

DATA SHEET

LFE18500X

**NPN silicon planar epitaxial
microwave power transistor**

Product specification
File under Discrete Semiconductors, SC15

December 1994

Philips Semiconductors



PHILIPS

NPN silicon planar epitaxial microwave power transistor

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FEATURES

- Diffused emitter ballasting resistors providing excellent current sharing and withstanding a high VSWR
- Interdigitated structure provides high emitter efficiency
- Gold metallization realizes very good stability of the characteristics and excellent lifetime
- Multicell geometry gives good balance of dissipated power and low thermal resistance
- Internal input and output prematching ensures good stability and allows an easier design of wideband circuits.

APPLICATION

Intended for use in common emitter, class AB amplifiers in CW conditions for professional applications between 1.8 GHz and 1.9 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-231 glued cap metal ceramic flange package, with emitter connected to flange.

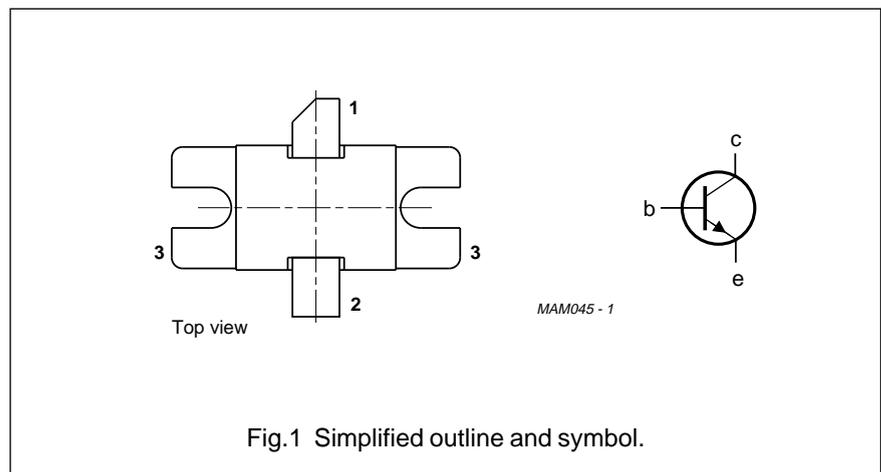
QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a common emitter class AB amplifier.

| MODE OF OPERATION | f (GHz) | V _{CE} (V) | I _{CQ} (A) | P _{L1} (W) | G _{po} (dB) | η _c (%) | Z _i ; Z _L (Ω) |
|-------------------|---------|---------------------|---------------------|---------------------|----------------------|--------------------|-------------------------------------|
| Class AB (CW) | 1.85 | 24 | 0.2 | ≥48 | ≥7 | typ. 42 | see Figs 7 and 8 |

PINNING - FO-231

| PIN | DESCRIPTION |
|-----|-----------------------------|
| 1 | collector |
| 2 | base |
| 3 | emitter connected to flange |



WARNING

Product and environmental safety - toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO slab is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with the general or domestic waste.

