# UHF push-pull power transistor BLV945B

## FEATURES

- Double internal input matching for easy matching and high gain
- Emitter ballasting resistors for an optimum temperature profile
- Gold metallization ensures excellent reliability.

## APPLICATIONS

- Base station transmitters in the 900 to 960 MHz range.

## PINNING - SOT324

| PIN | SYMBOL | DESCRIPTION |
|---|---|---|
| 1 | c1 | collector 1 |
| 2 | c2 | collector 2 |
| 3 | b1 | base 1 |
| 4 | b2 | base 2 |
| 5 | e | emitter connected to flange |

## DESCRIPTION

Two NPN silicon planar epitaxial transistors in push-pull configuration, intended for linear common emitter class-AB operation. The device has double internal input matching. The transistor is encapsulated in a 4-lead SOT324 flange envelope with a ceramic cap. The flange provides the common emitter connection for both transistors.

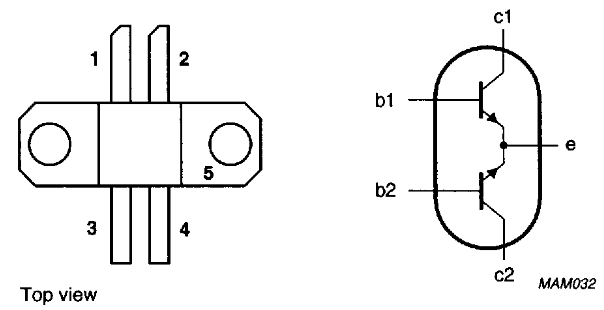



Fig.1 Simplified outline and symbol.

## QUICK REFERENCE DATA

RF performance at $T_h$ = 25 °C in a common emitter push-pull test circuit.

| MODE OF OPERATION | f (MHz) | $V_{CE}$ (V) | $P_L$ (W) | $G_p$ (dB) | $\eta_C$ (%) | $d_3$ (dBc) |
|---|---|---|---|---|---|---|
| CW, class-AB | 960 | 25 | 25 | ≥ 8.5 | ≥ 45 | – |
| 2-tone, class-AB | 960 | 25 | 30 (PEP) | ≥ 8.5 | ≥ 35 | ≤ –32 |
| 2-tone, class-A | 960 | 25 | 6 (PEP) | typ. 12.5 | – | typ. –43 |

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

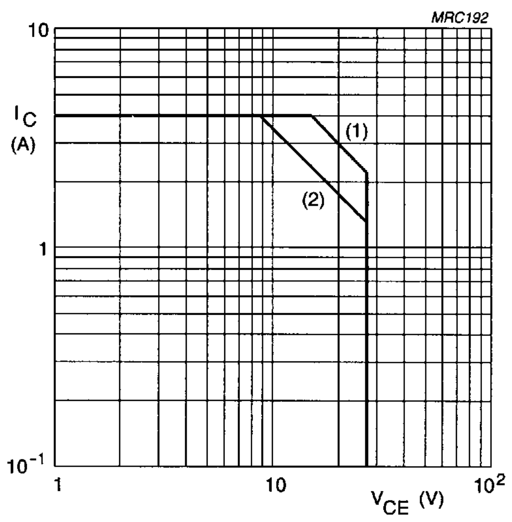
## LIMITING VALUES

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

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| **Per transistor section** | | | | | |
| $V_{CEO}$ | collector-emitter voltage | open base | – | 27 | V |
| $V_{CES}$ | collector-emitter voltage | $V_{BE} = 0$ | – | 50 | V |
| $V_{EBO}$ | emitter-base voltage | open collector | – | 3.5 | V |
| $I_C$ | collector current (DC) | | – | 2 | A |
| $I_{C(AV)}$ | average collector current | | – | 2 | A |
| $P_{tot}$ | total power dissipation (DC) | up to $T_{mb}$ = 25 °C; total device; both sections equally loaded | – | 60 | W |
| $T_{stg}$ | storage temperature | | –65 | +150 | °C |
| $T_j$ | operating junction temperature | | – | 200 | °C |

