

DATA SHEET

BLV33F VHF linear power transistor

Product specification

1996 Oct 10

VHF linear power transistor

BLV33F

FEATURES

- Internally matched input for wideband operation and high power gain
- Diffused emitter ballasting resistors for an optimum temperature profile
- Gold metallization ensures excellent reliability.

APPLICATIONS

- Primarily intended for use in linear VHF amplifiers for television transmitters and transposers.

DESCRIPTION

NPN silicon planar epitaxial transistor encapsulated in a 1/2" 6 lead SOT119A capstan package with ceramic cap. All leads are isolated from the flange.

PINNING - SOT119A

| PIN | SYMBOL | DESCRIPTION |
|-----|--------|-------------|
| 1 | e | emitter |
| 2 | e | emitter |
| 3 | b | base |
| 4 | c | collector |
| 5 | e | emitter |
| 6 | e | emitter |

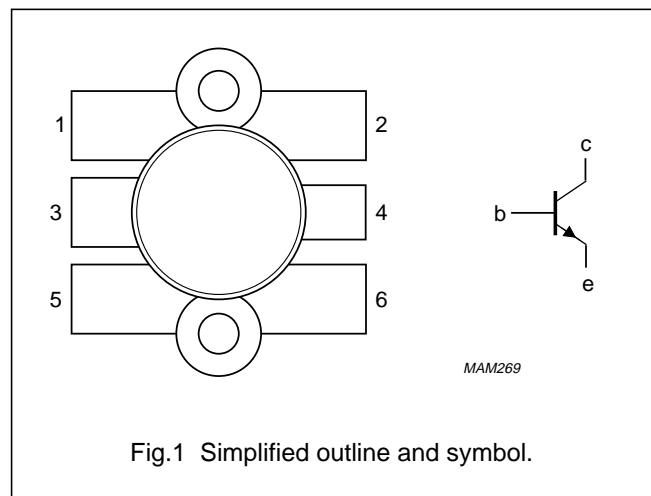


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

RF performance in a common emitter push-pull test circuit.

| MODE OF OPERATION | f _{vision} (MHz) | V _{CE} (V) | I _C , I _{C(ZS)} (A) | T _h (°C) | d _{im} ⁽¹⁾ (dB) | P _{o sync} ⁽¹⁾ (W) | G _P (dB) | sync compr. ⁽²⁾ sync in/sync out (%) |
|-------------------|---------------------------|---------------------|---|---------------------|-------------------------------------|--|---------------------|---|
| CW, class-A | 224.25 | 25 | 3.2 | 70 | -55 | >13 | >13.5 | |
| | | | | 25 | -55 | typ. 19 | typ. 14.8 | |
| CW, class-AB | 224.25 | 28 | 0.2 | 70 | - | typ. 85 | typ. 10.5 | 30/25 |

Notes

1. Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.
2. Television service (negative modulation, C.C.I.R. system).

| WARNING |
|--|
| Product and environmental safety - toxic materials |
| This product contains beryllium oxide. The product is entirely safe provided that the BeO disc 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. |

VHF linear power transistor

BLV33F

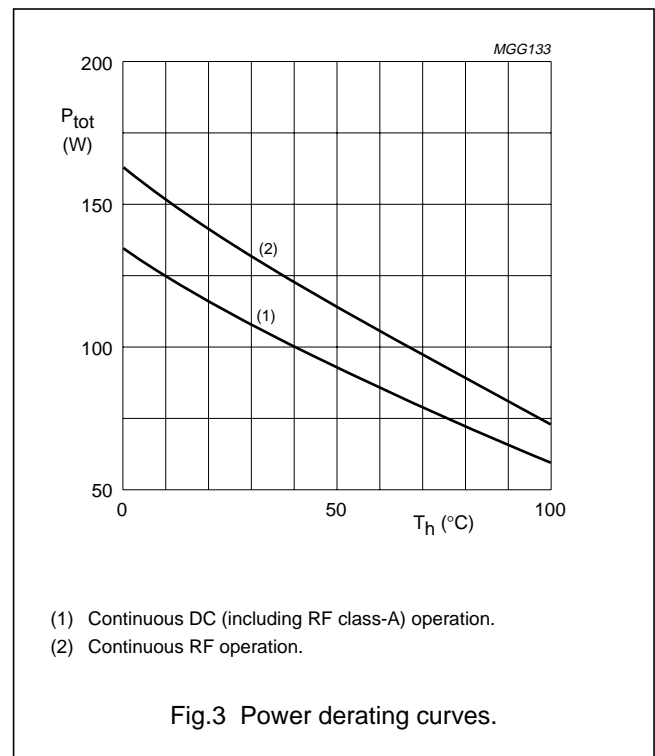
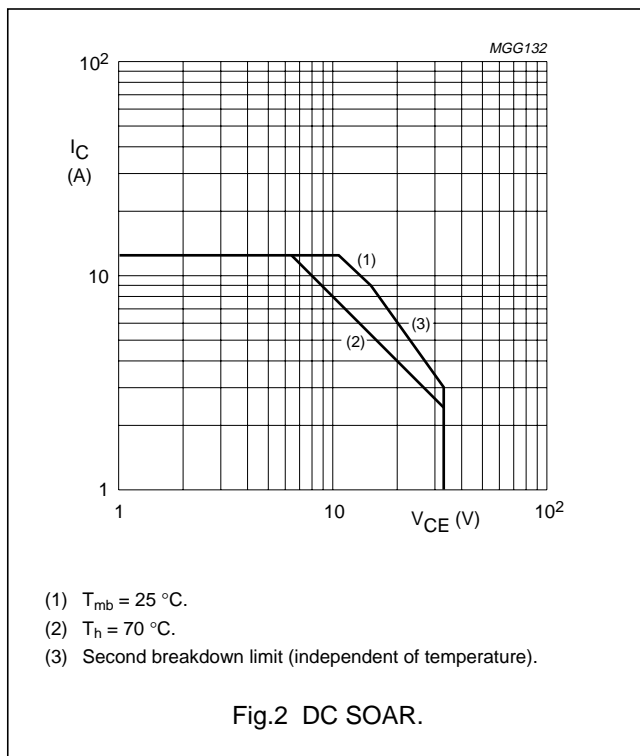
LIMITING VALUES

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

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|-------------|--------------------------------|---|------|------|------------------|
| V_{CESM} | collector-emitter voltage | $V_{BE} = 0$ | – | 65 | V |
| V_{CEO} | collector-emitter voltage | open base | – | 33 | V |
| V_{EBO} | emitter-base voltage | open collector | – | 4 | V |
| I_C | collector current (DC) | | – | 12.5 | A |
| $I_{C(AV)}$ | average collector current | | – | 12.5 | A |
| I_{CM} | peak collector current | $f > 1 \text{ MHz}$ | – | 20 | A |
| P_{tot} | total power dissipation (DC) | $T_{mb} = 25 \text{ }^\circ\text{C}$ | – | 133 | W |
| P_{rf} | RF power dissipation | $f > 1 \text{ MHz}; T_{mb} = 25 \text{ }^\circ\text{C}$ | – | 162 | W |
| T_{stg} | storage temperature | | –65 | +150 | $^\circ\text{C}$ |
| T_j | operating junction temperature | | – | 200 | $^\circ\text{C}$ |