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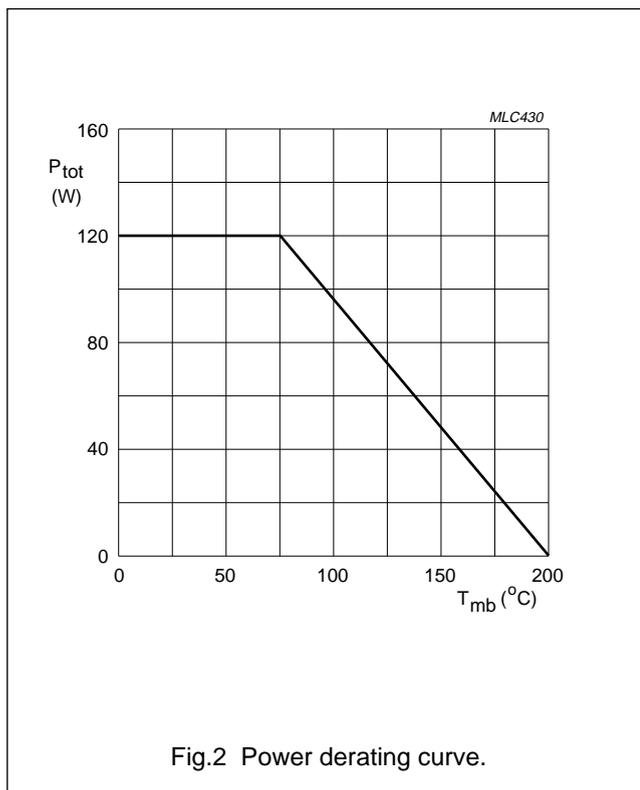
LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|-----------|---------------------------|---|------|------|------------------|
| V_{CBO} | collector-base voltage | open emitter | – | 45 | V |
| V_{CER} | collector-emitter voltage | $R_{BE} = 220 \Omega$ | – | 30 | V |
| V_{CEO} | collector-emitter voltage | open base | – | 22 | V |
| V_{EBO} | emitter-base voltage | open collector | – | 3 | V |
| I_C | DC collector current | | – | 12 | A |
| P_i | input power | $f = 1.85 \text{ GHz}; V_{CE} = 24 \text{ V}; \text{ class AB}$ | – | 20 | W |
| P_{tot} | total power dissipation | $T_{mb} = 75 \text{ }^\circ\text{C}$ | – | 120 | W |
| T_{stg} | storage temperature | | –65 | +200 | $^\circ\text{C}$ |
| T_j | junction temperature | | – | 200 | $^\circ\text{C}$ |
| T_{sld} | soldering temperature | $t \leq 10 \text{ s}; \text{ note 1}$ | – | 235 | $^\circ\text{C}$ |

Note

- Up to 0.2 mm from ceramic.



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THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | MAX. | UNIT |
|----------------|---|-----------------------|------|------|
| $R_{th\ j-mb}$ | thermal resistance from junction to mounting base | $T_j = 100\text{ °C}$ | 1 | K/W |
| $R_{th\ mb-h}$ | thermal resistance from mounting base to heatsink | | 0.2 | K/W |

CHARACTERISTICS

$T_{mb} = 25\text{ °C}$ unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---------------|-------------------------------------|---|------|------|------|
| I_{CBO} | collector cut-off current | $I_E = 0; V_{CB} = 20\text{ V}$ | – | 6 | mA |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage | $I_C = 30\text{ mA}; R_{BE} = 56\ \Omega$ | 30 | – | V |
| $V_{(BR)CBO}$ | collector-base breakdown voltage | $I_C = 30\text{ mA}$ | 45 | – | V |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage | $I_E = 30\text{ mA}$ | 3 | – | V |
| h_{FE} | DC current gain | $I_C = 1\text{ A}; V_{CE} = 5\text{ V}$ | 15 | 100 | |