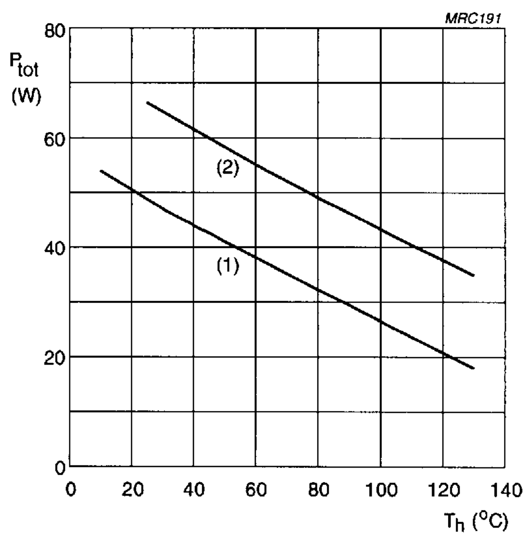
## THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---|---|---|---|---|
| $R_{th\ j\text{-}mb}$ | thermal resistance from junction to mounting base | $P_{tot}$ = 60 W; $T_{mb}$ = 25 °C; total device; both sections equally loaded | 2.9 | K/W |
| $R_{th\ mb\text{-}h}$ | thermal resistance from mounting base to heatsink | total device; both sections equally loaded | 0.5 | K/W |




Total device; both sections equally loaded.
(1) $T_{mb}$ = 25 °C.
(2) $T_h$ = 70 °C.

Fig.2 DC SOAR.



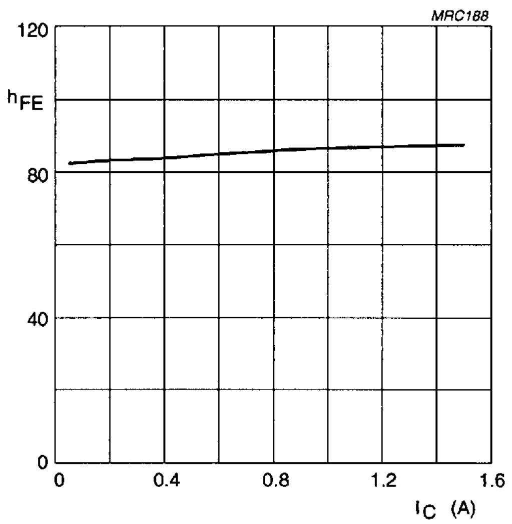

Total device; both sections equally loaded.
(1) Continuous operation.
(2) Short-time operation during mismatch.

Fig.3 Power derating curves.

## CHARACTERISTICS

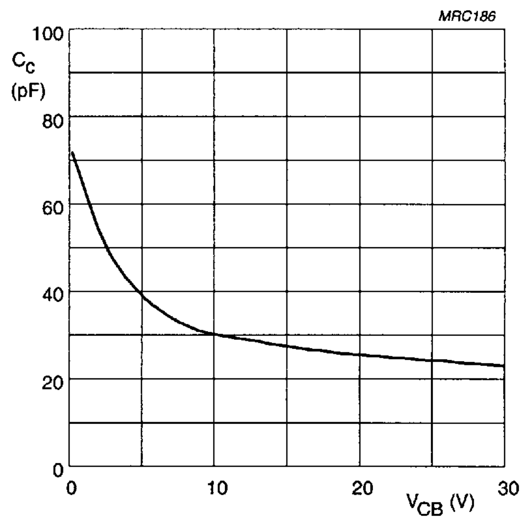
$T_j$ = 25 °C unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| **Per transistor section** | | | | | | |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage | open base; $I_C$ = 25 mA | 27 | – | – | V |
| $V_{(BR)CES}$ | collector-emitter breakdown voltage | $V_{BE}$ = 0; $I_C$ = 10 mA | 50 | – | – | V |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage | open collector; $I_E$ = 5 mA | 3.5 | – | – | V |
| $I_{CES}$ | collector leakage current | $V_{BE}$ = 0; $V_{CE}$ = 27 V | – | – | 1 | mA |
| $h_{FE}$ | DC current gain | $V_{CE}$ = 25 V; $I_C$ = 0.85 A | 30 | – | 120 | |
| $C_c$ | collector capacitance | $V_{CB}$ = 25 V; $I_E$ = $i_e$ = 0; f = 1 MHz | – | 24 | 30 | pF |




$V_{CE}$ = 25 V.

Fig.4 DC current gain as a function of collector current; typical values.




$I_E$ = $i_e$ = 0; f = 1 MHz.

Fig.5 Collector capacitance as a function of collector-base voltage; typical values.

