

# BFG10; BFG10/X

NPN 2 GHz RF power transistor

Rev. 05 — 22 November 2007

Product data sheet

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NXP Semiconductors

## NPN 2 GHz RF power transistor

## BFG10; BFG10/X

## FEATURES

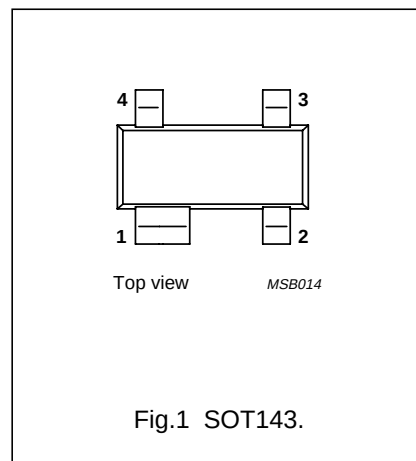
- High power gain
- High efficiency
- Small size discrete power amplifier
- 1.9 GHz operating area
- Gold metallization ensures excellent reliability.

## APPLICATIONS

- Common emitter class-AB operation in hand-held radio equipment at 1.9 GHz.

## PINNING

| PIN                        | DESCRIPTION |
|----------------------------|-------------|
| <b>BFG10</b> (see Fig.1)   |             |
| 1                          | collector   |
| 2                          | base        |
| 3                          | emitter     |
| 4                          | emitter     |
| <b>BFG10/X</b> (see Fig.1) |             |
| 1                          | collector   |
| 2                          | emitter     |
| 3                          | base        |
| 4                          | emitter     |



## DESCRIPTION

NPN silicon planar epitaxial transistor encapsulated in plastic, 4-pin dual-emitter SOT143 package.

## MARKING

| TYPE NUMBER | CODE |
|-------------|------|
| BFG10       | %MS  |
| BFG10/X     | %MT  |

## QUICK REFERENCE DATA

RF performance at  $T_{amb} = 25\text{ }^{\circ}\text{C}$  in a common-emitter test circuit (see Fig.7).

| MODE OF OPERATION                     | f<br>(GHz) | $V_{CE}$<br>(V) | $P_L$<br>(mW) | $G_p$<br>(dB) | $\eta_c$<br>(%) |
|---------------------------------------|------------|-----------------|---------------|---------------|-----------------|
| Pulsed, class-AB, duty cycle: < 1 : 8 | 1.9        | 3.6             | 200           | $\geq 5$      | $\geq 50$       |

## 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                                                 | —    | 20   | V                  |
| $V_{CEO}$   | collector-emitter voltage | open base                                                    | —    | 8    | V                  |
| $V_{EBO}$   | emitter-base voltage      | open collector                                               | —    | 2.5  | V                  |
| $I_C$       | collector current (DC)    |                                                              | —    | 250  | mA                 |
| $I_{C(AV)}$ | average collector current |                                                              | —    | 250  | mA                 |
| $P_{tot}$   | total power dissipation   | up to $T_s = 60\text{ }^{\circ}\text{C}$ ; see Fig.2; note 1 | —    | 400  | mW                 |
| $T_{stg}$   | storage temperature       |                                                              | -65  | +150 | $^{\circ}\text{C}$ |
| $T_j$       | junction temperature      |                                                              | —    | 175  | $^{\circ}\text{C}$ |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

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## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                                                               | VALUE | UNIT |
|---------------|-----------------------------------------------------|--------------------------------------------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | up to $T_s = 60\ ^\circ\text{C}$ ; note 1;<br>$P_{tot} = 400\ \text{mW}$ | 290   | K/W  |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

## CHARACTERISTICS

$T_j = 25\ ^\circ\text{C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                           | CONDITIONS                                                       | MIN. | MAX. | UNIT          |
|---------------|-------------------------------------|------------------------------------------------------------------|------|------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | open emitter; $I_C = 0.1\ \text{mA}$                             | 20   | —    | V             |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage | open base; $I_C = 5\ \text{mA}$                                  | 8    | —    | V             |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage      | open collector; $I_E = 0.1\ \text{mA}$                           | 2.5  | —    | V             |
| $I_{CES}$     | collector leakage current           | $V_{CE} = 5\ \text{V}$ ; $V_{BE} = 0$                            | —    | 100  | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                     | $I_C = 50\ \text{mA}$ ; $V_{CE} = 5\ \text{V}$                   | 25   | —    |               |
| $C_c$         | collector capacitance               | $I_E = I_E = 0$ ; $V_{CB} = 3.6\ \text{V}$ ; $f = 1\ \text{MHz}$ | —    | 3    | pF            |
| $C_{re}$      | feedback capacitance                | $I_C = 0$ ; $V_{CE} = 3.6\ \text{V}$ ; $f = 1\ \text{MHz}$       | —    | 2    | pF            |