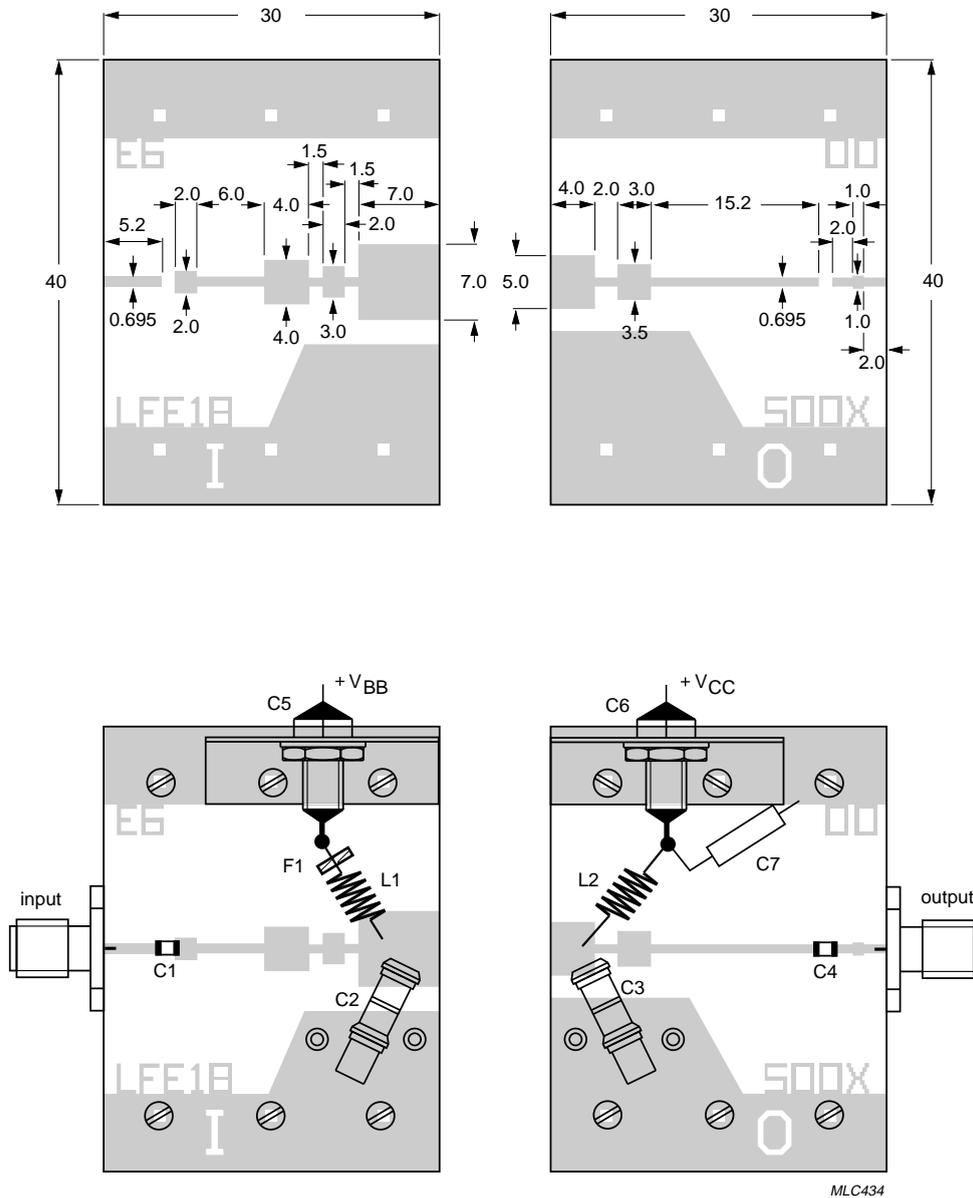
APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ °C}$ in a common emitter class AB amplifier.

| MODE OF OPERATION | f (GHz) | V_{CE} (V) | I_{CQ} (A) | P_{L1} (W) | G_{po} (dB) | η_c (%) | $Z_i; Z_L$ (Ω) |
|-------------------|---------|--------------|--------------|----------------------|----------------------|--------------|-------------------------|
| Class AB (CW) | 1.85 | 24 | 0.2 | ≥ 48 typ. 53 | ≥ 7 typ. 7.5 | typ. 42 | see Figs 7 and 8 |

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The test circuit is split into two independent halves, each being 30 x 40 mm in size.
 Dimensions in mm.
 Substrate: Epsilam 10.
 Thickness: 0.635 mm.
 Permittivity: $\epsilon_r = 10$.

Fig.3 Prematching test circuit board.