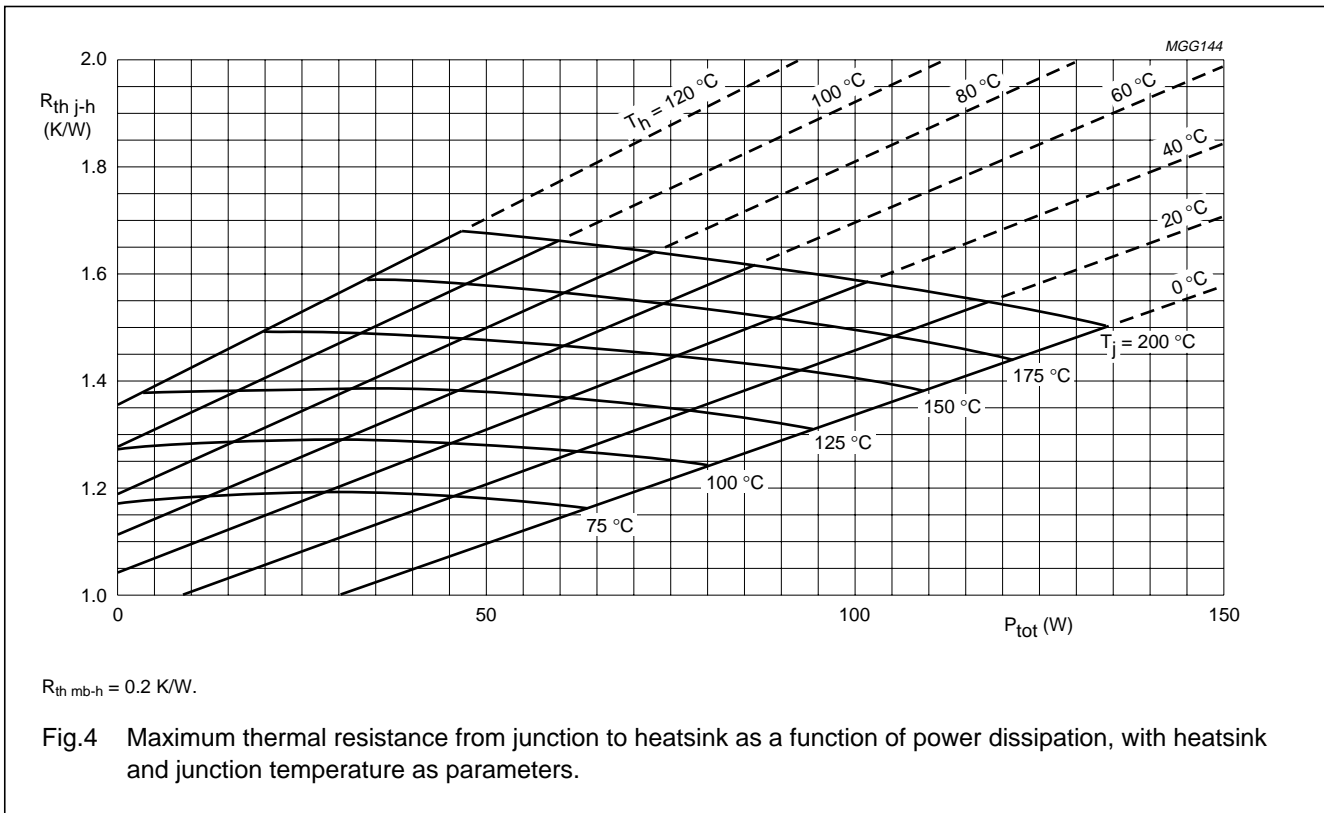
THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---------------------------|--|--|-------|------|
| $R_{th \text{ j-mb}(dc)}$ | thermal resistance from junction to mounting base (DC dissipation) | $P_{diss} = 80 \text{ W}; T_{mb} = 82 \text{ }^\circ\text{C}; T_h = 70 \text{ }^\circ\text{C}$ | 1.43 | K/W |
| $R_{th \text{ j-mb}(rf)}$ | thermal resistance from junction to mounting base (RF dissipation) | $P_{diss} = 80 \text{ W}; T_{mb} = 82 \text{ }^\circ\text{C}; T_h = 70 \text{ }^\circ\text{C}$ | 1.17 | K/W |
| $R_{th \text{ mb-h}}$ | thermal resistance from mounting base to heatsink | $P_{diss} = 80 \text{ W}; T_{mb} = 82 \text{ }^\circ\text{C}; T_h = 70 \text{ }^\circ\text{C}$ | 0.2 | K/W |



VHF linear power transistor

BLV33F



Example

Nominal class-A operation (without RF signal): $V_{CE} = 25\ V$; $I_C = 3.2\ A$; $T_h = 70\ ^\circ C$.

Figure 4 shows:

$R_{th\ j-h} = \text{max. } 1.63\ K/W$

$T_j = \text{max. } 200\ ^\circ C$.

Typical device:

$R_{th\ j-h} = \text{typ. } 1.53\ K/W$

$T_j = \text{typ. } 192\ ^\circ C$.

VHF linear power transistor

BLV33F

CHARACTERISTICS

$T_j = 25\text{ °C}$; unless otherwise specified.