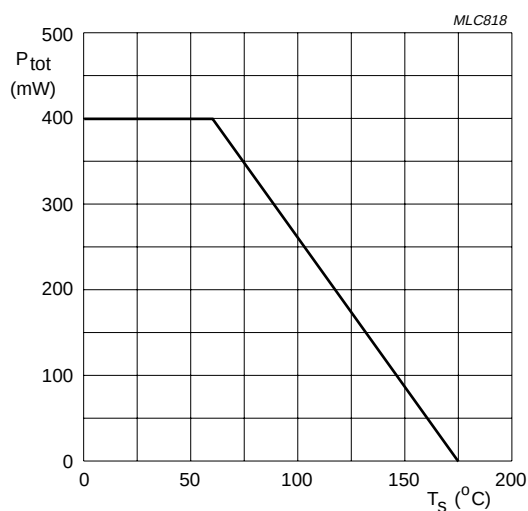
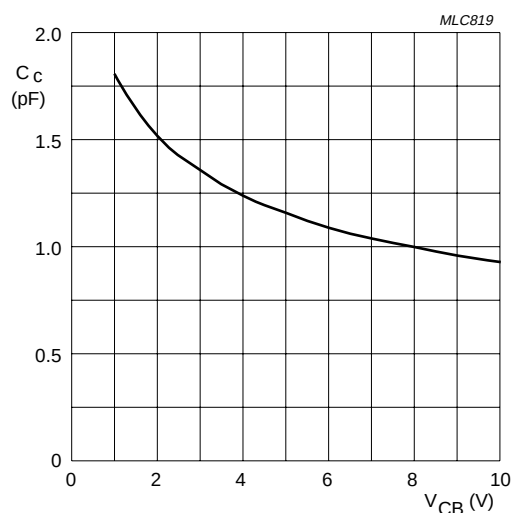


Fig. 2 Power derating curve



$I_C = 0$ ;  $f = 1\ \text{MHz}$ .

Fig. 3 Collector capacitance as a function of collector-base voltage; typical values.

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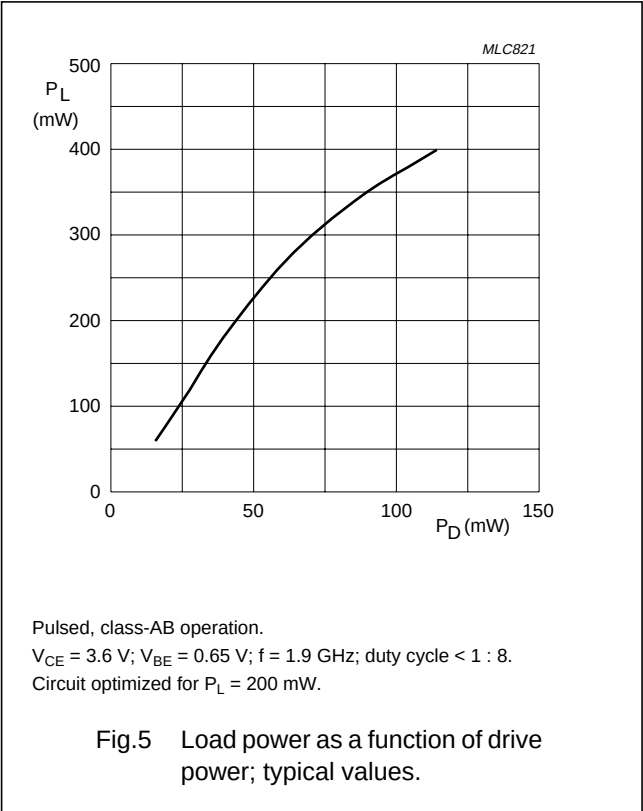
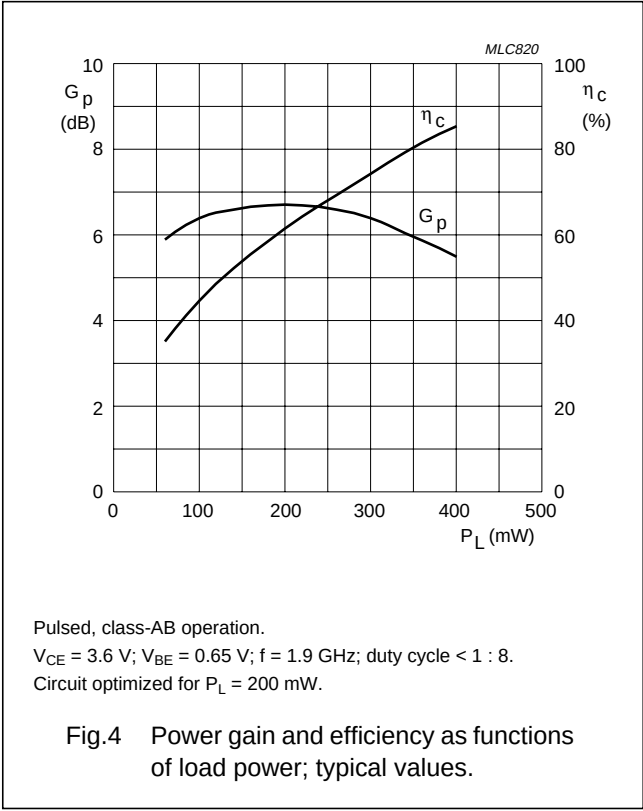
APPLICATION INFORMATION

