

# DATA SHEET

## **BFG10; BFG10/X** NPN 2 GHz RF power transistor

Product specification  
Supersedes data of 1995 Mar 07  
File under Discrete Semiconductors, SC14

1995 Aug 31

## NPN 2 GHz RF power transistor

## BFG10; BFG10/X

## FEATURES

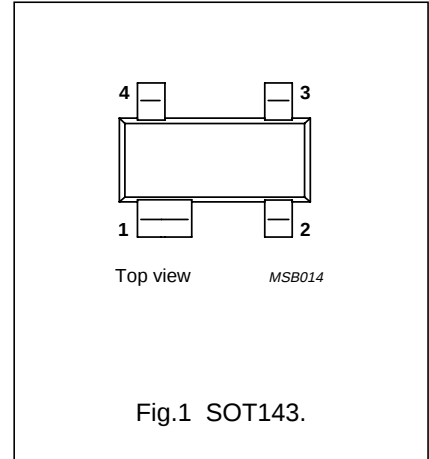
- High power gain
- High efficiency
- Small size discrete power amplifier
- 1.9 GHz operating area
- Gold metallization ensures excellent reliability.

## 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       | N70  |
| BFG10/X     | N71  |

## 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 <sub>CE</sub><br>(V) | P <sub>L</sub><br>(mW) | G <sub>p</sub><br>(dB) | $\eta_c$<br>(%) |
|---------------------------------------|------------|------------------------|------------------------|------------------------|-----------------|
| Pulsed, class-AB, duty cycle: < 1 : 8 | 1.9        | 3.6                    | 200                    | ≥5                     | ≥50             |

## LIMITING VALUES

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

| SYMBOL             | PARAMETER                 | CONDITIONS                                      | MIN. | MAX. | UNIT |
|--------------------|---------------------------|-------------------------------------------------|------|------|------|
| V <sub>CB0</sub>   | collector-base voltage    | open emitter                                    | –    | 20   | V    |
| V <sub>CEO</sub>   | collector-emitter voltage | open base                                       | –    | 8    | V    |
| V <sub>EBO</sub>   | emitter-base voltage      | open collector                                  | –    | 2.5  | V    |
| I <sub>C</sub>     | collector current (DC)    |                                                 | –    | 250  | mA   |
| I <sub>C(AV)</sub> | average collector current |                                                 | –    | 250  | mA   |
| P <sub>tot</sub>   | total power dissipation   | up to T <sub>s</sub> = 60 °C; see Fig.2; note 1 | –    | 400  | mW   |
| T <sub>stg</sub>   | storage temperature       |                                                 | –65  | +150 | °C   |
| T <sub>j</sub>     | junction temperature      |                                                 | –    | 175  | °C   |

## Note

1. T<sub>s</sub> 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 $T_s = 60\text{ }^{\circ}\text{C}$ ; note 1;<br>$P_{tot} = 400\text{ mW}$ | 290   | K/W  |