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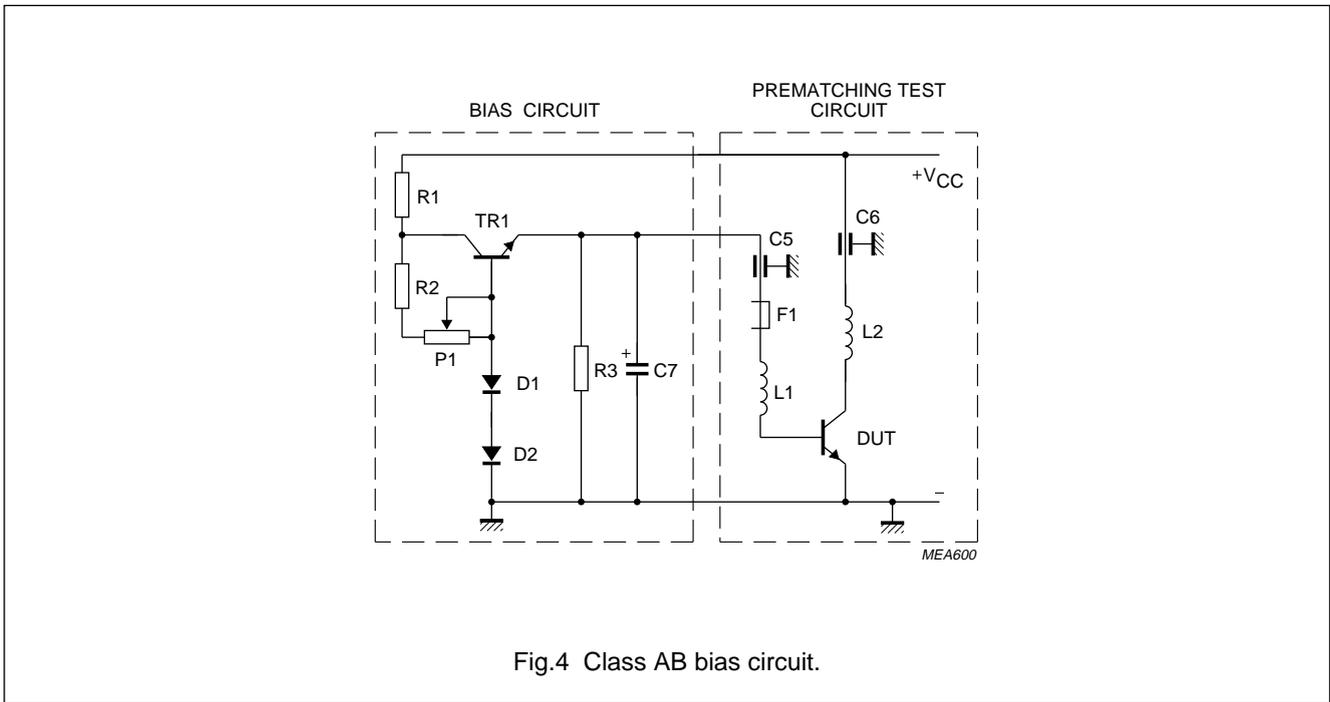


Fig.4 Class AB bias circuit.

List of components (see Figs 3 and 4)