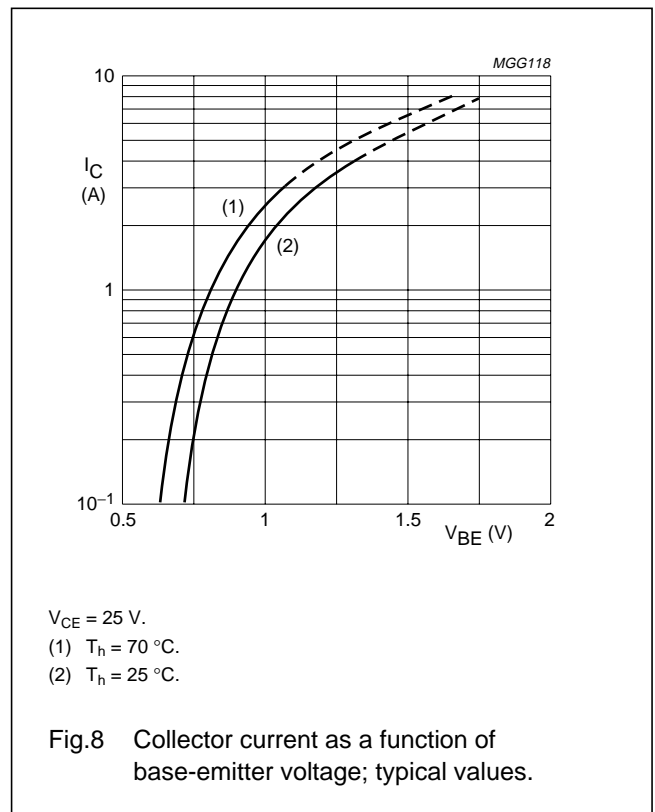
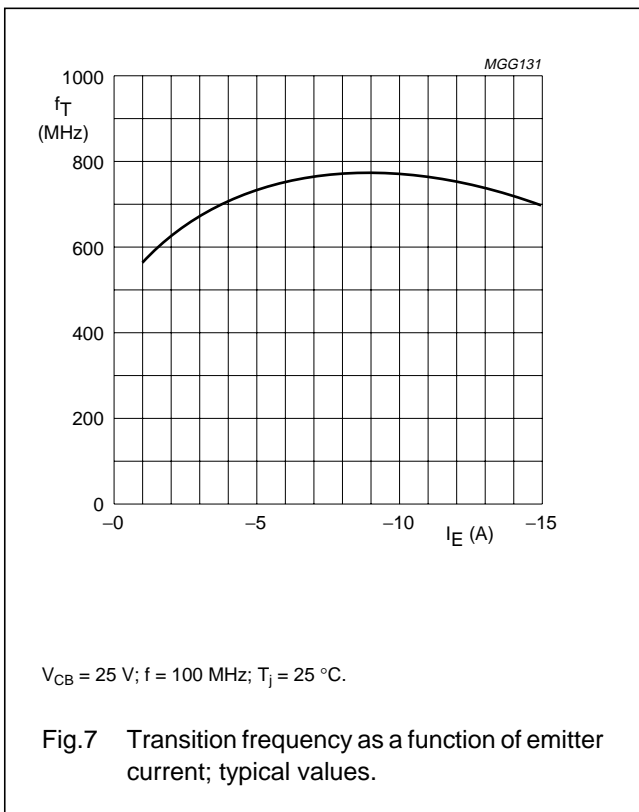
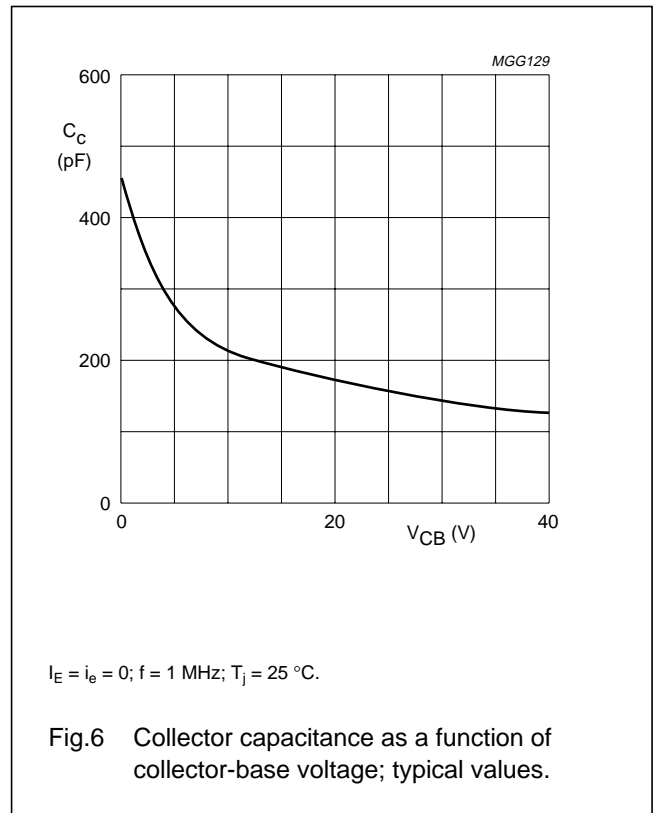
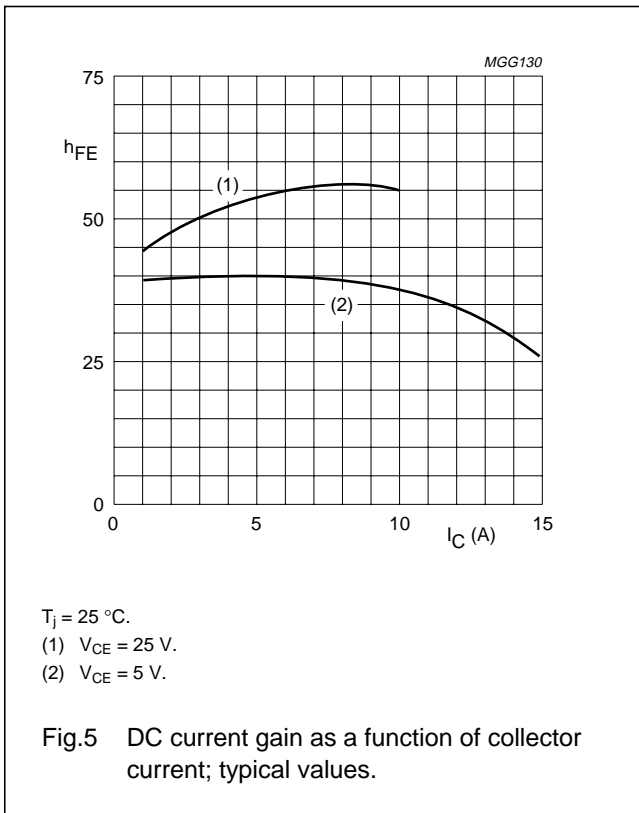
| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---------------|--------------------------------------|---|------|------|------|------|
| $V_{(BR)CES}$ | collector-emitter breakdown voltage | $V_{BE} = 0$; $I_C = 25\text{ mA}$ | 65 | – | – | V |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage | open base; $I_C = 100\text{ mA}$ | 33 | – | – | V |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage | open collector; $I_E = 10\text{ mA}$ | 4 | – | – | V |
| I_{CES} | collector cut-off current | $V_{BE} = 0$; $V_{CE} = 30\text{ V}$ | – | – | 1 | mA |
| h_{FE} | DC current gain | $V_{CE} = 25\text{ V}$; $I_C = 3\text{ A}$; note 1 | 15 | 50 | 100 | |
| V_{CEsat} | collector-emitter saturation voltage | $I_C = 6\text{ A}$; $I_B = 0.6\text{ A}$; note 1 | – | 0.75 | – | V |
| f_T | transition frequency | $V_{CB} = 25\text{ V}$; $I_E = -3\text{ A}$; $f = 100\text{ MHz}$; note 2 | – | 680 | – | MHz |
| | | $V_{CB} = 25\text{ V}$; $I_E = -6\text{ A}$; $f = 100\text{ MHz}$; note 2 | – | 750 | – | MHz |
| C_C | collector capacitance | $V_{CB} = 25\text{ V}$; $I_E = i_e = 0$; $f = 1\text{ MHz}$ | – | 155 | – | pF |
| C_{re} | feedback capacitance | $I_C = 50\text{ mA}$; $V_{CE} = 25\text{ V}$; $f = 1\text{ MHz}$ | – | 88 | – | pF |
| C_{cf} | collector-flange capacitance | | – | 3 | – | pF |

Notes

1. Measured under pulse conditions: $t_p \leq 300\text{ }\mu\text{s}$; $\delta \leq 0.02$.
2. Measured under pulse conditions: $t_p \leq 50\text{ }\mu\text{s}$; $\delta \leq 0.01$.

VHF linear power transistor

BLV33F



VHF linear power transistor

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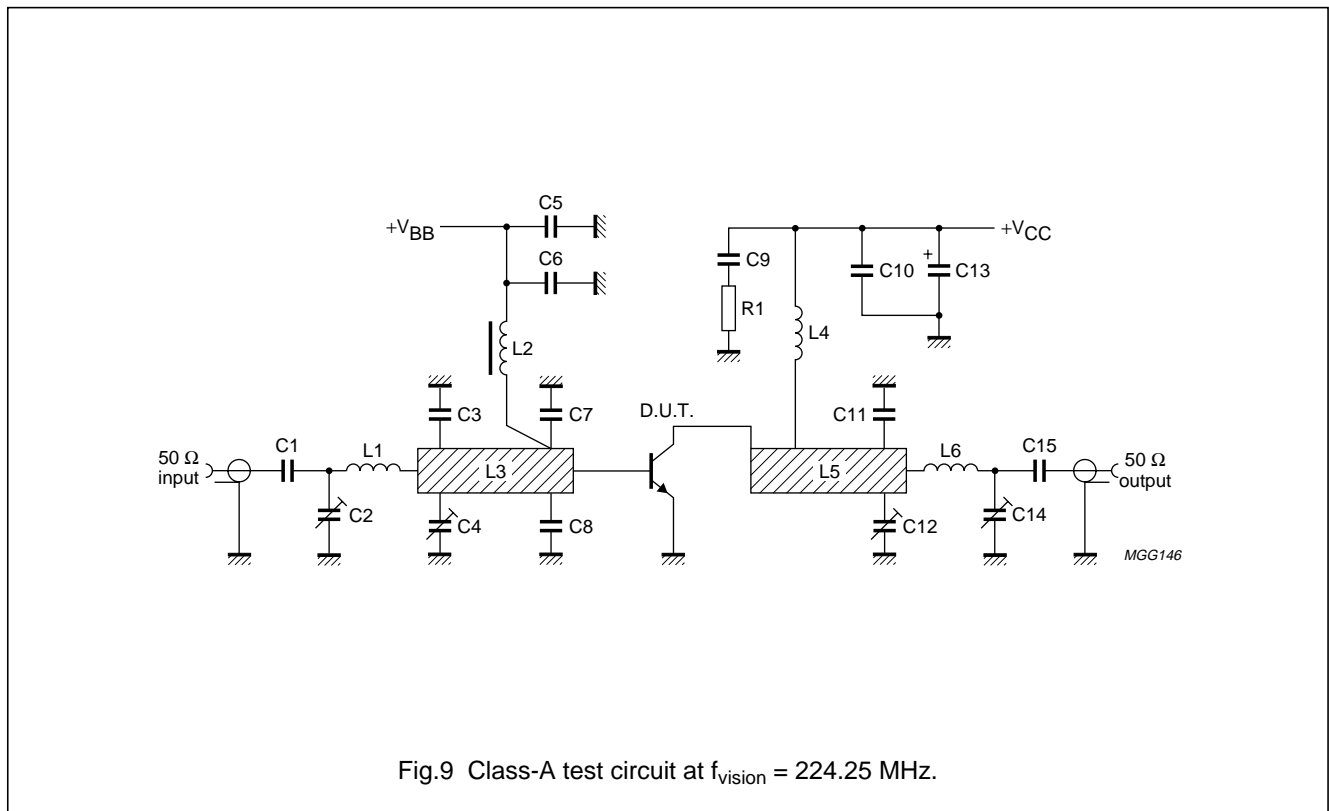
APPLICATION INFORMATION