## APPLICATION INFORMATION

RF performance at $T_h$ = 25 °C in a common emitter push-pull, class-AB test circuit.

| MODE OF OPERATION | f (MHz) | $V_{CE}$ (V) | $I_{CQ}$ (mA) | $P_L$ (W) | $G_p$ (dB) | $\eta_C$ (%) | $d_3$ (dBc) |
|---|---|---|---|---|---|---|---|
| CW, class-AB | 960 | 25 | 2 × 75 | 25 | ≥8.5<br>typ. 9.5 | ≥45<br>typ. 48 | – |
| 2-tone, class-AB | 960(1) | 25 | 2 × 75 | 30 (PEP) | ≥8.5<br>typ. 9.5 | ≥35<br>typ. 42 | ≤ –32<br>typ. –34 |

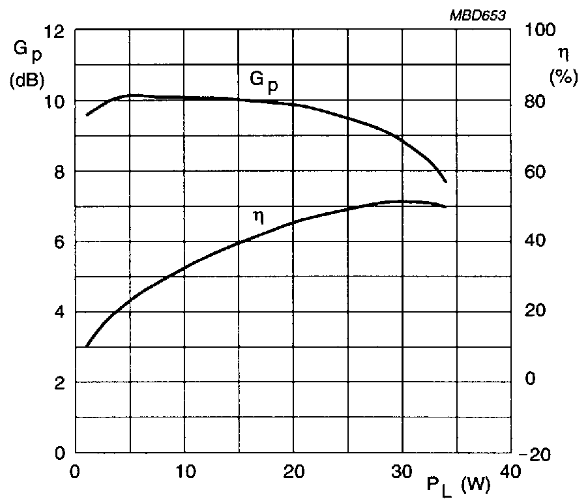
**Note**

1. $f_1$ = 960.0 MHz; $f_2$ = 960.1 MHz.

### Ruggedness in class-AB operation

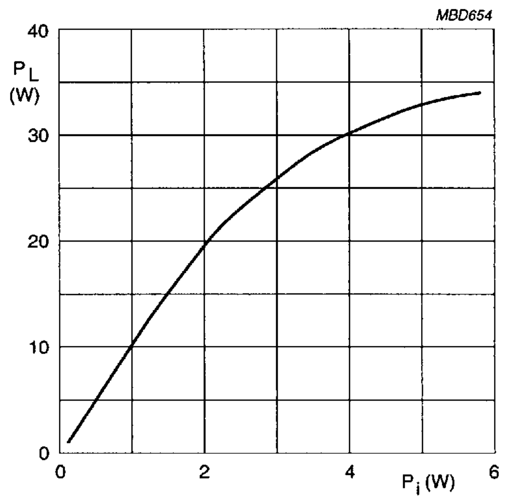
The BLV945B is capable of withstanding a full load mismatch corresponding to VSWR = 3 : 1 through all phases under the following conditions: $P_L$ = 25 W; f = 960 MHz; $V_{CE}$ = 25 V; $T_h$ = 25 °C; $I_{CQ}$ = 2 × 75 mA; $R_{th\ mb\text{-}h}$ = 0.5 K/W.

It is capable of withstanding a full load mismatch corresponding to VSWR = 5 : 1 through all phases under the following conditions: $P_L$ = 30 W (PEP); $f_1$= 960  MHz; $f_2$ = 960.1 MHz; $V_{CE}$ = 25 V; $I_{CQ}$ = 2 × 75 mA; $T_h$ = 25 °C; $R_{th\ mb\text{-}h}$ = 0.5 K/W.



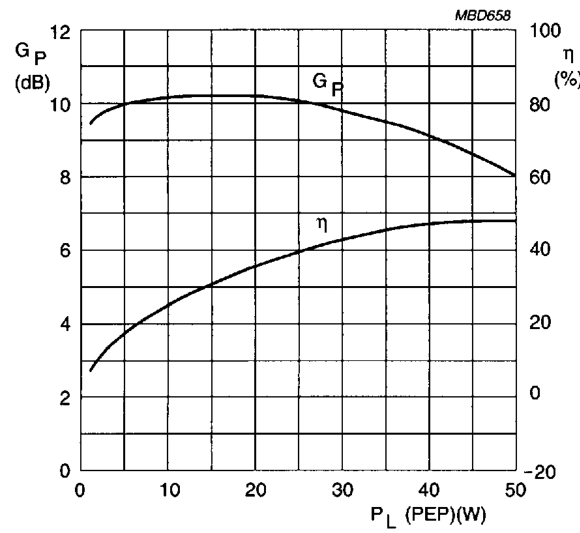

**Class-AB operation.**
$V_{CE}$ = 25 V; $I_{CQ}$ = 2 × 75 mA; f = 960 MHz.

Fig.6 Power gain and efficiency as functions of load power; typical values.