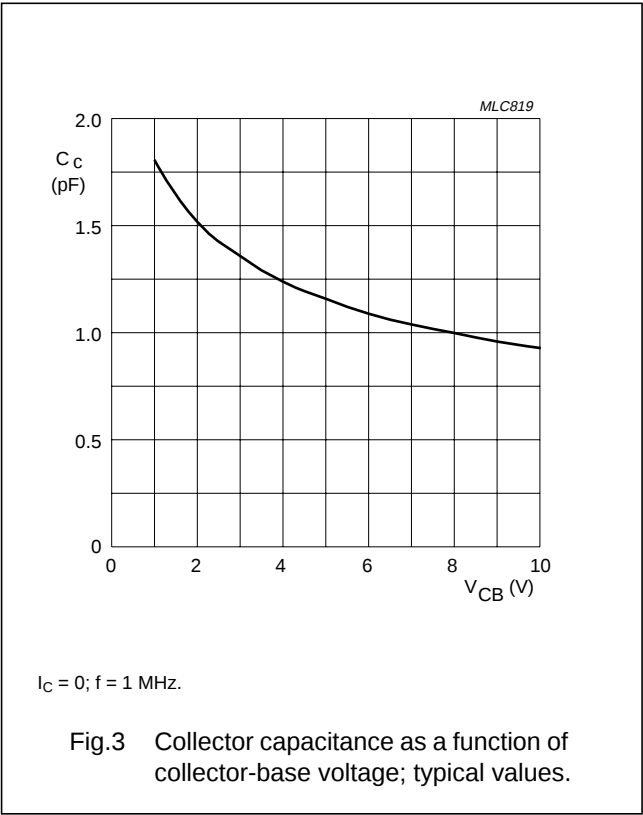
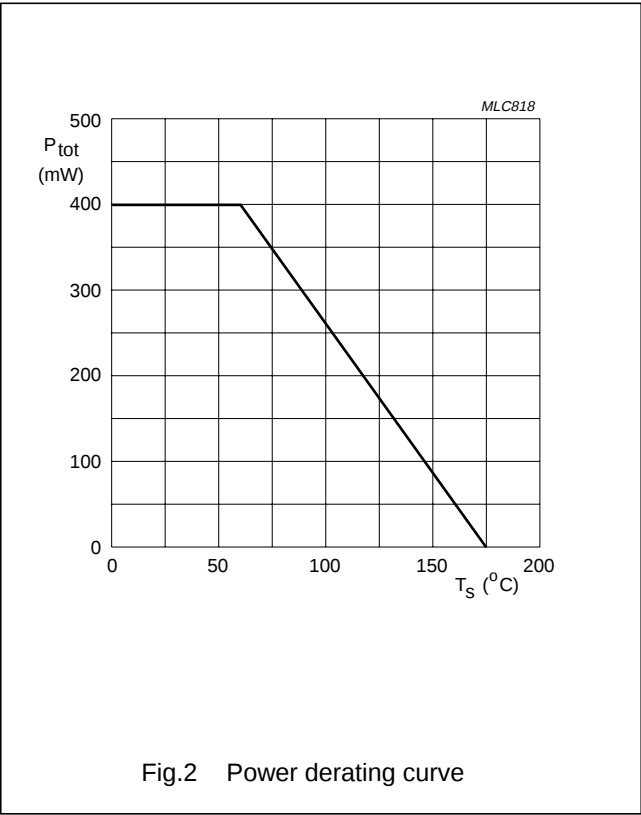
Note

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

CHARACTERISTICS

$T_j = 25\text{ }^{\circ}\text{C}$  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            |



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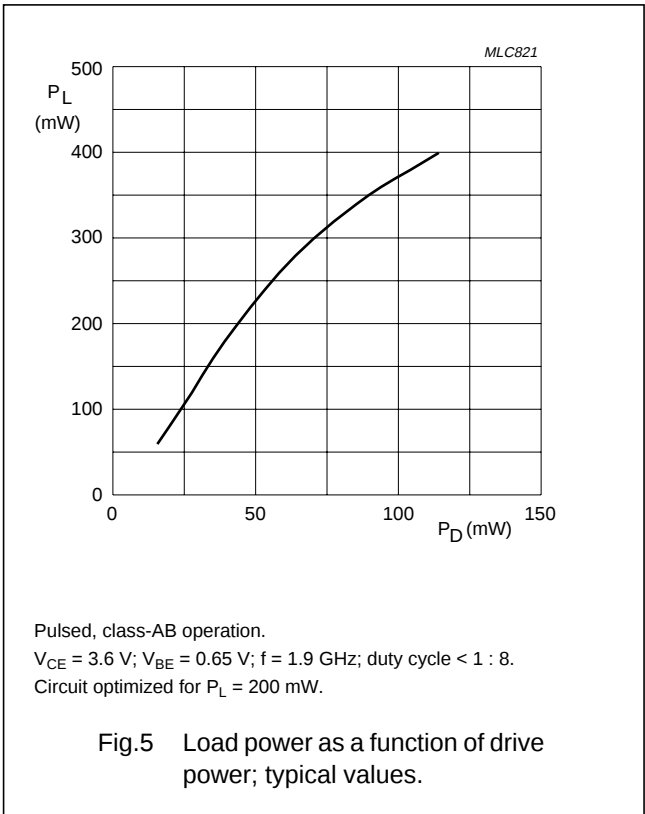
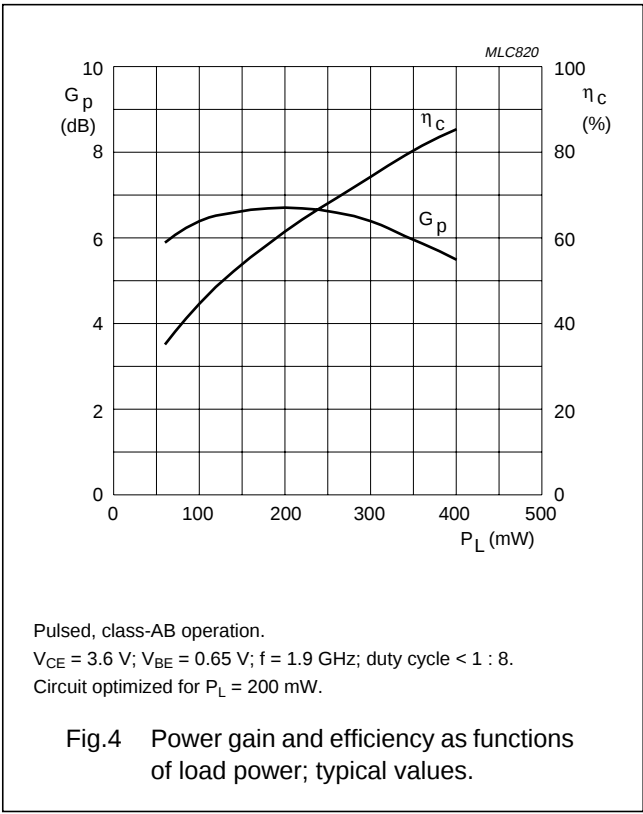
APPLICATION INFORMATION

