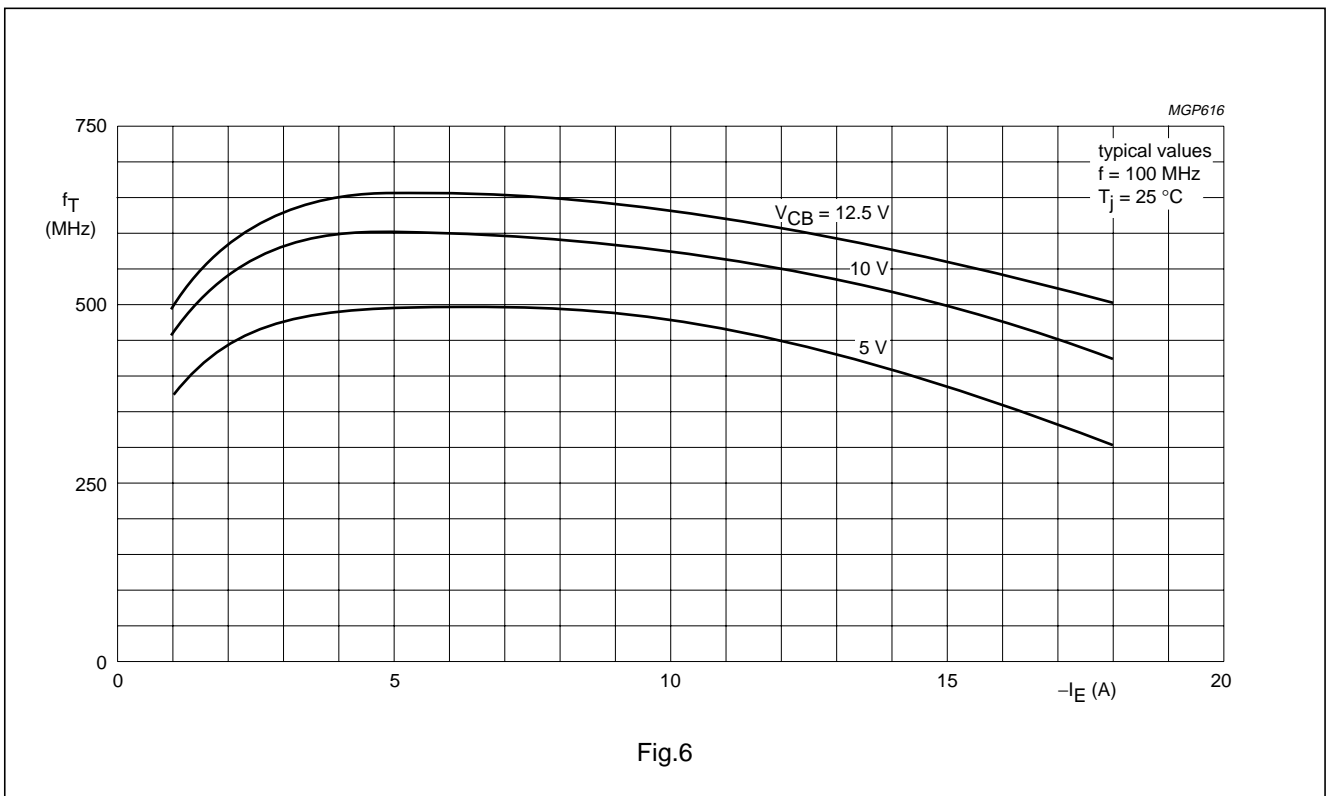
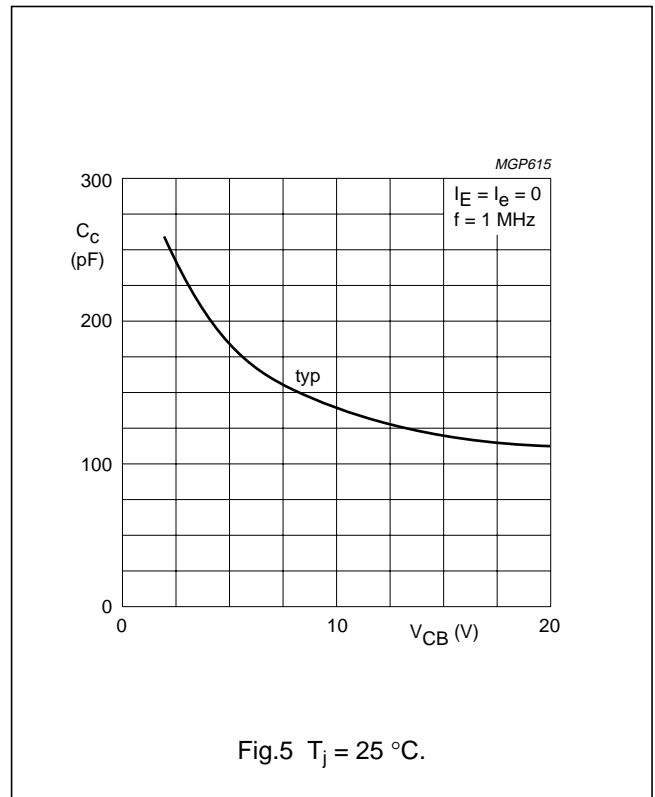
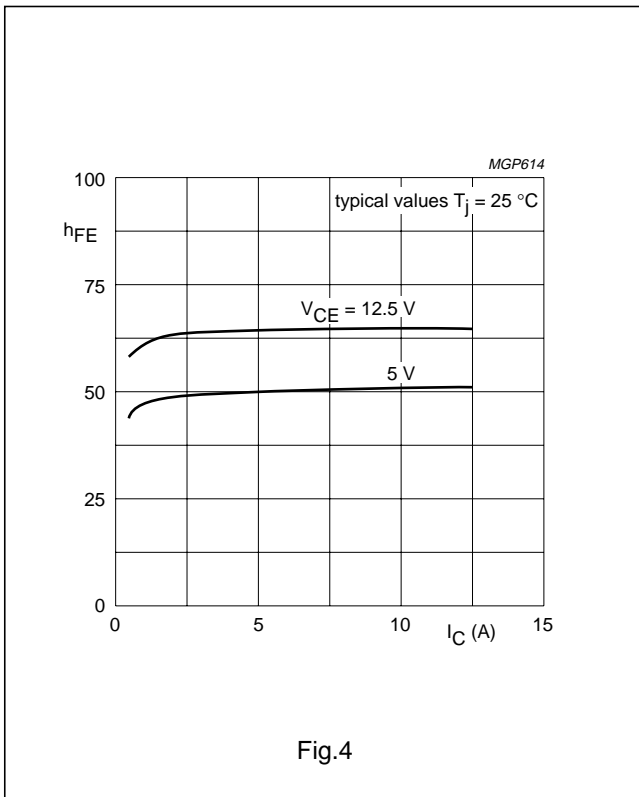
 $E_{SBO} > 8\text{ mJ}$  $R_{BE} = 10\ \Omega$  $E_{SBR} > 8\text{ mJ}$ D.C. current gain<sup>(1)</sup> $I_C = 4\text{ A}; V_{CE} = 5\text{ V}$  $h_{FE}$  typ. 50  
10 to 80D.C. current gain ratio of matched devices<sup>(1)</sup> $I_C = 4\text{ A}; V_{CE} = 5\text{ V}$  $h_{FE1}/h_{FE2} < 1,2$ Collector-emitter saturation voltage<sup>(1)</sup> $I_C = 12,5\text{ A}; I_B = 2,5\text{ A}$  $V_{CESat}$  typ. 1,5 VTransition frequency at  $f = 100\text{ MHz}$ <sup>(1)</sup> $-I_E = 4\text{ A}; V_{CB} = 12,5\text{ V}$  $f_T$  typ. 650 MHz $-I_E = 12,5\text{ A}; V_{CB} = 12,5\text{ V}$  $f_T$  typ. 600 MHzCollector capacitance at  $f = 1\text{ MHz}$  $I_E = I_e = 0; V_{CB} = 15\text{ V}$  $C_c$  typ. 120 pFFeedback capacitance at  $f = 1\text{ MHz}$  $I_C = 200\text{ mA}; V_{CE} = 15\text{ V}$  $C_{re}$  typ. 82 pF