**Class-AB operation.**
$V_{CE}$ = 25 V; $I_{CQ}$ = 2 × 75 mA; f = 960 MHz.

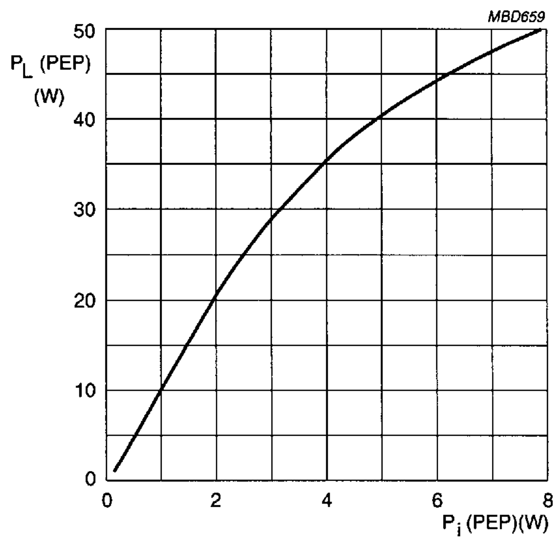
Fig.7 Load power as a function of input power; typical values.




**Class-AB operation.**

$V_{CE}$ = 25 V; $I_{CQ}$ = 2 × 75 mA; $f_1$ = 960.0 MHz; $f_2$ = 960.1 MHz;
$T_h$ = 25 °C; $R_{th\ mb\text{-}h}$ = 0.5 K/W.

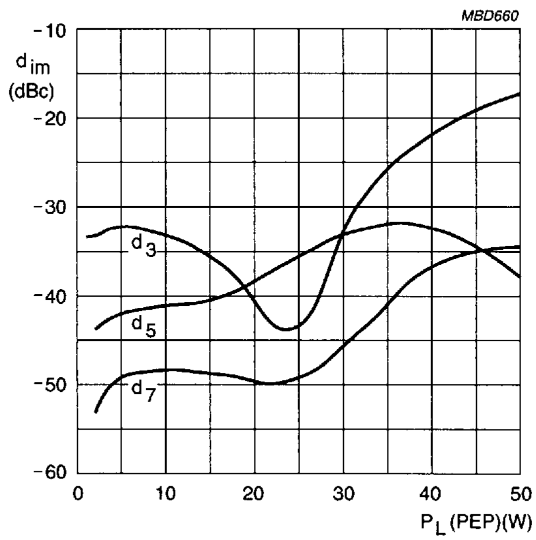
Fig.8 Power gain and efficiency as functions of load power; typical values.




**Class-AB operation.**

$V_{CE}$ = 25 V; $I_{CQ}$ = 2 × 75 mA; $f_1$ = 960.0 MHz; $f_2$ = 960.1 MHz;
$T_h$ = 25 °C; $R_{th\ mb\text{-}h}$ = 0.5 K/W.

Fig.9 Load power as a function of input power; typical values.




**Class-AB operation.**

$V_{CE}$ = 25 V; $I_{CQ}$ = 2 × 75 mA; $f_1$ = 960.0 MHz; $f_2$ = 960.1 MHz;
$T_h$ = 25 °C; $R_{th\ mb\text{-}h}$ = 0.5 K/W.

Fig.10 Intermodulation distortion as functions of load power; typical values.

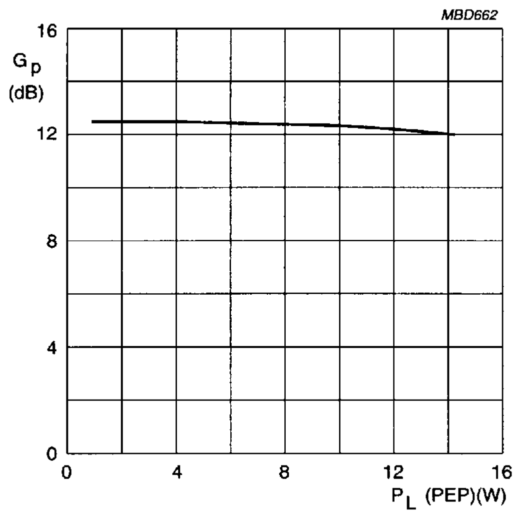
## APPLICATION INFORMATION

RF performance at $T_h$ = 25 °C in a common emitter push-pull, class-A test circuit.

| MODE OF OPERATION | f (MHz) | $V_{CE}$ (V) | $I_{CQ}$ (mA) | $P_L$ (W) | $G_p$ (dB) | $d_3$ (dBc) |
|---|---|---|---|---|---|---|
| 2-tone, class-A | 960(1) | 25 | 2 × 850 | 6 (PEP) | typ. 12.5 | typ. −43 |