RF performance in VHF class-A operation (linear power amplifier)

| MODE OF OPERATION | f_{vision} (MHz) | V_{CE} (V) | I_{C} (A) | T_{h} (°C) | $d_{\text{im}}^{(1)}$ (dB) | $P_{\text{o sync}}^{(1)}$ (W) | G_{p} (dB) |
|-------------------|---------------------------|---------------------|--------------------|---------------------|----------------------------|-------------------------------|---------------------|
| CW, class-A | 224.25 | 25 | 3.2 | 70 | -55 | >13 | >13.5 |
| | | | | 70 | -55 | typ. 14.5 | typ. 14.5 |
| | | | | 70 | -52 | typ. 22 | typ. 14.5 |
| | | | | 25 | -55 | typ. 19 | typ. 14.8 |

Note

1. Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.



VHF linear power transistor

BLV33F

List of components used in test circuit (see Figs 9 and 10).

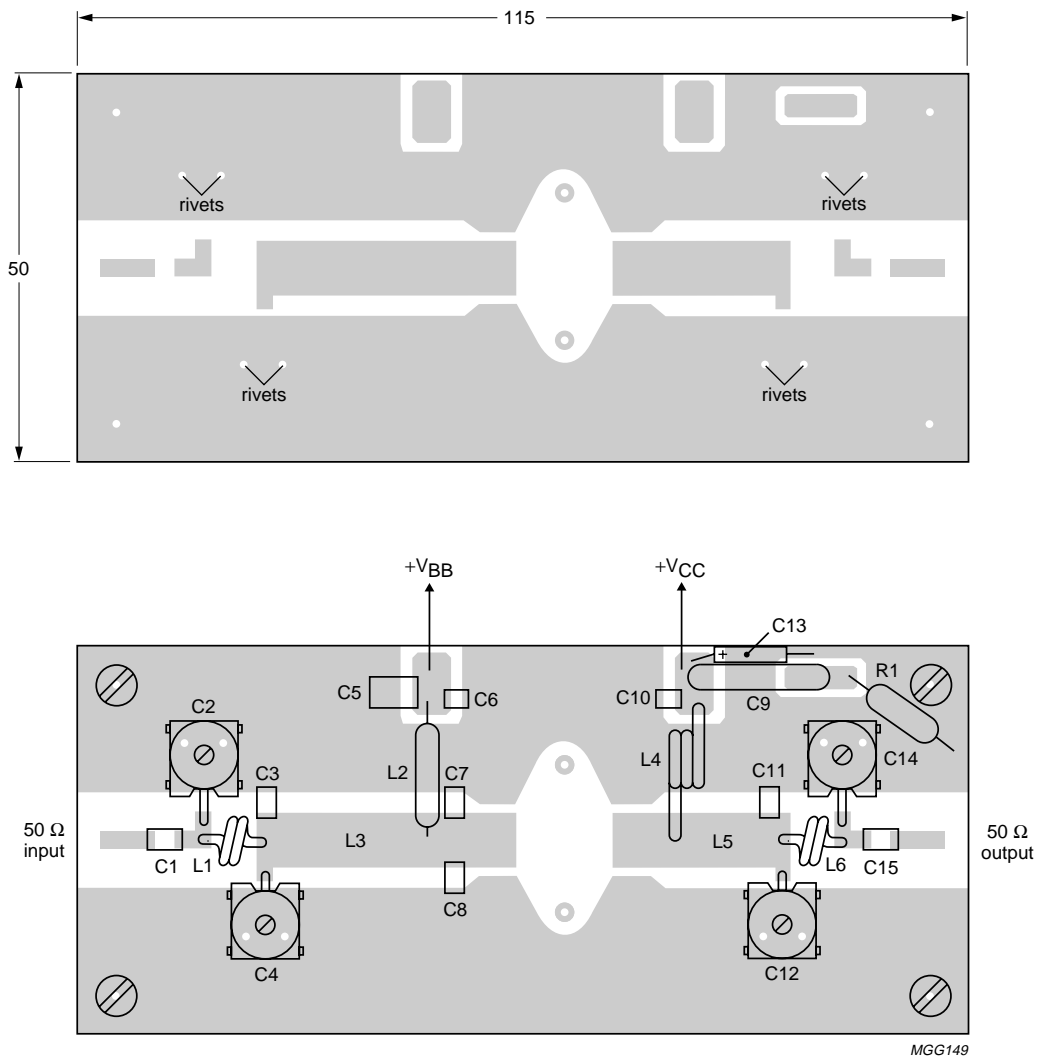
| COMPONENT | DESCRIPTION | VALUE | DIMENSIONS | CATALOGUE No. |
|------------------|---|-------------------|--|----------------|
| C1, C15 | multilayer ceramic chip capacitor; note 1 | 560 pF, 500 V | | |
| C2, C4, C12, C14 | film dielectric trimmer | 4 to 40 pF | | 2222 809 08002 |
| C3 | multilayer ceramic chip capacitor; note 1 | 10 pF, 500 V | | |
| C5 | multilayer ceramic chip capacitor | 470 nF, 50 V | | 2222 856 48474 |
| C6, C10 | multilayer ceramic chip capacitor | 680 pF, 50 V | | 2222 852 13681 |
| C7, C8 | multilayer ceramic chip capacitor; note 1 | 47 pF, 500 V | placed 8 mm from transistor edge | |
| C9 | polyester capacitor | 330 nF | | |
| C11 | multilayer ceramic chip capacitor; note 1 | 68 pF, 500 V | | |
| C13 | solid tantalum capacitor | 6.8 μ F, 35 V | | |
| L1 | 2 turns of 1.6 mm enamelled Cu wire | | int. diameter 5 mm length 5 mm leads 2 \times 3 mm | |
| L2 | microchoke | 1 μ H | | 4322 057 01080 |
| L3 | stripline; note 2 | 30 Ω | 6 mm \times 32.7 mm | |
| L4 | 2 turns of closely wound 1 mm enamelled Cu wire | | int. diameter 5 mm leads 2 \times 10 mm | |
| L5 | stripline; note 2 | 30 Ω | 6 mm \times 24 mm | |
| L6 | 2 turns of 1.6 mm enamelled Cu wire | | int. diameter 4 mm length 4.5 mm leads 2 \times 3 mm | |
| R1 | carbon resistor | 10 Ω | | |

Notes

- American Technical Ceramics type 100B or capacitor of same quality.
- The striplines are on a double Cu-clad printed-circuit board, with epoxy fibre-glass dielectric ($\epsilon_r = 4.5$); thickness $\frac{1}{16}$ ".