Collector-flange capacitance

 $C_{cf}$  typ. 2 pF**Note**1. Measured under pulse conditions:  $t_p \leq 200\ \mu\text{s}; \delta \leq 0,02$ .

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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) | $P_S$ (W) | $G_p$ (dB) | $I_c$ (A) | $\eta$ (%) | $\bar{z}_i$ ( $\Omega$ ) | $\bar{Z}_L$ ( $\Omega$ ) |
|---------|--------------|-----------|-----------|------------|-----------|------------|--------------------------|--------------------------|
| 175     | 12,5         | 45        | < 16      | > 4,5      | < 4,8     | > 75       | $1,4 + j1,5$             | $2,7 - j1,3$             |
| 175     | 13,5         | 45        | –         | typ. 6,0   | –         | typ. 75    | –                        | –                        |

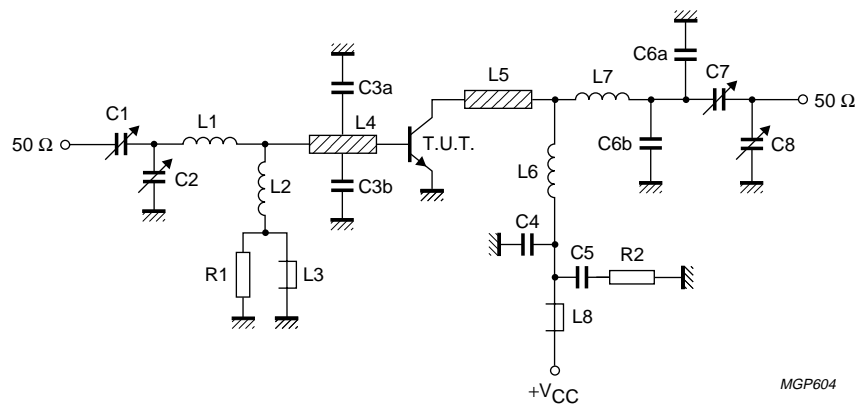


Fig.7 Test circuit; c.w. class-B.

## List of components:

- C1 = 2,5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
  - C2 = C8 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
  - C3a = C3b = 47 pF ceramic capacitor (500 V)
  - C4 = 120 pF ceramic capacitor (500 V)
  - C5 = 100 nF polyester capacitor
  - C6a = C6b = 8,2 pF ceramic capacitor (500 V)
  - C7 = 5 to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
  - L1 = 1 turn Cu wire (1,6 mm); int. dia. 9,0 mm; leads  $2 \times 5$  mm
  - L2 = 100 nH; 7 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 3 mm; leads  $2 \times 5$  mm
  - L3 = L8 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
  - L4 = L5 = strip (12 mm  $\times$  6 mm); taps for C3a and C3b at 5 mm from transistor
  - L6 = 2 turns enamelled Cu wire (1,6 mm); int. dia. 5,0 mm; length 6,0 mm; leads  $2 \times 5$  mm
  - L7 = 2 turns enamelled Cu wire (1,6 mm); int. dia. 4,5 mm; length 6,0 mm; leads  $2 \times 5$  mm
- L4 and L5 are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16".
- R1 = 10  $\Omega$  ( $\pm 10\%$ ) carbon resistor (0,25 W)
  - R2 = 4,7  $\Omega$  ( $\pm 5\%$ ) carbon resistor (0,25 W)

Component layout and printed-circuit board for 175 MHz test circuit are shown in Fig.8.