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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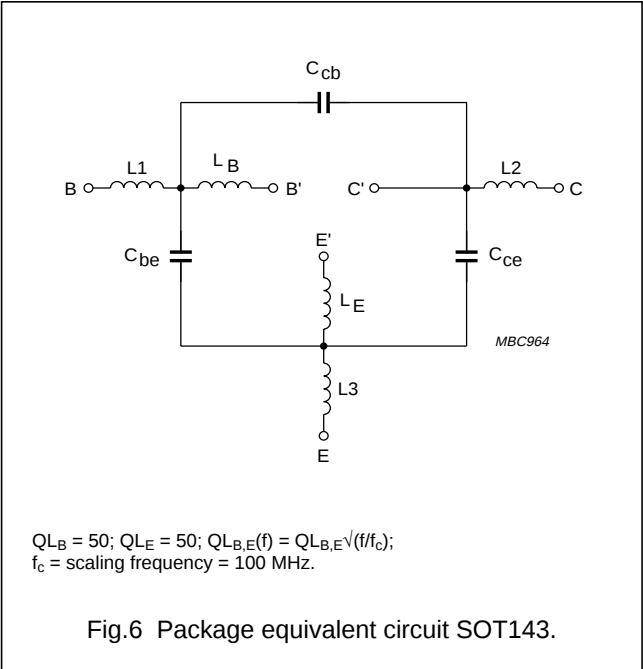
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SPICE parameters for the BFG10 crystal

| 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 | Ω    |
| 15                | IRB       | 1.000 | μA   |
| 16                | RBM       | 3.500 | Ω    |
| 17                | RE        | 0.217 | Ω    |
| 18                | RC        | 0.196 | Ω    |
| 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

1. 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   |

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## Test circuit information

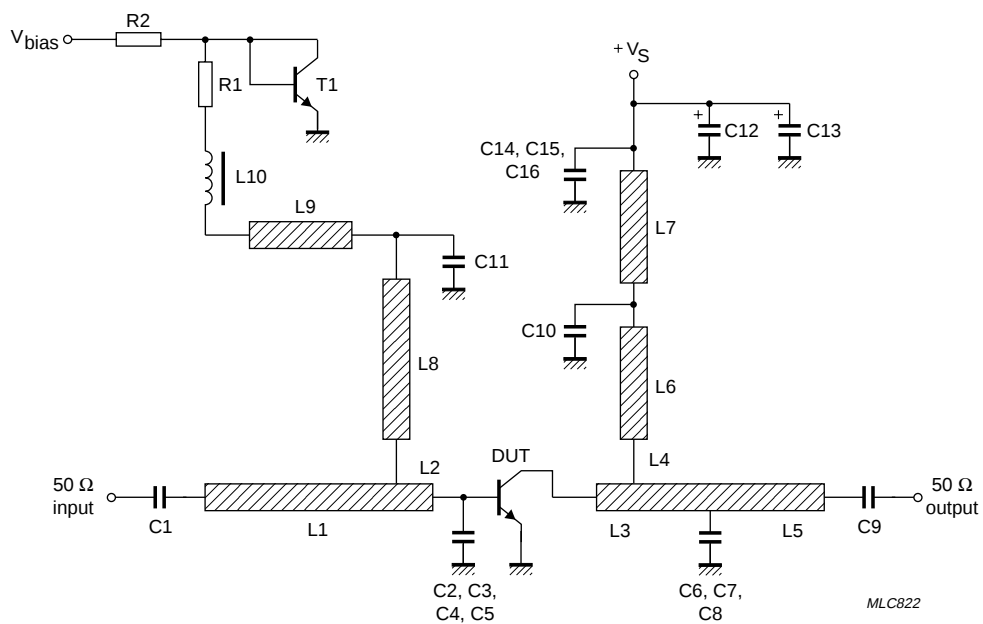


Fig.7 Common-emitter test circuit for class-AB operation at 1.9 GHz.