VHF linear power transistor

BLV33F



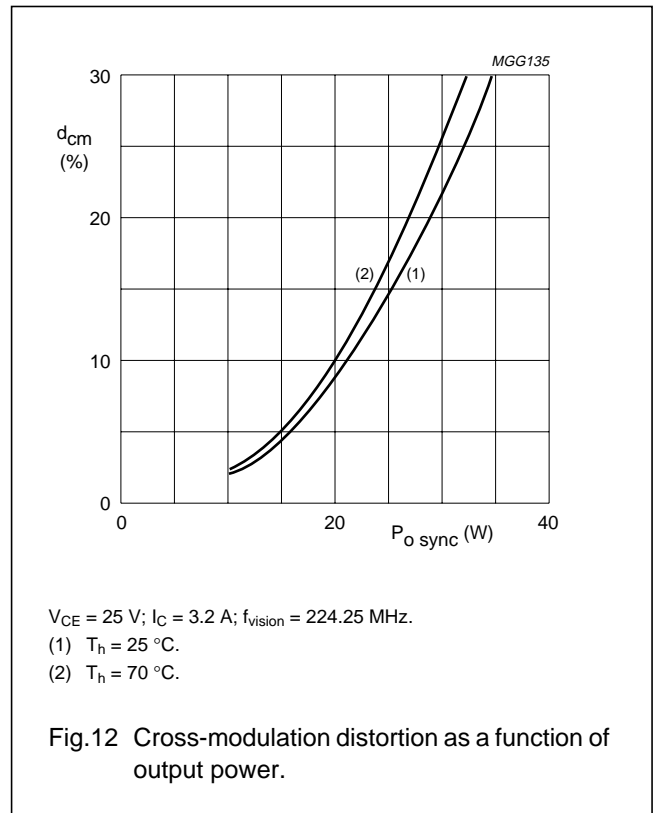
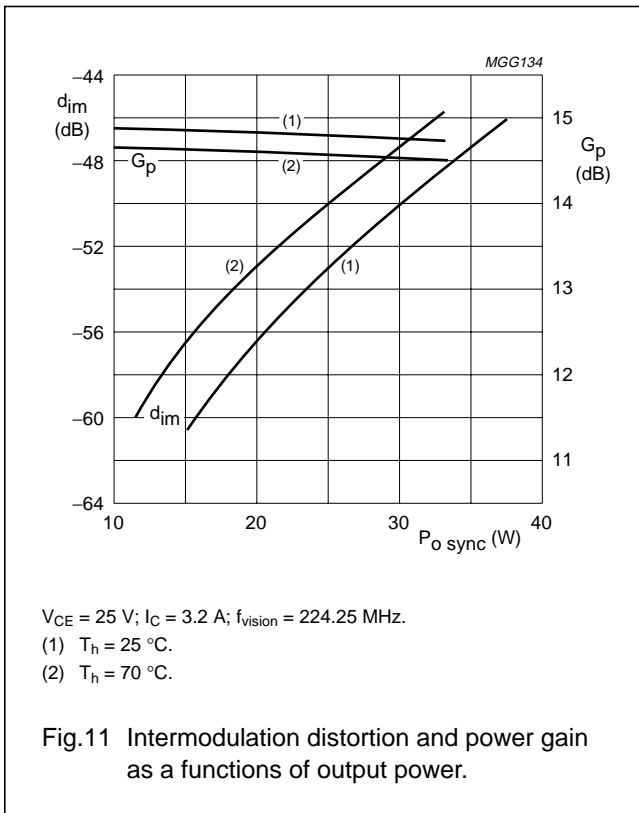
Dimensions in mm.

The circuit and the components are on one side of the epoxy fibre-glass board, the other side is unetched copper to serve as earth. Earth connections are made by hollow rivets. Additionally copper straps are used under the emitters and at the input and output to provide direct contact between the copper on the component side and the ground-plane.

Fig.10 Component layout and printed-circuit board for 224.25 MHz class-A test circuit.

VHF linear power transistor

BLV33F



Three-tone test method (vision carrier -8 dB , sound carrier -7 dB , sideband signal -16 dB), zero dB corresponds to peak sync level (see Fig.11). Intermodulation distortion of input signal $\leq -70\text{ dB}$.

Two-tone test method (vision carrier 0 dB , sound carrier -7 dB), zero dB corresponds to peak sync level.

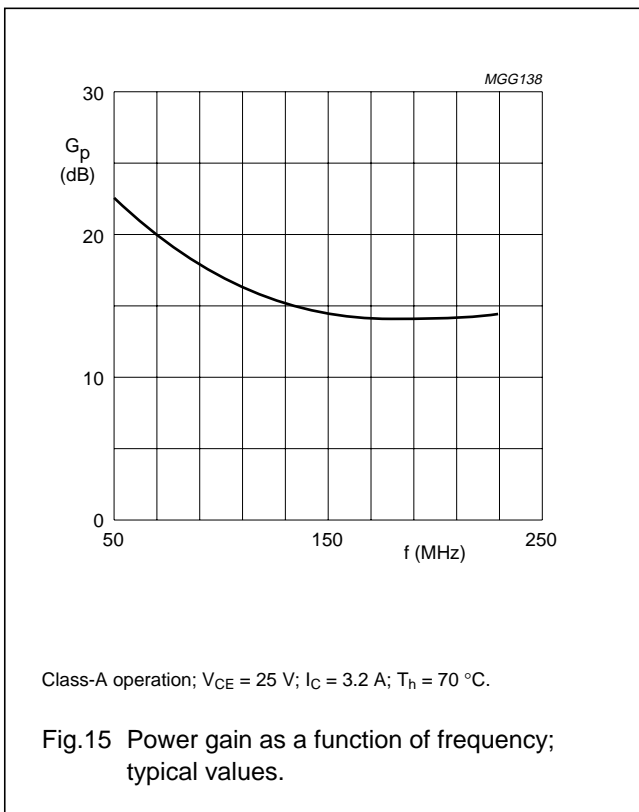
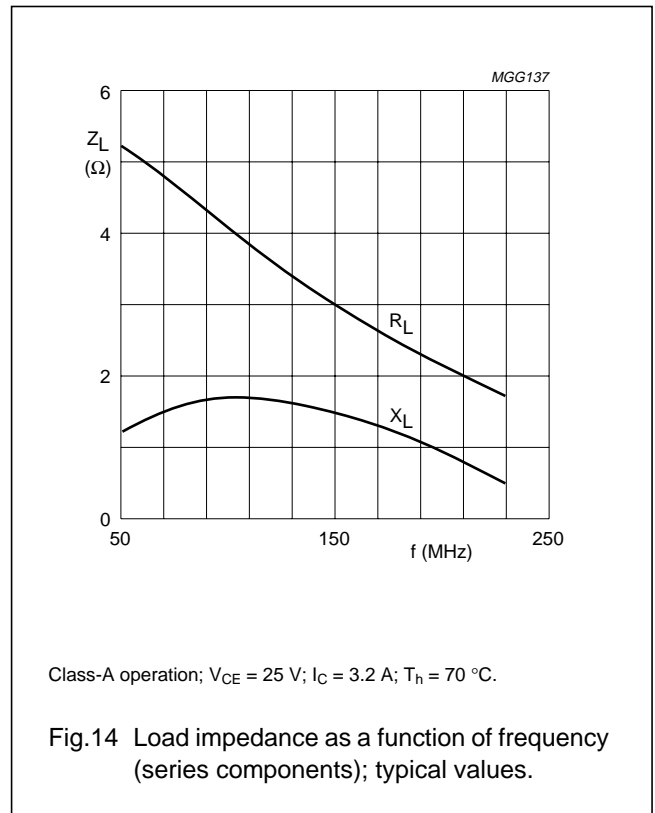
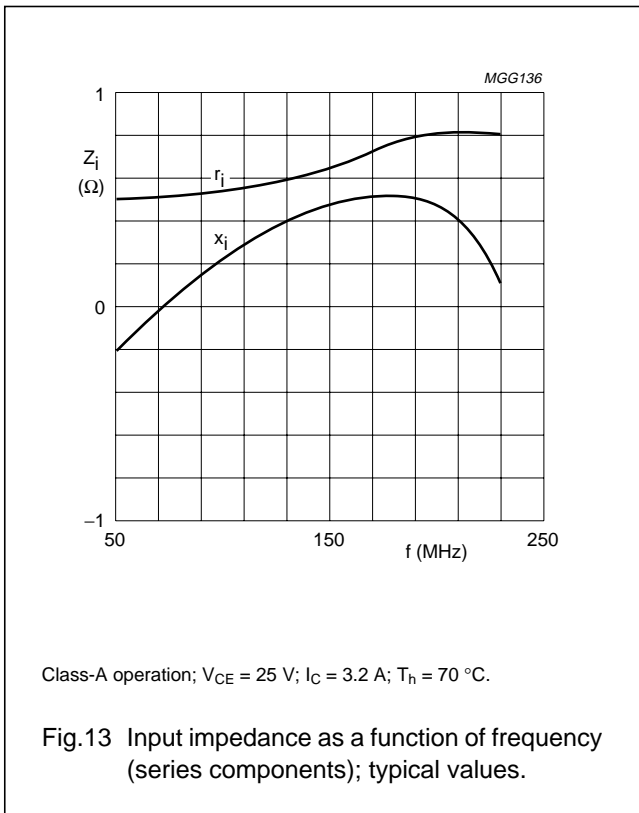
Cross-modulation distortion (d_{cm}) is the voltage variation (%) of sound carrier when vision carrier is switched from 0 dB to -20 dB (see Fig.12).