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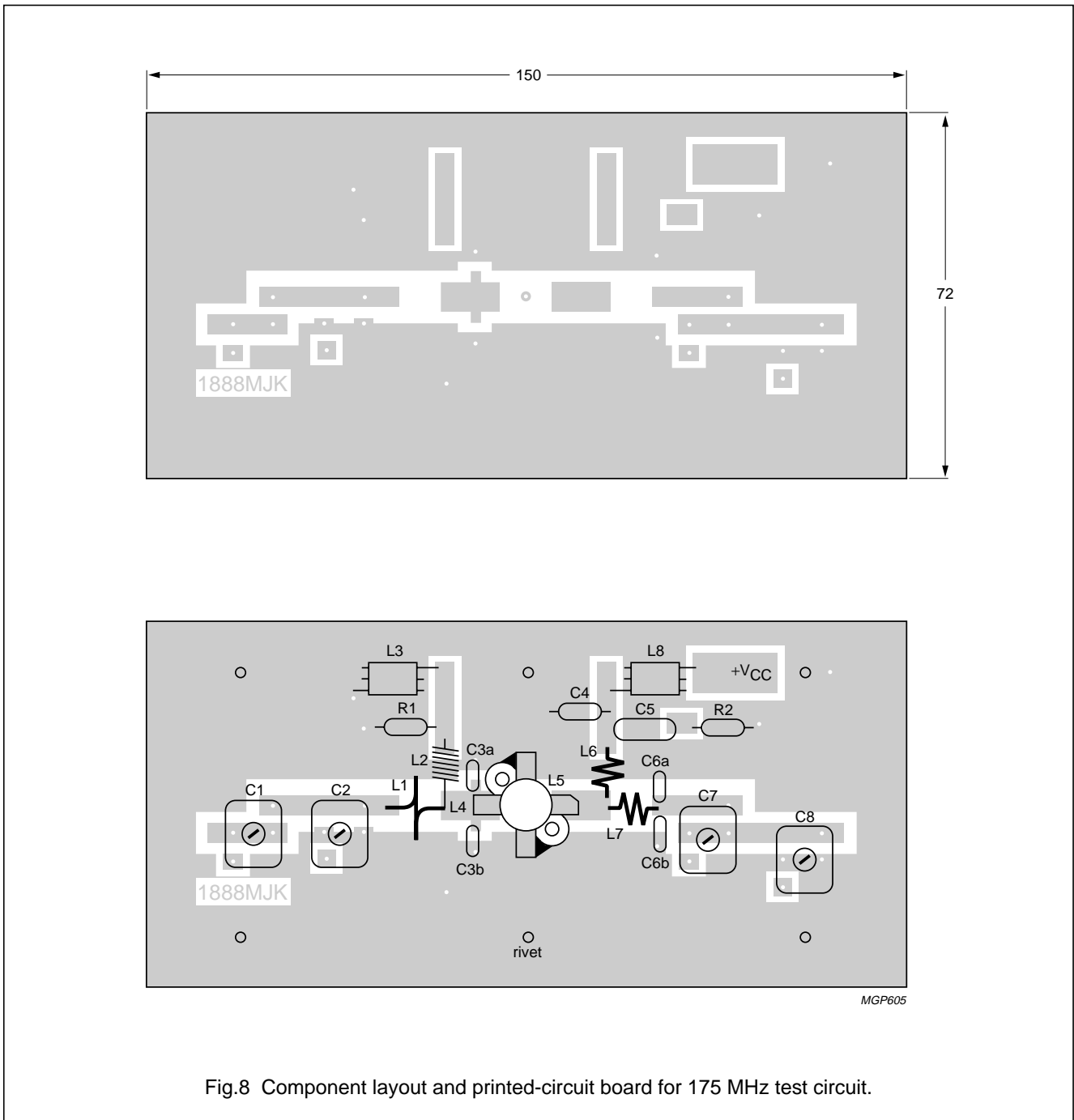