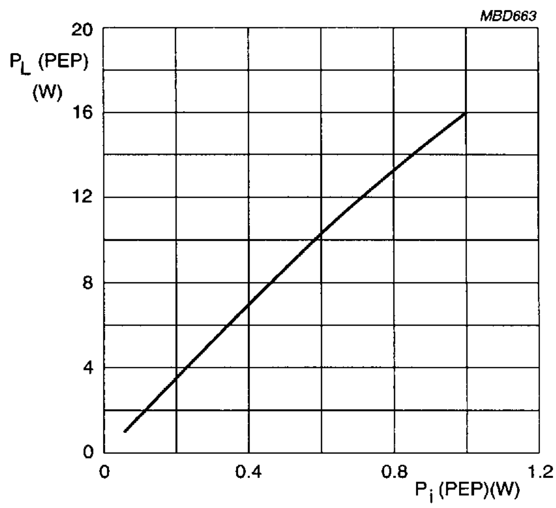
**Note**

1. $f_1$ = 960.0 MHz; $f_2$ = 960.1 MHz.



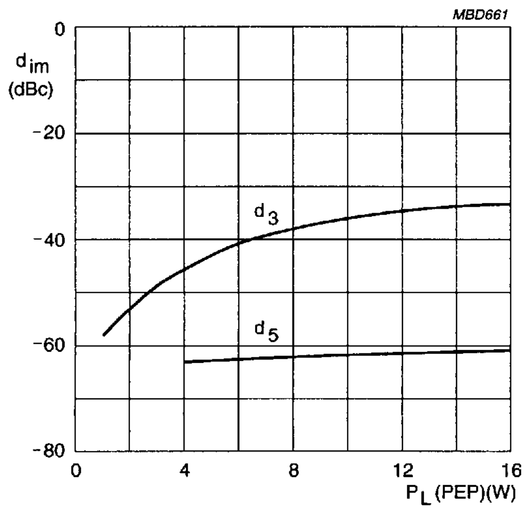

**Class-A operation.**
$V_{CE}$ = 25 V; $I_{CQ}$ = 2 × 850 mA; $f_1$ = 960.0 MHz; $f_2$ = 960.1 MHz.

Fig.11 Power gain as a function of load power; typical values.




**Class-A operation.**
$V_{CE}$ = 25 V; $I_{CQ}$ = 2 × 850 mA; $f_1$ = 960.0 MHz; $f_2$ = 960.1 MHz.

Fig.12 Load power as a function of input power; typical values.




**Class-A operation.**

$V_{CE}$ = 25 V; $I_{CQ}$ = 2 × 850 mA; $f_1$ = 960.0 MHz; $f_2$ = 960.1 MHz.

Fig.13 Intermodulation distortion as functions of load power; typical values.