Ruggedness in class-A operation

The BLV33F is capable of withstanding a full load mismatch corresponding to $VSWR = 50 : 1$ through all phases up to 30 W (RMS) or 40 W (PEP) under the following conditions: $V_{CE} = 25\text{ V}; I_C = 3.2\text{ A}; T_h = 70\text{ }^\circ\text{C}; f = 224.25\text{ MHz}; R_{th\text{ mb-h}} = 0.2\text{ K/W}.$

VHF linear power transistor

BLV33F



VHF linear power transistor

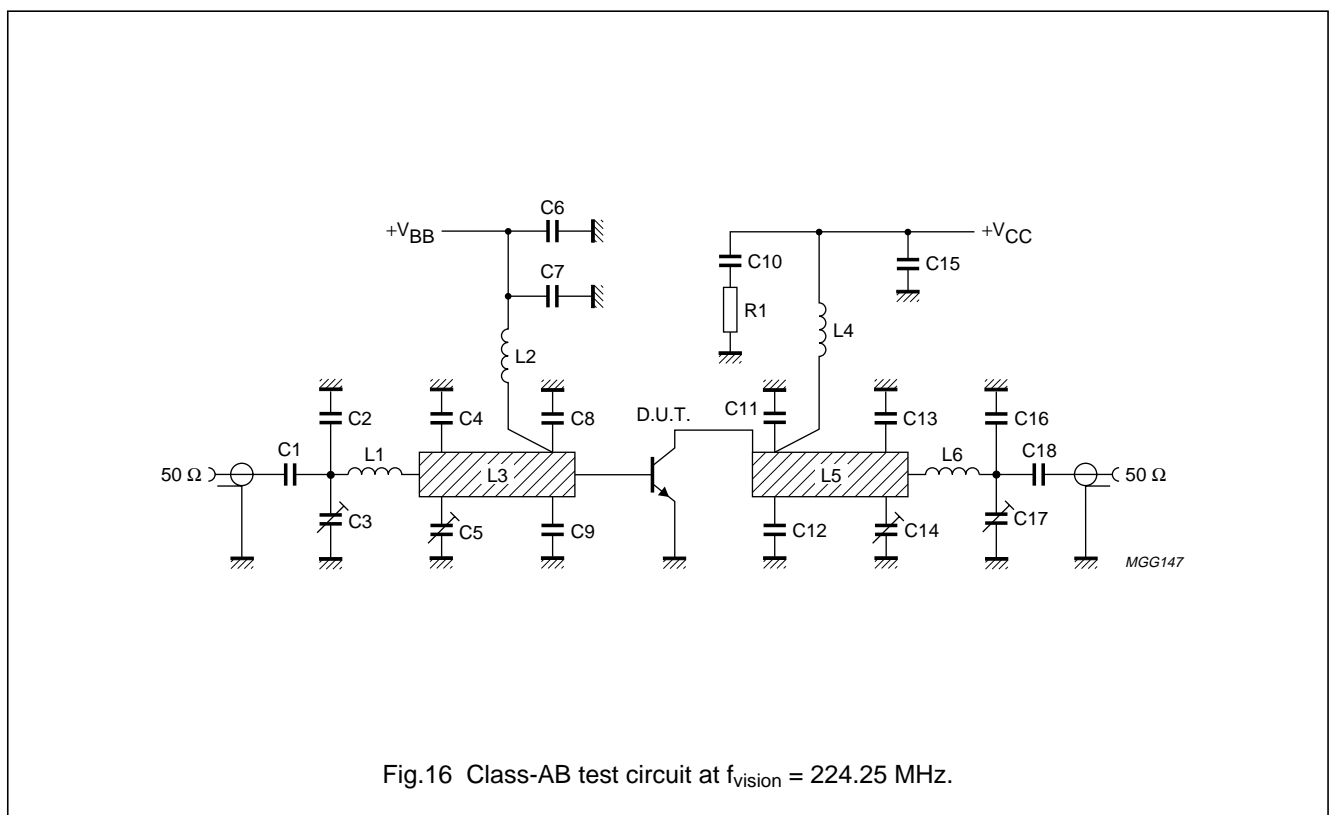
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RF performance in VHF class-AB operation (C.W.).

| MODE OF OPERATION | f (MHz) | V _{CE} (V) | I _c , I _{c(2S)} (A) | T _h (°C) | P _L (W) | I _c (A) | η _c (%) | G _p (dB) ⁽¹⁾ |
|-------------------|---------|---------------------|---|---------------------|--------------------|------------------------|--------------------|------------------------------------|
| CW, class-AB | 224.25 | 28 | 0.2 | 70 | 40 85 | typ. 2.75 typ. 4.25 | typ. 52 typ. 71 | typ. 11.5 typ. 10.5 |

Note

- Gain compression point of 1 dB is at typical 85 W (minimum 75 W). Using a 3rd-order amplitude transfer characteristic, 1 dB compression corresponds with 30 % sync input / 25 % sync output compression in television service (negative modulation, C.C.I.R. system).



VHF linear power transistor

BLV33F

List of components used in test circuit (see Figs 16 and 17).