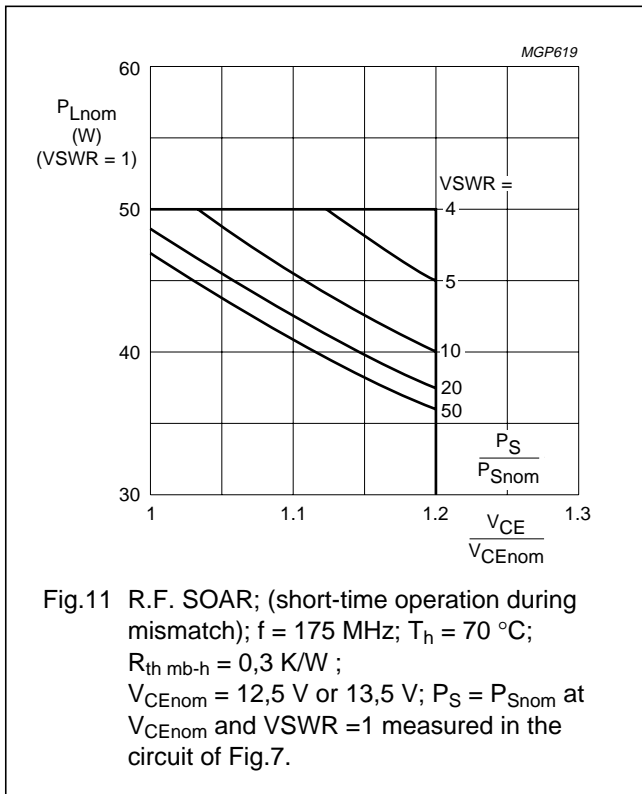
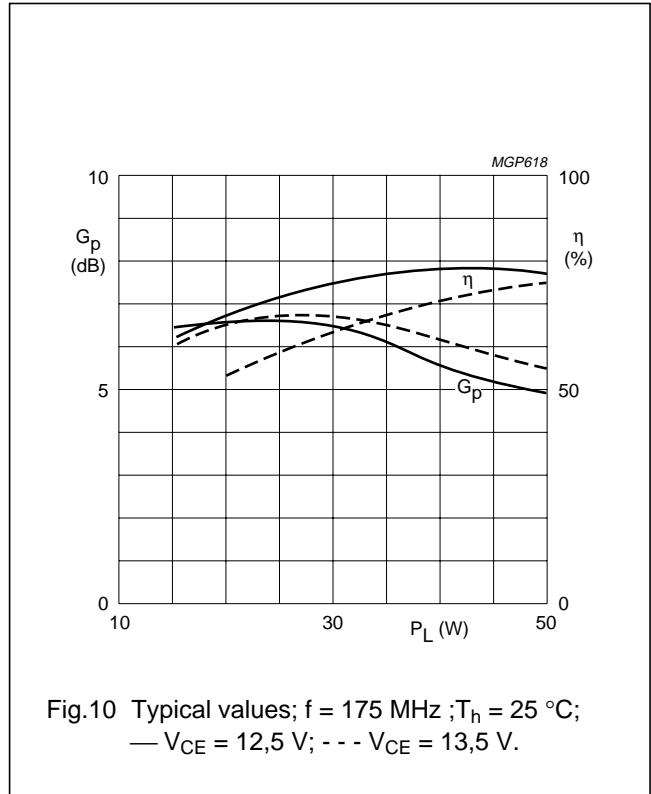
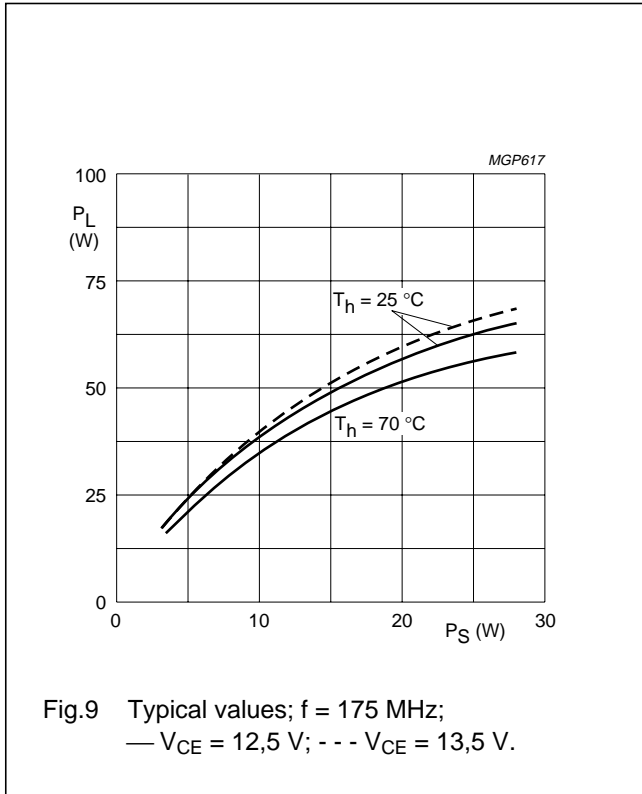
Fig.8 Component layout and printed-circuit board for 175 MHz test circuit.

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.

To minimize the dielectric losses, the ground plane under the interconnection of L7 and C7 has been removed.

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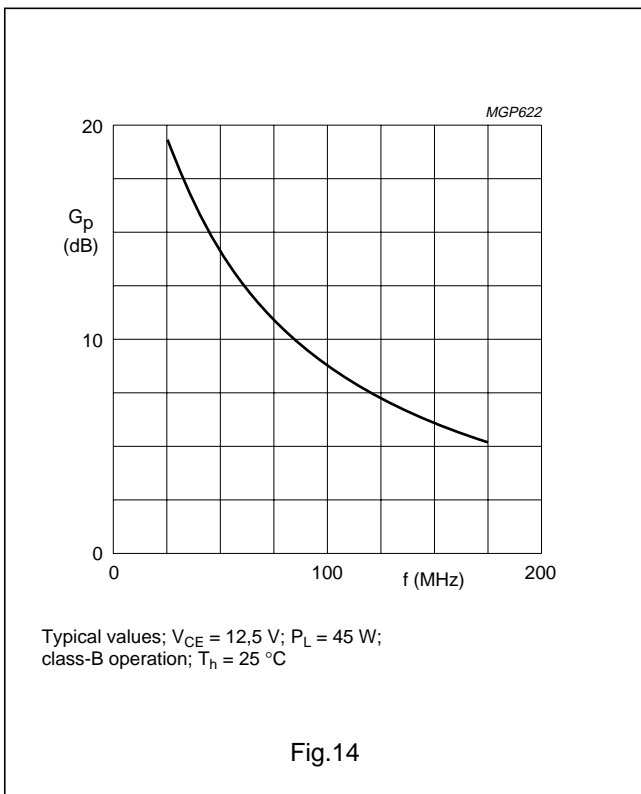
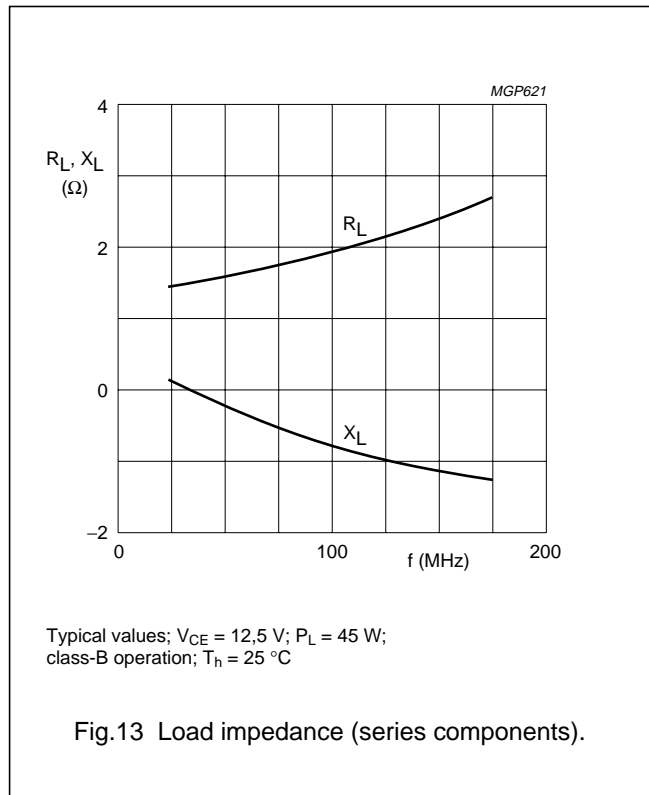
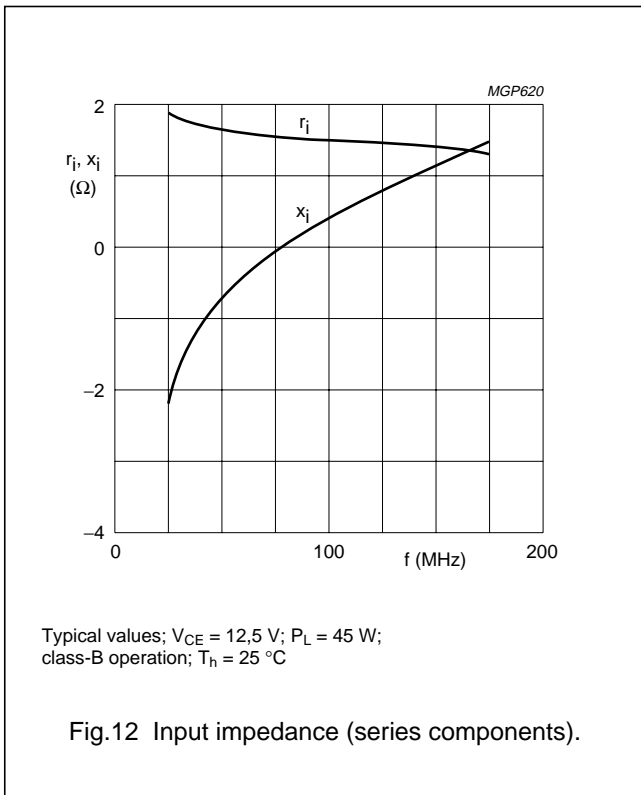
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions ( $VSWR = 1$ ), as a function of the expected supply over-voltage ratio with  $VSWR$  as parameter.