RF performance at  $T_{amb} = 25\text{ }^{\circ}\text{C}$  in a common-emitter test circuit (see Fig.7).

| MODE OF OPERATION                     | f<br>(GHz) | V <sub>CE</sub><br>(V) | I <sub>CQ</sub><br>(mA) | P <sub>L</sub><br>(mW) | G <sub>p</sub><br>(dB) | η <sub>c</sub><br>(%) |
|---------------------------------------|------------|------------------------|-------------------------|------------------------|------------------------|-----------------------|
| Pulsed, class-AB, duty cycle: < 1 : 8 | 1.9        | 3.6                    | 1                       | 200                    | >5<br>typ. 7           | >50<br>typ. 60        |

Ruggedness in class-AB operation

The BFG10 is capable of withstanding a load mismatch corresponding to VSWR = 8 : 1 through all phases, at rated output power under pulsed conditions up to a supply voltage of 7 V, f = 1.9 GHz and a duty cycle of 1 : 8.



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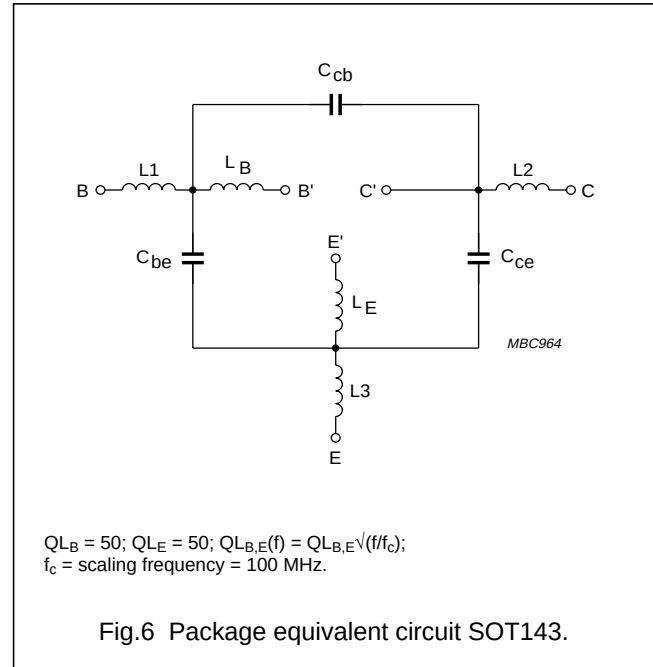
## BFG10; BFG10/X