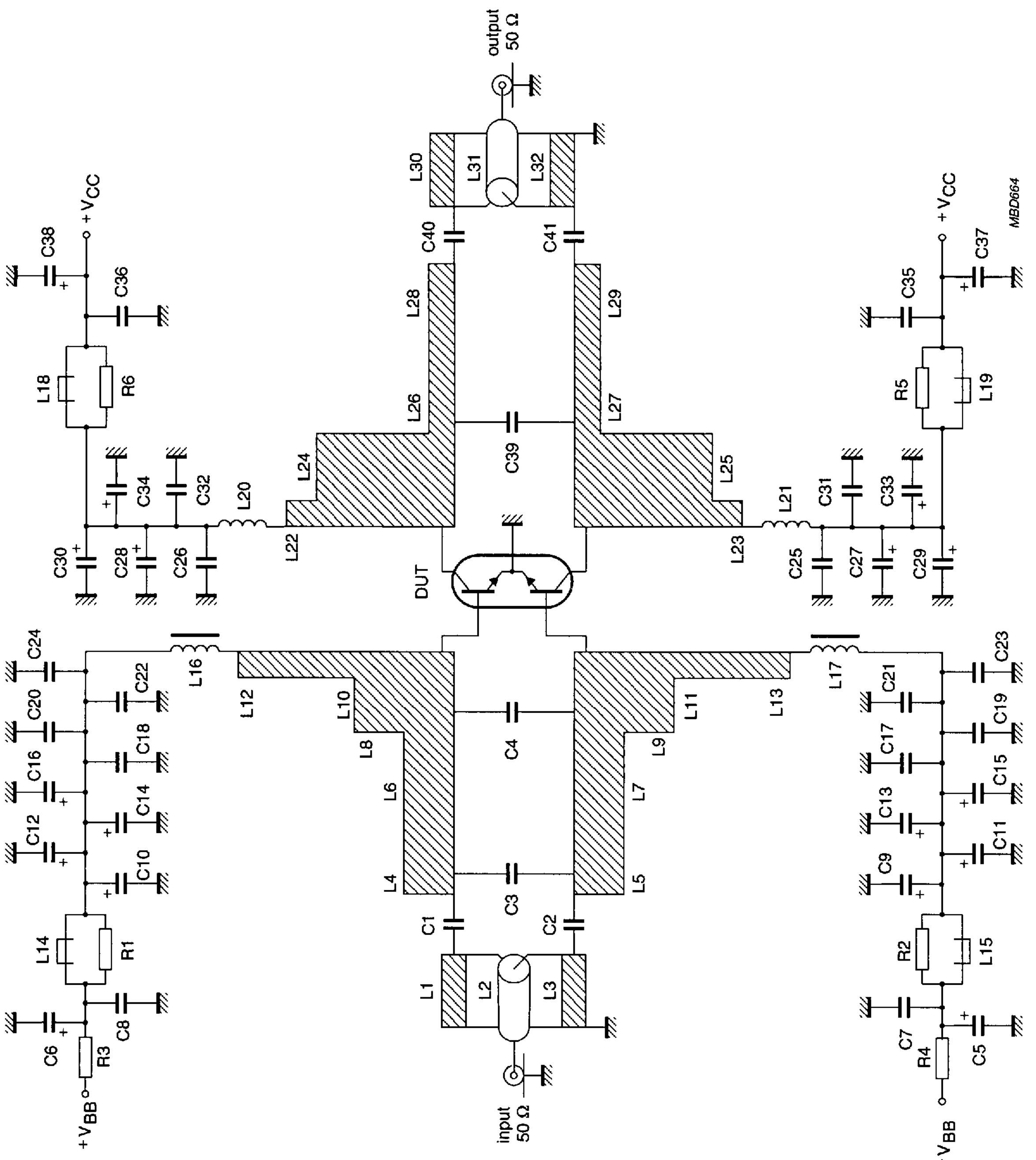



Fig.14 Test circuit for class-AB.

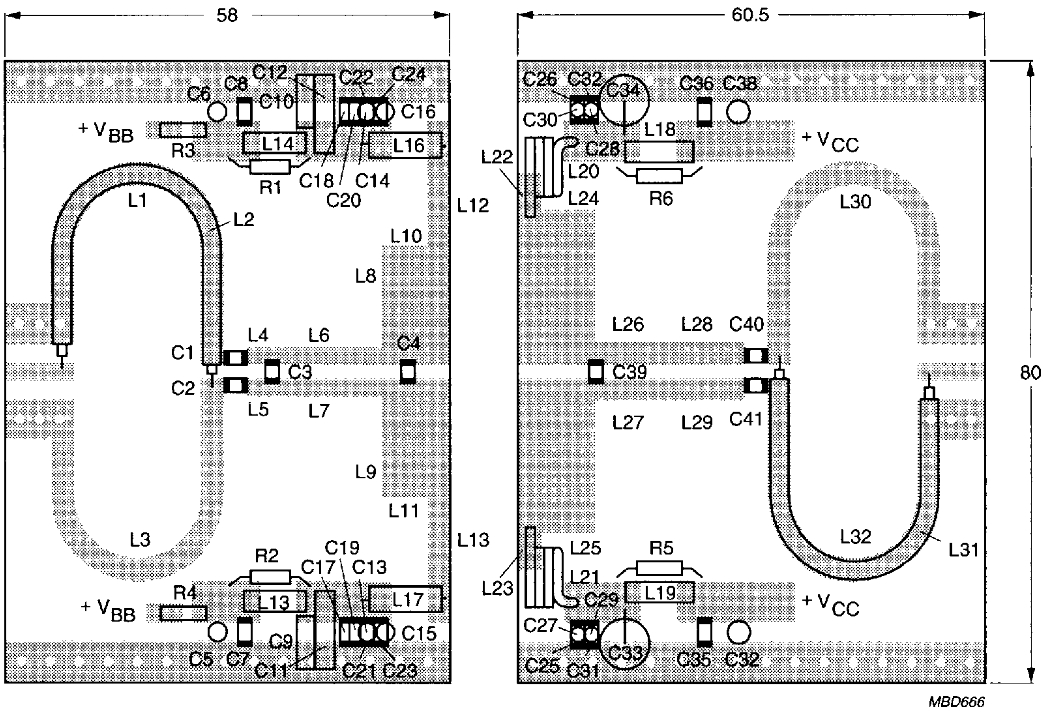
**List of components** (see Figs 14 and 15)