The graph applies to the situation in which the drive ( $P_S/P_{Snom}$ ) increases linearly with supply over-voltage ratio.



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R.F. performance in s.s.b. class-AB operation  
 $V_{CE} = 12,5 \text{ V}$ ;  $T_h$  up to  $25 \text{ }^\circ\text{C}$ ;  $R_{th\text{ mb-h}} \leq 0,3 \text{ K/W}$   
 $f_1 = 28,000 \text{ MHz}$ ;  $f_2 = 28,001 \text{ MHz}$

| OUTPUT POWER<br>W | $G_p$<br>dB | $\eta_{dt}$<br>% | $d_3$<br>dB <sup>(1)</sup> | $d_5$<br>dB <sup>(1)</sup> | $I_{C(zs)}$<br>mA |
|-------------------|-------------|------------------|----------------------------|----------------------------|-------------------|
| 3 to 30 (P.E.P.)  | typ. 19,5   | typ. 35          | typ. -33                   | typ. -36                   | 25                |

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.

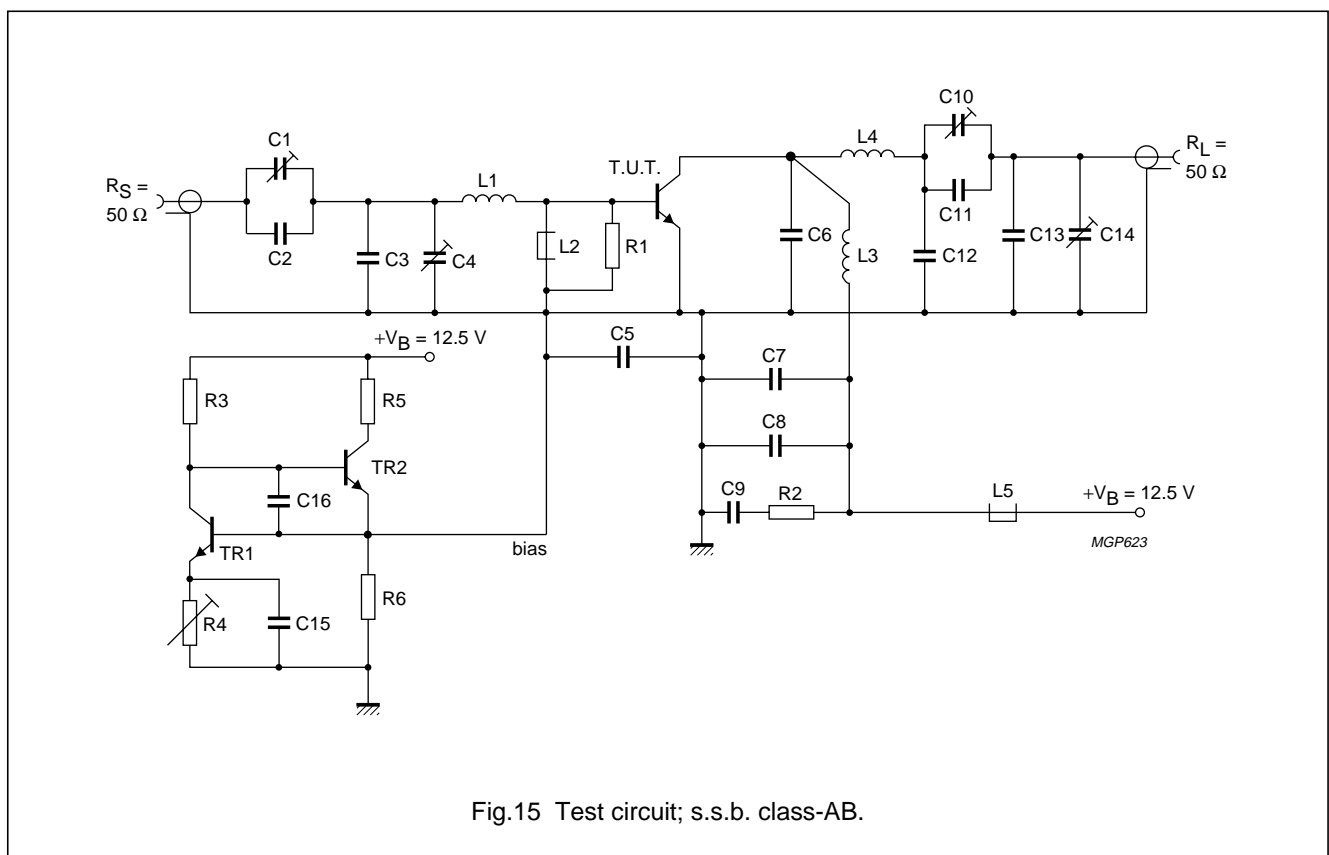


Fig.15 Test circuit; s.s.b. class-AB.