## SPICE parameters for the BFG10 crystal

| SEQUENCE No.      | PARAMETER | VALUE | UNIT     |
|-------------------|-----------|-------|----------|
| 1                 | IS        | 2.714 | fA       |
| 2                 | BF        | 102.8 | —        |
| 3                 | NF        | 0.998 | —        |
| 4                 | VAF       | 28.12 | V        |
| 5                 | IKF       | 6.009 | A        |
| 6                 | ISE       | 403.2 | pA       |
| 7                 | NE        | 2.937 | —        |
| 8                 | BR        | 31.01 | —        |
| 9                 | NR        | 0.999 | —        |
| 10                | VAR       | 2.889 | V        |
| 11                | IKR       | 0.284 | A        |
| 12                | ISC       | 1.487 | fA       |
| 13                | NC        | 1.100 | —        |
| 14                | RB        | 3.500 | $\Omega$ |
| 15                | IRB       | 1.000 | $\mu$ A  |
| 16                | RBM       | 3.500 | $\Omega$ |
| 17                | RE        | 0.217 | $\Omega$ |
| 18                | RC        | 0.196 | $\Omega$ |
| 19 <sup>(1)</sup> | XTB       | 0.000 | —        |
| 20 <sup>(1)</sup> | EG        | 1.110 | eV       |
| 21 <sup>(1)</sup> | XTI       | 3.000 | —        |
| 22                | CJE       | 5.125 | pF       |
| 23                | VJE       | 0.600 | V        |
| 24                | MJE       | 0.367 | —        |
| 25                | TF        | 12.07 | ps       |
| 26                | XTF       | 99.40 | —        |
| 27                | VTF       | 7.220 | V        |
| 28                | ITF       | 3.950 | A        |
| 29                | PTF       | 0.000 | deg      |
| 30                | CJC       | 2.327 | pF       |
| 31                | VJC       | 0.668 | V        |
| 32                | MJC       | 0.398 | —        |
| 33                | XCJC      | 0.160 | —        |
| 34 <sup>(1)</sup> | TR        | 0.000 | ns       |
| 35 <sup>(1)</sup> | CJS       | 0.000 | F        |
| 36 <sup>(1)</sup> | VJS       | 750.0 | mV       |
| 37 <sup>(1)</sup> | MJS       | 0.000 | —        |
| 38                | FC        | 0.652 | —        |

## Note

- These parameters have not been extracted, the default values are shown.



## List of components (see Fig.6)

| DESIGNATION | VALUE | UNIT |
|-------------|-------|------|
| $C_{be}$    | 84    | fF   |
| $C_{cb}$    | 17    | fF   |
| $C_{ce}$    | 191   | fF   |
| L1          | 0.12  | nH   |
| L2          | 0.21  | nH   |
| L3          | 0.06  | nH   |
| $L_B$       | 0.95  | nH   |
| $L_E$       | 0.40  | nH   |

## NPN 2 GHz RF power transistor

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## Test circuit information

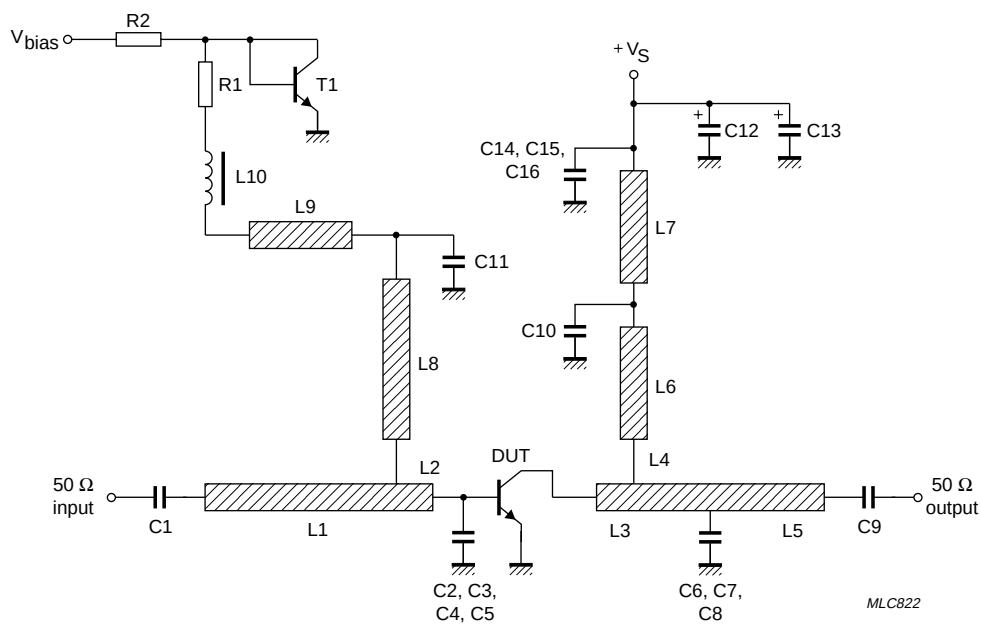


Fig.7 Common-emitter test circuit for class-AB operation at 1.9 GHz.