| COMPONENT | DESCRIPTION | VALUE | DIMENSION | CATALOGUE NO. |
|---|---|---|---|---|
| C1, C2 | multilayer ceramic chip capacitor; note 1 | 47 pF, 500 V | | |
| C3 | multilayer ceramic chip capacitor; note 1 | 1.2 pF, 500 V | | |
| C4 | multilayer ceramic chip capacitor; note 1 | 3.6 pF, 500 V | | |
| C5, C6, C15, C16, C27, C28, C37, C38 | tantalum capacitor | 1 μF, 35 V | | 2022 019 00056 |
| C7, C8, C21, C22, C31, C32, C35, C36 | multilayer ceramic chip capacitor; note 1 | 300 pF, 200 V | | |
| C9, C10 | SMD electrolytic capacitor | 1 μF, 63 V | | 2222 085 78108 |
| C11, C12 | SMD electrolytic capacitor | 10 μF, 16 V | | 2222 085 75109 |
| C13, C14, C29, C30 | tantalum capacitor | 2.2 μF, 35 V | | 2022 019 00058 |
| C17, C18 | multilayer ceramic chip capacitor | 100 nF, 50 V | | 2222 581 76641 |
| C19, C20 | multilayer ceramic chip capacitor | 10 nF, 50 V | | 2222 581 76627 |
| C23, C24, C25, C26 | multilayer ceramic chip capacitor; note 1 | 39 pF, 500V | | |
| C33, C34 | electrolytic capacitor | 10 μF, 63 V | | 2222 030 28109 |
| C39 | multilayer ceramic chip capacitor; note 1 | 6.2 pF, 500 V | | |
| C40, C41 | multilayer ceramic chip capacitor; note 1 | 27 pF, 500 V | | |
| L1, L3, L30, L32 | stripline; note 2 | 50 Ω | length 57.1 mm<br>width 3 mm | |
| L2, L31 | semi-rigid cable; note 3 | 50 Ω | ext. conductor;<br>length 57.1 mm<br>ext. diameter 2.2 mm | |
| L4, L5 | stripline; note 2 | | length 3 mm<br>width 2.6 mm | |
| L6, L7 | stripline; note 2 | | length 15 mm<br>width 2.6 mm | |
| L8, L9 | stripline; note 2 | | length 2.8 mm<br>width 15 mm | |
| L10, L11 | stripline; note 2 | | length 3 mm<br>width 15 mm | |
| L12, L13 | stripline; note 2 | | length 3 mm<br>width 31.5 mm | |
| L14, L15, L18, L19 | grade 4S2 Ferroxcube chip-bead | | | 4330 030 36300 |
| L16, L17 | microchoke | 470 nH | | 4322 057 04771 |
| L20, L21 | 4 turns enamelled 1 mm copper wire | | int. diameter 6 mm<br>close wound | |

| COMPONENT | DESCRIPTION | VALUE | DIMENSION | CATALOGUE NO. |
|---|---|---|---|---|
| L22, L23 | stripline; note 2 | | length 3 mm<br>width 24 mm | |
| L24, L25 | stripline; note 2 | | length 7.5 mm<br>width 20 mm | |
| L26, L27 | stripline; note 2 | | length 3.6 mm<br>width 3 mm | |
| L28, L29 | stripline; note 2 | | length 15.9 mm<br>width 3 mm | |
| R1, R2, R5, R6 | metal film resistor | 5.11 Ω, 0.4 W | | 2322 151 75118 |
| R3, R4 | metal film resistor | 7.5 Ω, 0.4 W | | 2322 151 77508 |

**Notes**

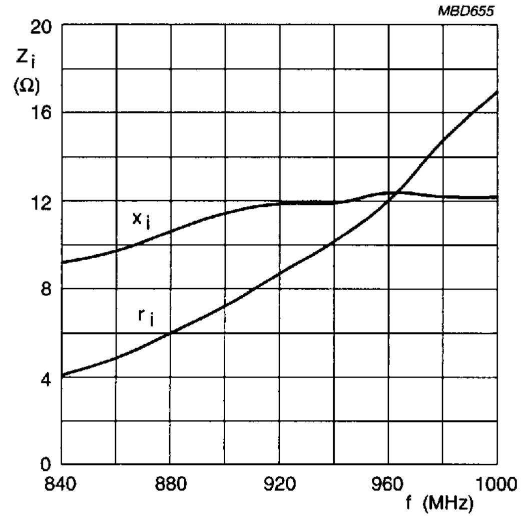
1. American Technical Ceramics type 100B or capacitor of same quality.
2. The striplines are on a double copper-clad printed-circuit board with microfibre-glass dielectric ($\varepsilon_r = 2.2$); thickness $^1/_{32}$ inch; thickness of the copper sheet 2 × 35 µm.
3. Semi-rigid cables L2 and L31 are soldered onto striplines L1 and L30.