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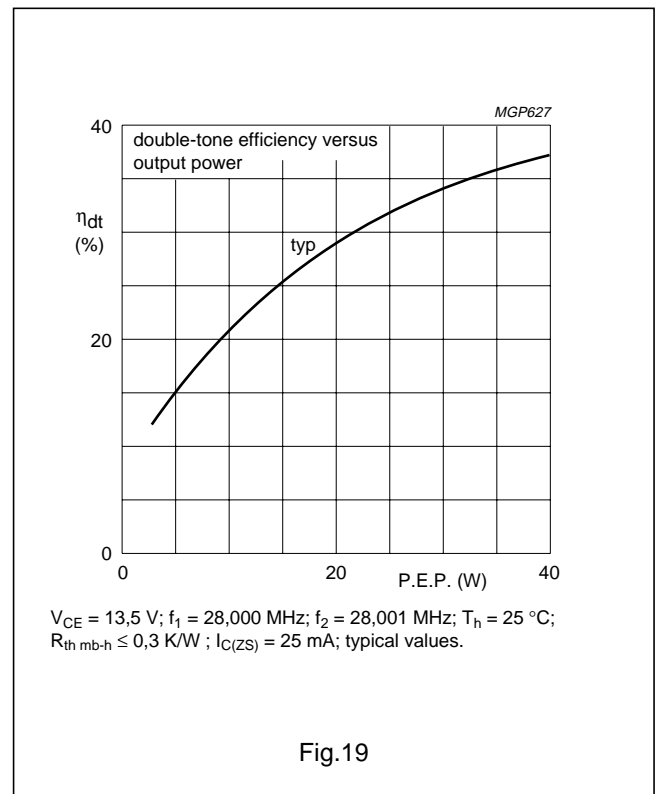
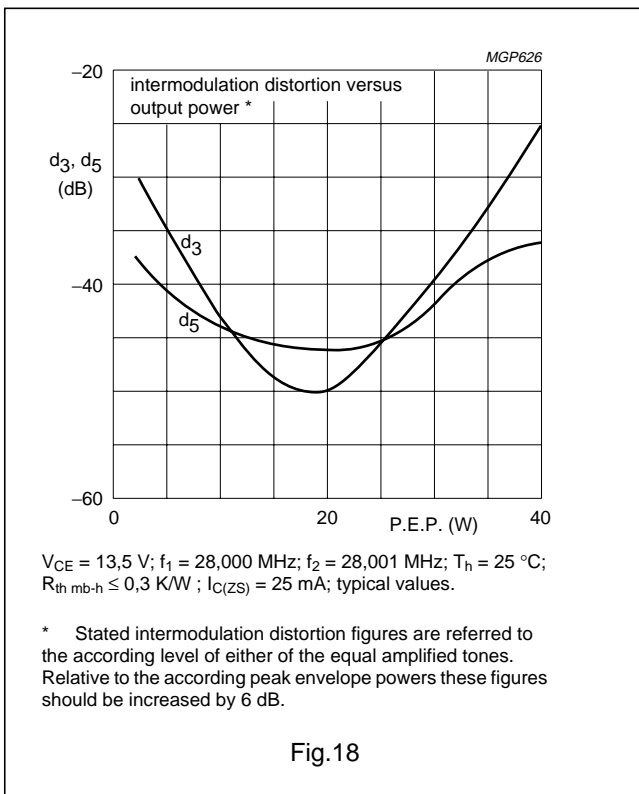
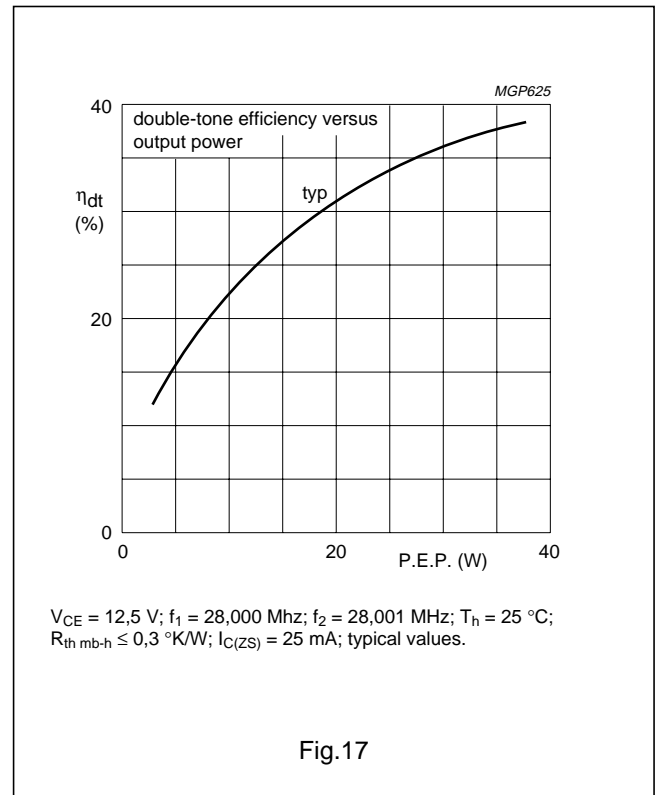
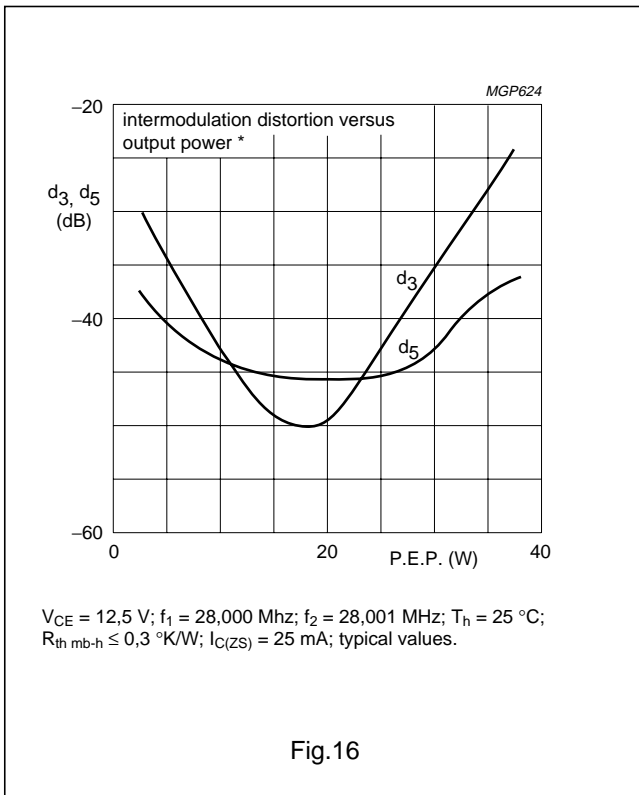
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**List of components:**