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## List of components used in test circuit (see Fig.7)

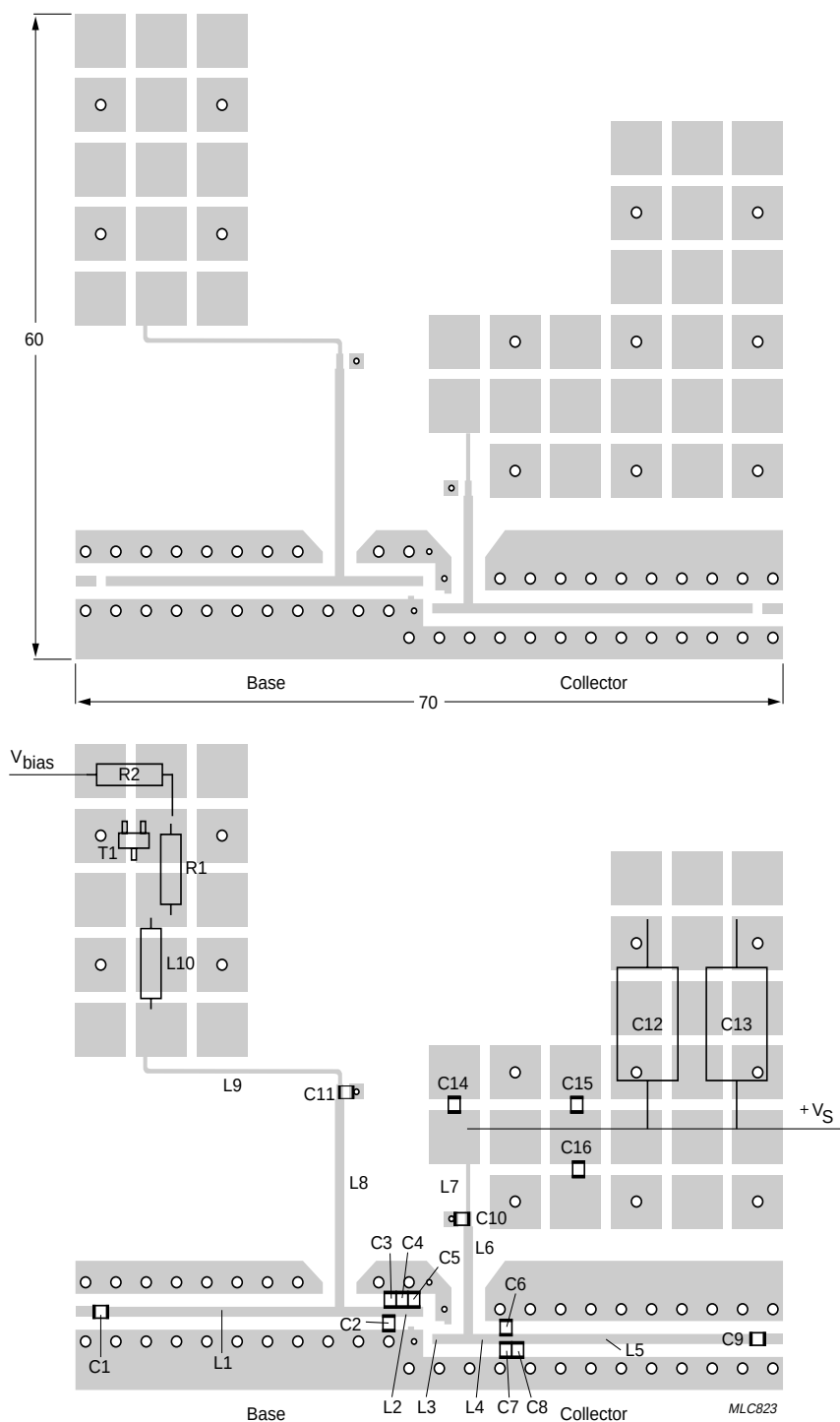
| COMPONENT              | DESCRIPTION                               | VALUE                | DIMENSIONS                      | CATALOGUE No.  |
|------------------------|-------------------------------------------|----------------------|---------------------------------|----------------|
| C1, C9, C10, C11       | multilayer ceramic chip capacitor; note 1 | 24 pF                |                                 |                |
| C2, C3, C4, C5, C6, C7 | multilayer ceramic chip capacitor; note 1 | 0.86 pF              |                                 |                |
| C8                     | multilayer ceramic chip capacitor; note 1 | 1.1 pF               |                                 |                |
| C12, C13               | electrolytic capacitor                    | 470 $\mu$ F; 10 V    |                                 | 2222 031 34471 |
| C14, C15, C16          | multilayer ceramic chip capacitor; note 1 | 10 nF                |                                 |                |
| L1                     | stripline; note 2                         |                      | length 28.5 mm<br>width 0.93 mm |                |
| L2                     | stripline; note 2                         |                      | length 2.3 mm<br>width 0.93 mm  |                |
| L3                     | stripline; note 2                         |                      | length 3.1 mm<br>width 0.93 mm  |                |
| L4                     | stripline; note 2                         |                      | length 3.3 mm<br>width 0.93 mm  |                |
| L5                     | stripline; note 2                         |                      | length 16.3 mm<br>width 0.93 mm |                |
| L6                     | stripline; note 2                         |                      | length 10 mm<br>width 0.93 mm   |                |
| L7                     | stripline; note 2                         |                      | length 4.4 mm<br>width 0.4 mm   |                |
| L8                     | stripline; note 2                         |                      | length 19.3 mm<br>width 0.93 mm |                |
| L9                     | stripline; note 2                         |                      | length 19.7 mm<br>width 0.4 mm  |                |
| L10                    | micro choke                               |                      |                                 |                |
| T1                     | BD228                                     |                      |                                 |                |
| R1                     | metal film resistor                       | 20 $\Omega$ ; 0.4 W  |                                 | 2322 157 10209 |
| R2                     | metal film resistor                       | 530 $\Omega$ ; 0.4 W |                                 | 2322 157 15301 |