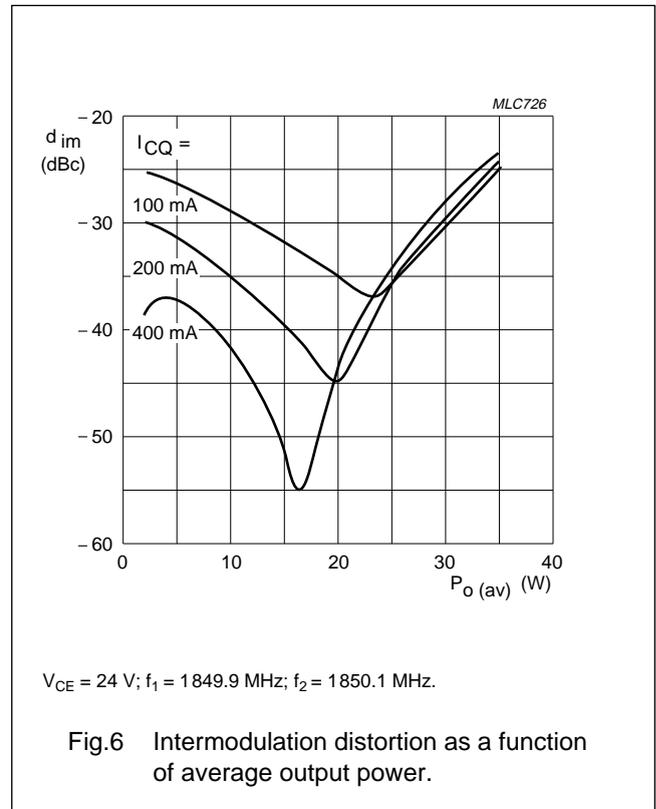
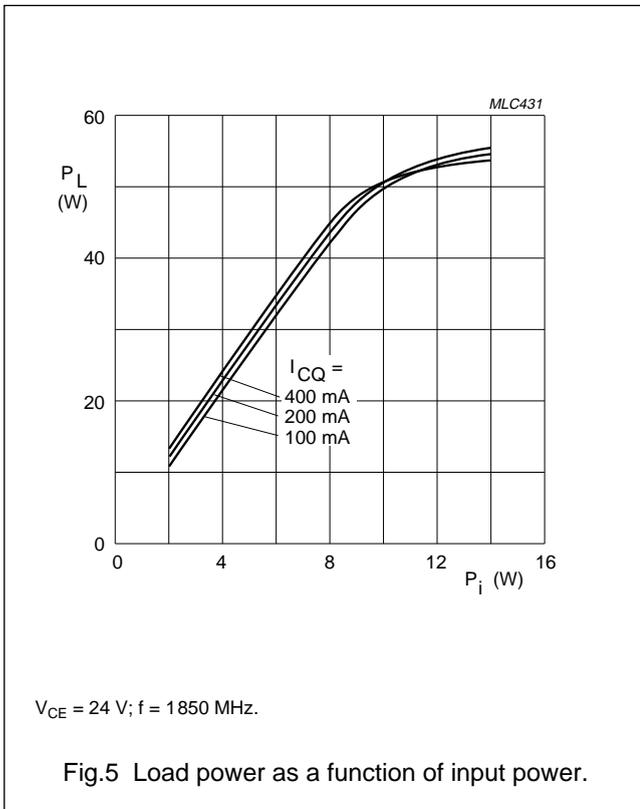
| COMPONENT | DESCRIPTION | VALUE | ORDERING INFORMATION |
|-----------|---|------------------------|---|
| TR1 | transistor, BDT91 or equivalent | | |
| C1, C4 | DC blocking chip capacitor | 100 pF | ATC 100A101kp |
| C2, C3 | trimmer capacitor | 0.5 to 5.0 pF | Tekelec 727-1 |
| C5, C6 | feedthrough bypass capacitor | 1500 pF | Erie 1250-003 |
| C7 | electrolytic capacitor | 10 μ F, 50 V | |
| D1 | diode BY239 or equivalent; note 1 | | |
| D2 | diode BY239 or equivalent; note 2 | | |
| L1 | 4 turns 0.5 mm copper wire; internal diameter = 2 mm | | |
| L2 | 3 turns 0.5 mm copper wire; internal diameter = 2 mm | | |
| P1 | linear potentiometer | 4.7 k Ω | |
| R1 | resistor | 100 Ω , 0.25 W | |
| R2 | resistor | 10 k Ω , 0.25 W | |
| R3 | resistor | 56 Ω , 0.25 W | |
| F1 | ferrite bead | | Philips tube, 12NC = 4330 030 43081 4.2 x 2.2 x 3.2 mm (4B1) |

Notes

1. In thermal contact with TR1.
2. In thermal contact with DUT.

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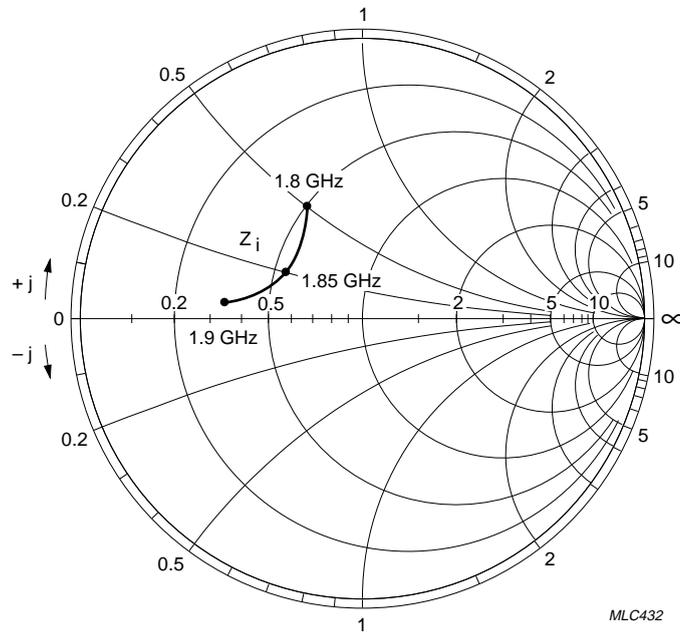
Input and optimum load impedances

$V_{CE} = 24\text{ V}; I_{CQ} = 0.2\text{ A}; Z_o = 10\ \Omega;$ typical values at $P_L = P_{L1}$ (see Figs 7 and 8).