- TR1 = TR2 = BD137
- C1 = 100 pF air dielectric trimmer (single insulated rotor type)
- C2 = 27 pF ceramic capacitor (500 V)
- C3 = 180 pF polystyrene capacitor
- C4 = 100 pF air dielectric trimmer (single non-insulated rotor type)
- C5 = C7 = 3,9 nF polyester capacitor
- C6 = 2 × 270 pF polystyrene capacitors in parallel
- C8 = C15 = C16 = 100 nF polyester capacitor
- C9 = 2,2 µF moulded metallized polyester capacitor
- C10 = 2 × 385 pF (sections in parallel) film dielectric trimmer
- C11 = 68 pF ceramic capacitor (500 V)
- C12 = 2 × 82 pF ceramic capacitors in parallel (500 V)
- C13 = 47 pF ceramic capacitor (500 V)
- C14 = 385 pF film dielectric trimmer
- L1 = 88 nH; 3 turns Cu wire (1,0 mm); int. dia. 9 mm; length 6,1 mm; leads 2 × 5 mm
- L2 = L5 = Ferroxcube choke coil (cat. no. 4312 020 36640)
- L3 = 68 nH; 3 turns enamelled Cu wire (1,6 mm); int. dia. 8 mm; length 8,3 mm; leads 2 × 5 mm
- L4 = 96 nH; 3 turns enamelled Cu wire (1,6 mm); int. dia. 10 mm; length 7,6 mm; leads 2 × 5 mm
- R1 = 27 Ω (±5%) carbon resistor (0,5 W)
- R2 = 4,7 Ω (±5%) carbon resistor (0,25 W)
- R3 = 1,5 kΩ (±5%) carbon resistor (0,5 W)
- R4 = 10 Ω wirewound potentiometer (3 W)
- R5 = 47 Ω wirewound resistor (5,5 W)
- R6 = 150 Ω (±5%) carbon resistor (0,25 W)

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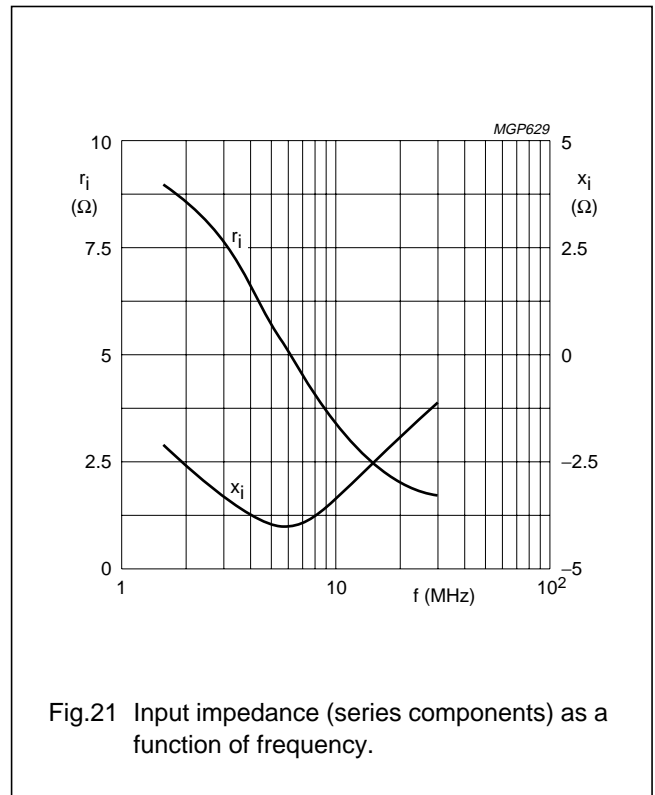
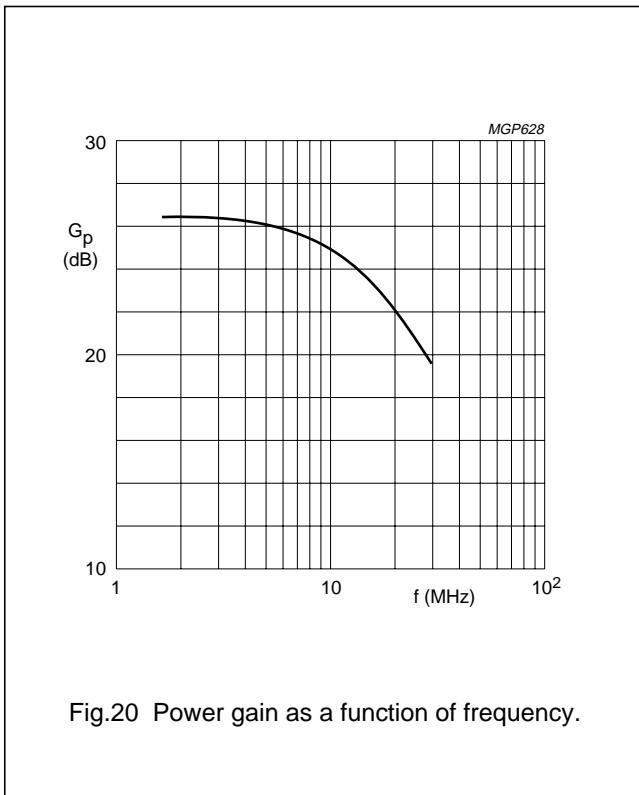


Fig. 20 and 21 are typical curves and hold for an unneutralized amplifier in s.s.b. class-AB operation.