## Notes

1. American Technical Ceramics (ATC) capacitor, type 100A or other capacitor of the same quality.
2. The striplines are on a  $\frac{1}{32}$  inch double copper-clad printed-circuit board with PTFE fibre-glass dielectric ( $\epsilon_r = 6$ ).

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Dimensions in mm.

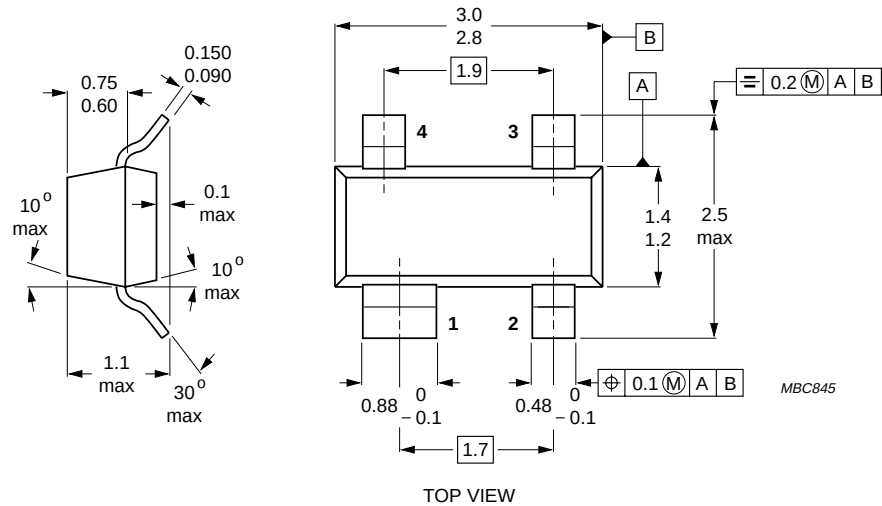
The components are situated on one side of the copper-clad PTFE microfibre-glass board, the other side is not etched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through metallization.

Fig.8 Printed-circuit board and component lay-out for common-emitter test circuit in Fig.7.

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## PACKAGE OUTLINE



Dimensions in mm.

Fig.9 SOT143.

## Legal information

### Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | Definition                                                                            |
|-----------------------------------|-------------------------------|---------------------------------------------------------------------------------------|
| Objective [short] data sheet      | Development                   | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet    | Qualification                 | This document contains data from the preliminary specification.                       |
| Product [short] data sheet        | Production                    | This document contains the product specification.                                     |

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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