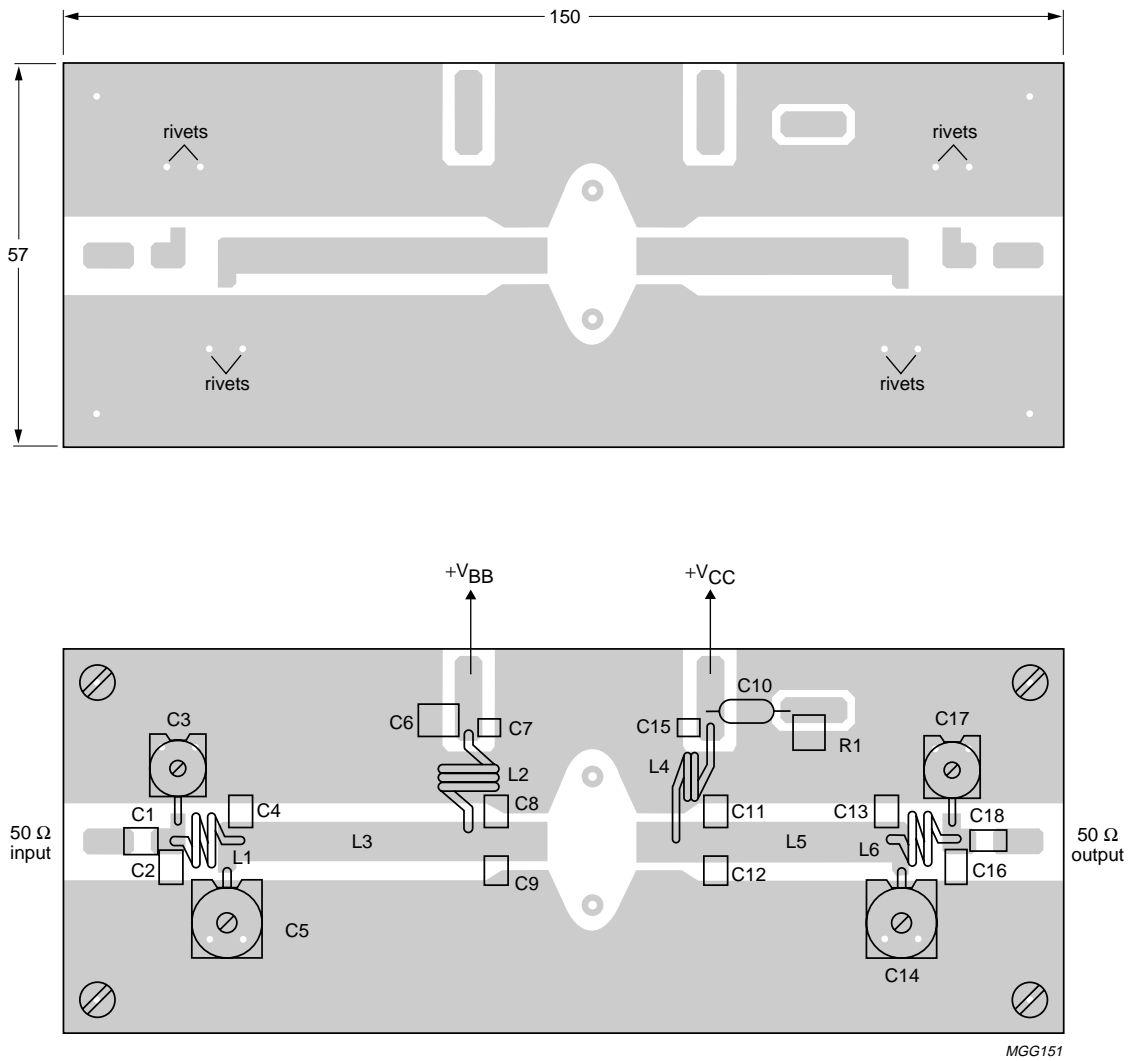
| COMPONENT | DESCRIPTION | VALUE | DIMENSIONS | CATALOGUE No. |
|-----------|---|---------------|---|----------------|
| C1, C18 | multilayer ceramic chip capacitor; note 1 | 620 pF, 100 V | | |
| C2 | multilayer ceramic chip capacitor; note 1 | 27 pF, 500 V | | |
| C3 | film dielectric trimmer | 2 to 18 pF | | 2222 809 09003 |
| C4 | multilayer ceramic chip capacitor; note 1 | 30 pF, 500 V | | |
| C5, C14 | film dielectric trimmer | 4 to 40 pF | | 2222 809 08002 |
| C6, C10 | multilayer ceramic chip capacitor | 470 nF, 50 V | | 2222 856 48474 |
| C7, C15 | multilayer ceramic chip capacitor | 680 pF, 50 V | | 2222 852 13681 |
| C8, C9 | multilayer ceramic chip capacitor; note 1 | 68 pF, 500 V | placed 6.4 mm from transistor edge | |
| C11, C12 | multilayer ceramic chip capacitor; note 1 | 43 pF, 500 V | placed 10 mm from transistor edge | |
| C13 | multilayer ceramic chip capacitor; note 1 | 39 pF, 500 V | | |
| C16 | multilayer ceramic chip capacitor; note 1 | 3.3 pF, 500 V | | |
| C17 | film dielectric trimmer | 1.4 to 5.5 pF | | 2222 809 09001 |
| L1 | 2 turns of 1.6 mm enamelled Cu wire | | int. diameter 4.5 mm length 4 mm leads 2 × 4 mm | |
| L2 | 3 turns of 1 mm closely wound enamelled Cu wire | | int. diameter 5 mm leads 2 × 7 mm | |
| L3 | stripline; note 2 | 30 Ω | 6 mm × 47.8 mm | |
| L4 | 2 turns of 1 mm closely wound enamelled Cu wire | | int. diameter 5 mm leads 2 × 8 mm | |
| L5 | stripline; note 2 | 30 Ω | 6 mm × 42.9 mm | |
| L6 | 2 turns of 1.6 mm enamelled Cu wire | | int. diameter 4 mm length 4 mm leads 2 × 3 mm | |
| R1 | carbon resistor | 10 Ω | | |

Notes

- American Technical Ceramics type 100B or capacitor of same quality.
- The striplines are on a double Cu-clad printed-circuit board, with epoxy fibre-glass dielectric ($\epsilon_r = 4.5$); thickness $\frac{1}{16}$ ".

VHF linear power transistor

BLV33F



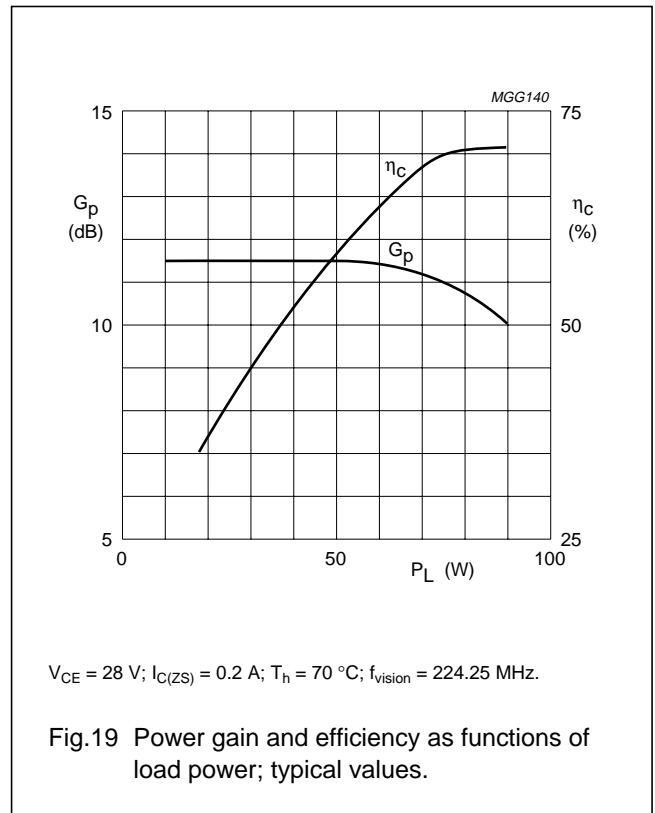
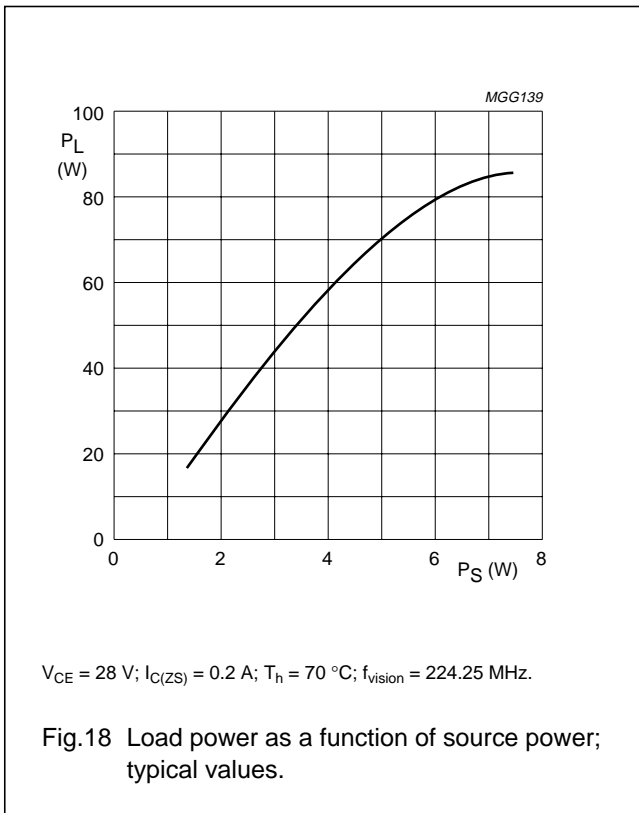
Dimensions in mm.

The circuit and the components are on one side of the epoxy fibre-glass board, the other side is unetched copper to serve as earth. Earth connections are made by hollow rivets. Additionally copper straps are used under the emitters and at the input and output to provide direct contact between the copper on the component side and the ground-plane.

Fig.17 Component layout and printed-circuit board for 224.25 MHz class-AB test circuit.