Dimensions in mm.

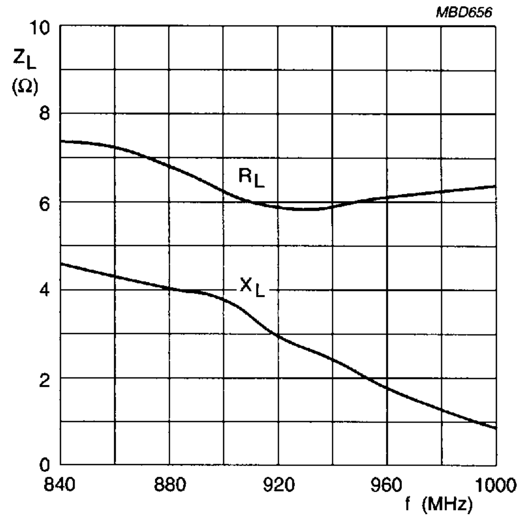
The components are situated on one side of the copper-clad PTFE microfibre-glass board. The other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through-metallization.

Fig.15 Component layout for 960 MHz class-AB test circuit.



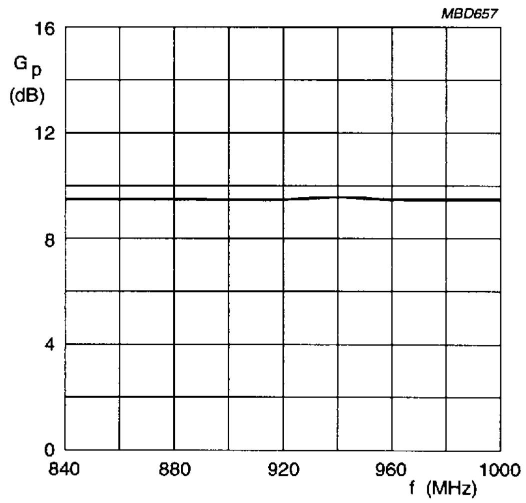

$V_{CE}$ = 25 V; $I_{CQ}$ = 2 × 75 mA; $T_h$ = 25 °C; $R_{th\ mb-h}$ = 0.5 K/W;
$P_L$ = 25 W.

Fig.16 Input impedance as a function of frequency (series components); typical values per section.




$V_{CE}$ = 25 V; $I_{CQ}$ = 2 × 75 mA; $T_h$ = 25 °C; $R_{th\ mb-h}$ = 0.5 K/W;
$P_L$ = 25 W.

Fig.17 Load impedance as a function of frequency (series components); typical values per section.




$V_{CE}$ = 25 V; $I_{CQ}$ = 2 × 75 mA; $T_h$ = 25 °C; $R_{th\ mb-h}$ = 0.5 K/W;
$P_L$ = 25 W.

Fig.18 Gain as a function of frequency, total device; typical values.

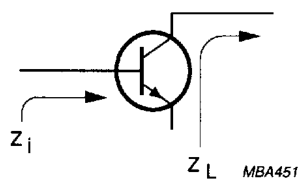
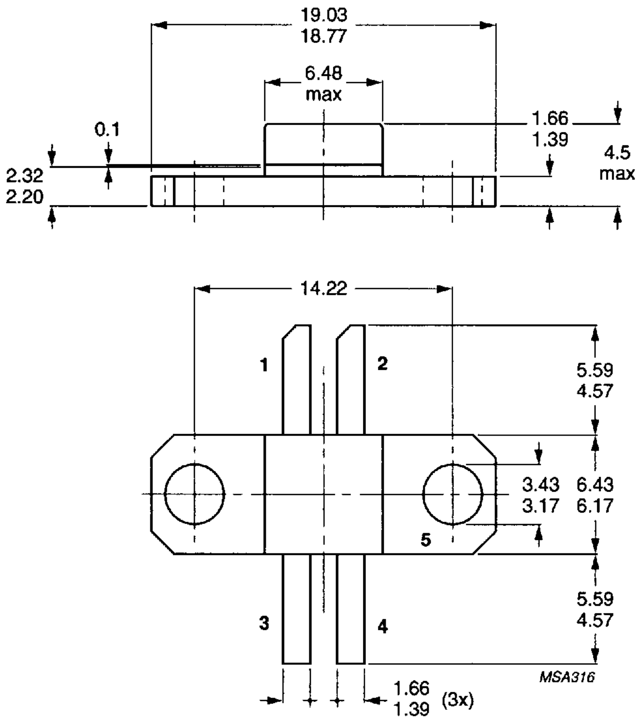



Fig.19 Definition of transistor impedance.

## 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.20 SOT324.