| f (GHz) | Z_i (Ω) | Z_L (Ω) |
|---------|--------------------|--------------------|
| 1.80 | $5.0 + j4.9$ | $2.0 - j2.0$ |
| 1.85 | $5.5 + j2.0$ | $1.8 - j1.2$ |
| 1.90 | $3.7 + j0.6$ | $1.6 - j1.6$ |

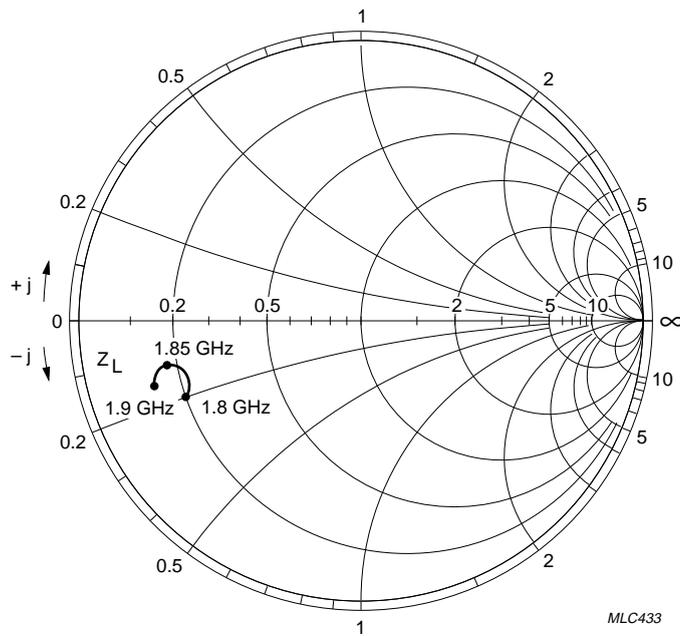
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$V_{CE} = 24 \text{ V}; Z_0 = 10 \ \Omega; I_{CQ} = 0.2 \text{ A}.$

Fig.7 Input impedance as a function of frequency; typical values at $P_L = P_{L1}$.



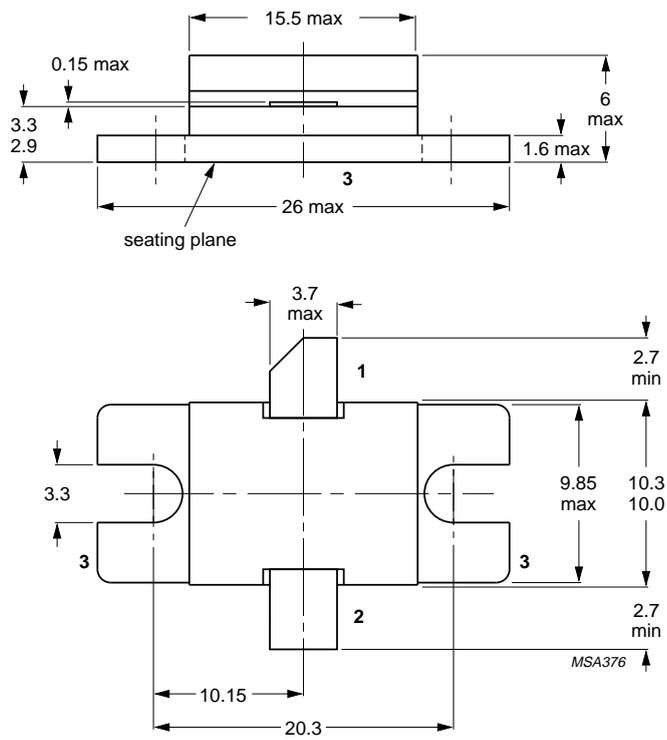
$V_{CE} = 24 \text{ V}; Z_0 = 10 \ \Omega; I_{CQ} = 0.2 \text{ A}.$

Fig.8 Optimum load impedance as a function of frequency; typical values at $P_L = P_{L1}$.

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PACKAGE OUTLINE



Dimensions in mm.
Torque on screws: max. 0.5 Nm.
Recommended screw: M3.

Fig.9 FO-231.

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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. | |

LIFE SUPPORT APPLICATIONS

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