VHF linear power transistor

BLV33F

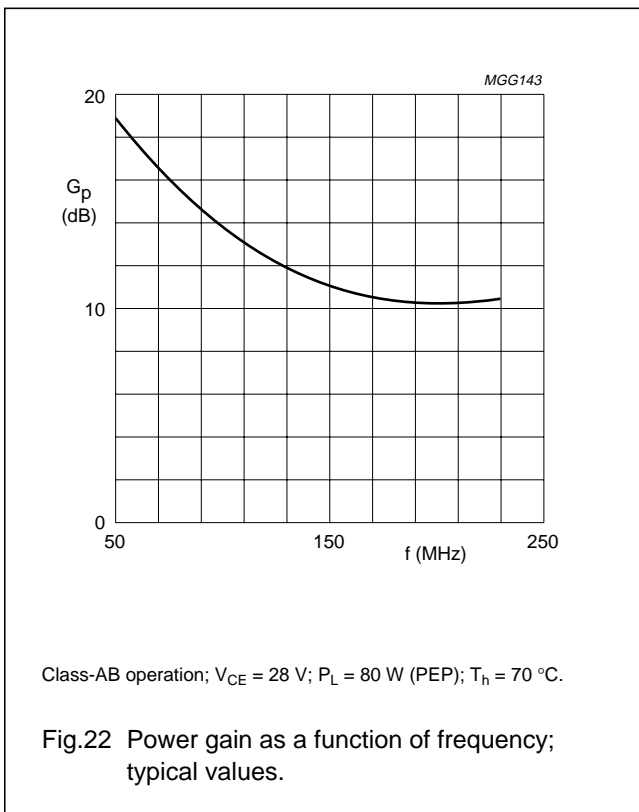
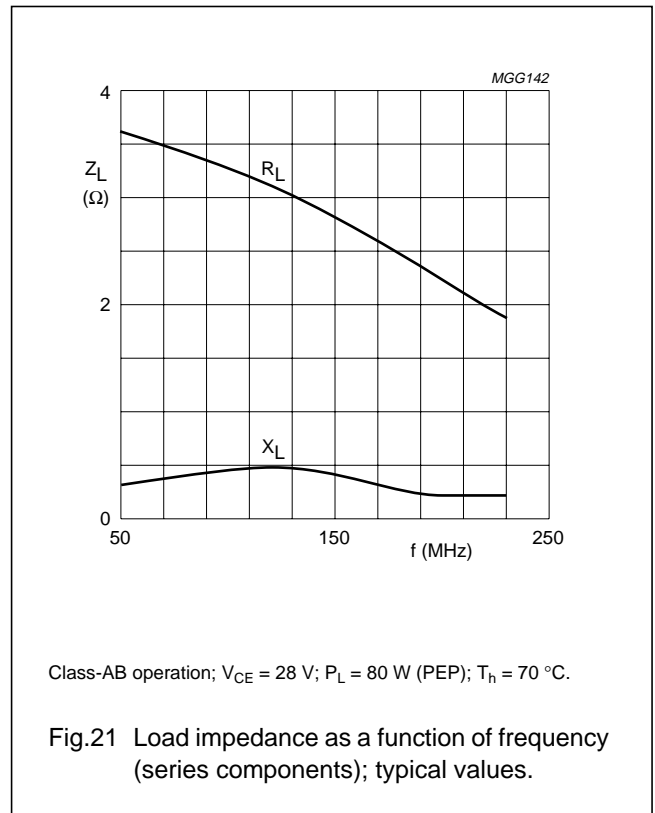
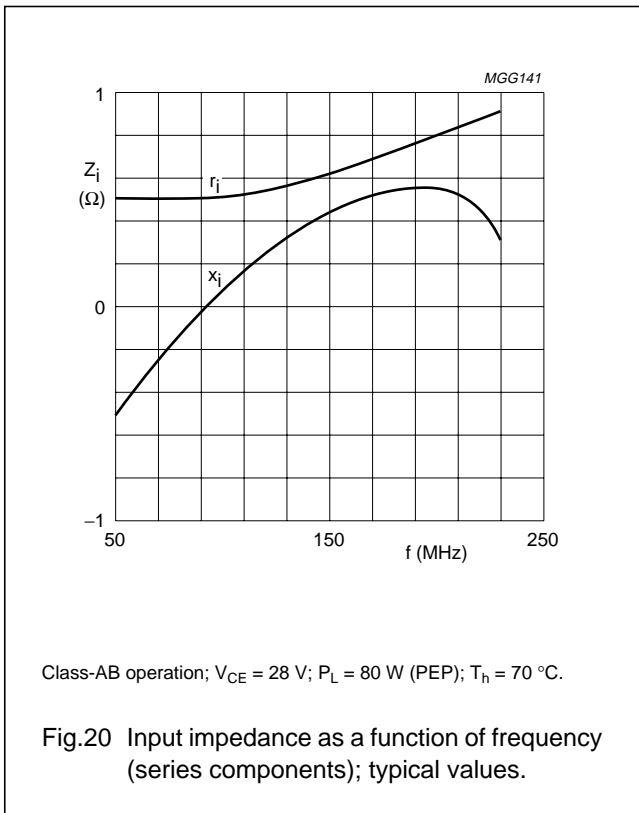


Ruggedness in class-AB operation

The BLV33F is capable of withstanding a full load mismatch corresponding to VSWR ≤ 2 through all phases) up to 60 W (RMS) and 85 W (PEP) under the following conditions: $V_{CE} = 28 \text{ V}; T_h = 70 \text{ }^\circ\text{C}; f = 224.25 \text{ MHz}; R_{th\text{ mb-h}} = 0.2 \text{ K/W.}$

VHF linear power transistor

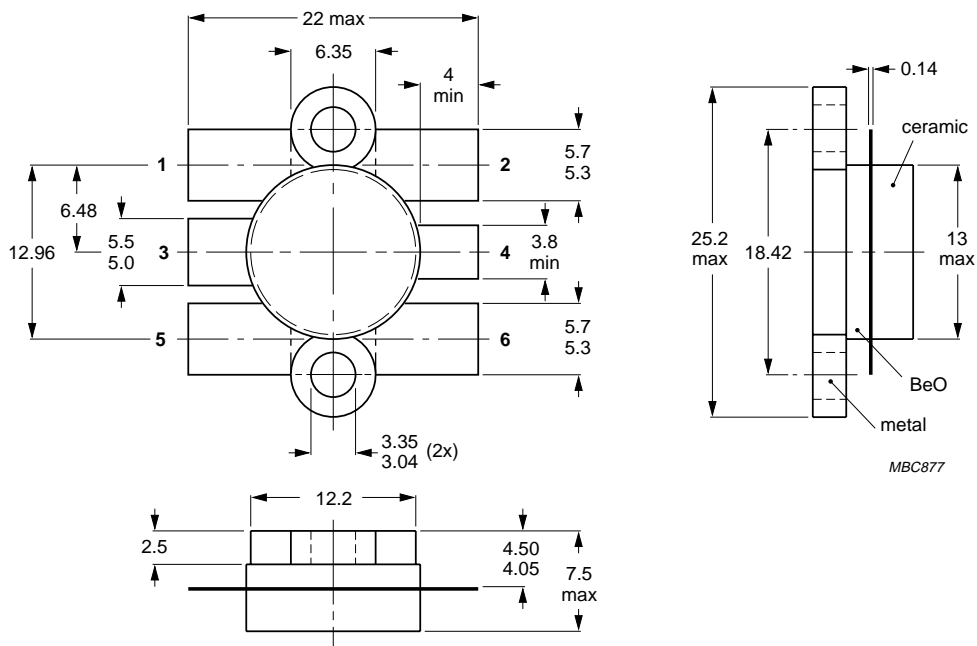
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PACKAGE OUTLINE



Dimensions in mm.
 Torque on screw: min. 0.6 Nm; max. 0.75 Nm.
 Recommended screw: cheese-head 4-40 UNC/2A.
 Heatsink compound must be applied sparingly and evenly distributed.

Fig.23 SOT119A.

VHF linear power transistor

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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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These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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NOTES

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