Conditions:

- $V_{CE} = 12,5 \text{ V}$
- $P_L = 30 \text{ W (P.E.P.)}$
- $T_h = 25 \text{ }^\circ\text{C}$
- $R_{th \text{ mb-h}} \leq 0,3 \text{ K/W}$
- $I_{C(ZS)} = 25 \text{ mA}$
- $Z_L = 1,8 \text{ } \Omega$

- $V_{CE} = 13,5 \text{ V}$
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- $T_h = 25 \text{ }^\circ\text{C}$
- $R_{th \text{ mb-h}} \leq 0,3 \text{ K/W}$
- $I_{C(ZS)} = 25 \text{ mA}$
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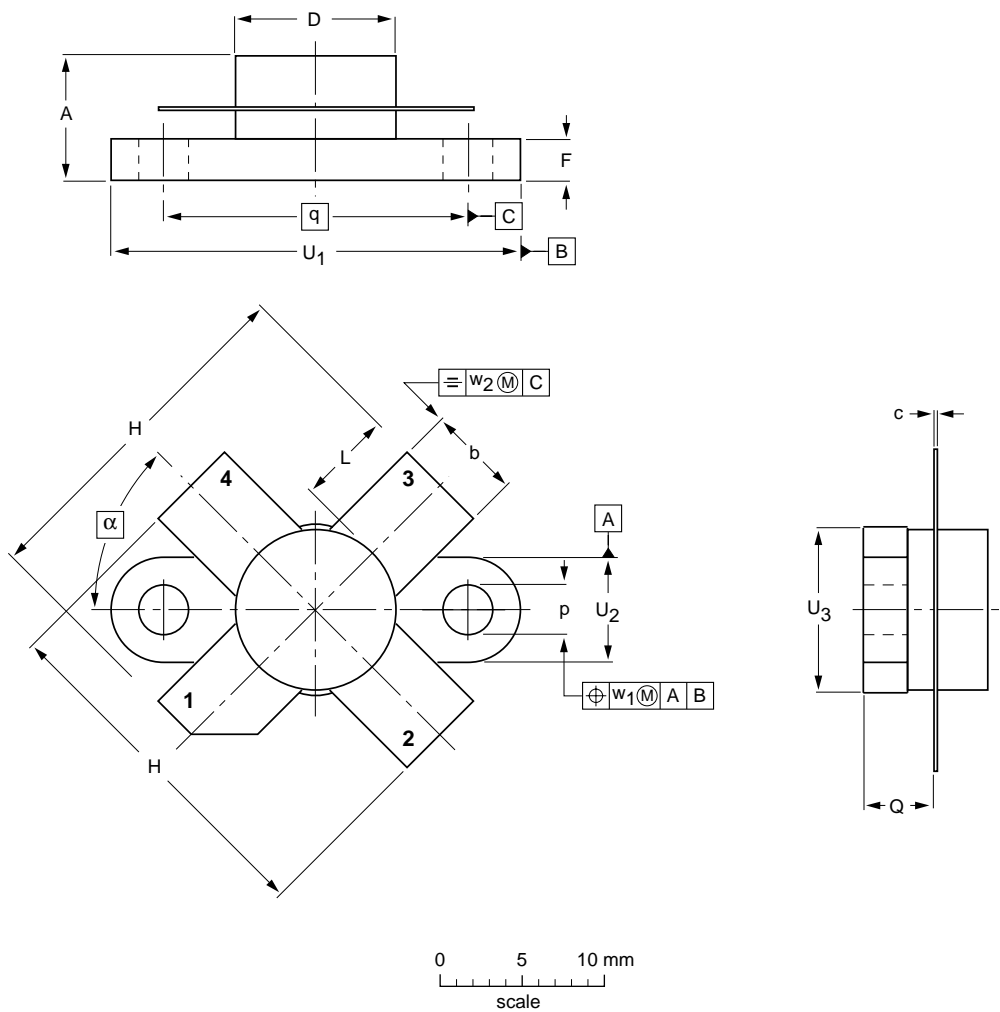
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PACKAGE OUTLINE

Flanged ceramic package; 2 mounting holes; 4 leads

SOT123A



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> | α   |
|--------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------|----------------|----------------|----------------|----------------|----------------|-----|
| mm     | 7.47<br>6.37   | 5.82<br>5.56   | 0.18<br>0.10   | 9.73<br>9.47   | 9.63<br>9.42   | 2.72<br>2.31   | 20.71<br>19.93 | 5.61<br>5.16   | 3.33<br>3.04   | 4.63<br>4.11   | 18.42 | 25.15<br>24.38 | 6.61<br>6.09   | 9.78<br>9.39   | 0.51           | 1.02           | 45° |
| inches | 0.294<br>0.251 | 0.229<br>0.219 | 0.007<br>0.004 | 0.383<br>0.373 | 0.397<br>0.371 | 0.107<br>0.091 | 0.815<br>0.785 | 0.221<br>0.203 | 0.131<br>0.120 | 0.182<br>0.162 | 0.725 | 0.99<br>0.96   | 0.26<br>0.24   | 0.385<br>0.370 | 0.02           | 0.04           |     |

| OUTLINE VERSION | REFERENCES |       |      |  | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|-------|------|--|---------------------|------------|
|                 | IEC        | JEDEC | EIAJ |  |                     |            |
| SOT123A         |            |       |      |  |                     | 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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