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

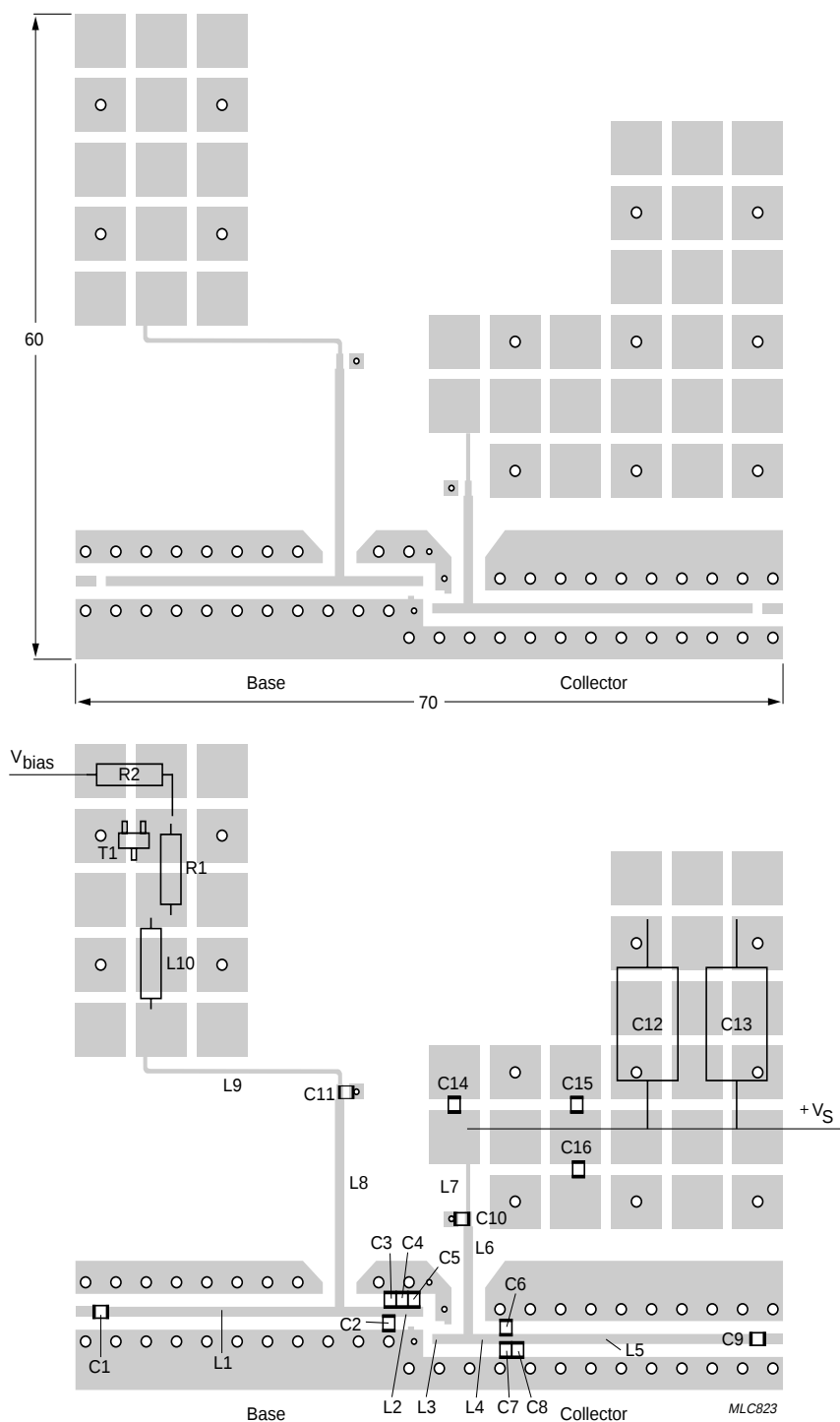
| COMPONENT              | DESCRIPTION                               | VALUE                | DIMENSIONS                      | CATALOGUE No.  |
|------------------------|-------------------------------------------|----------------------|---------------------------------|----------------|
| C1, C9, C10, 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.

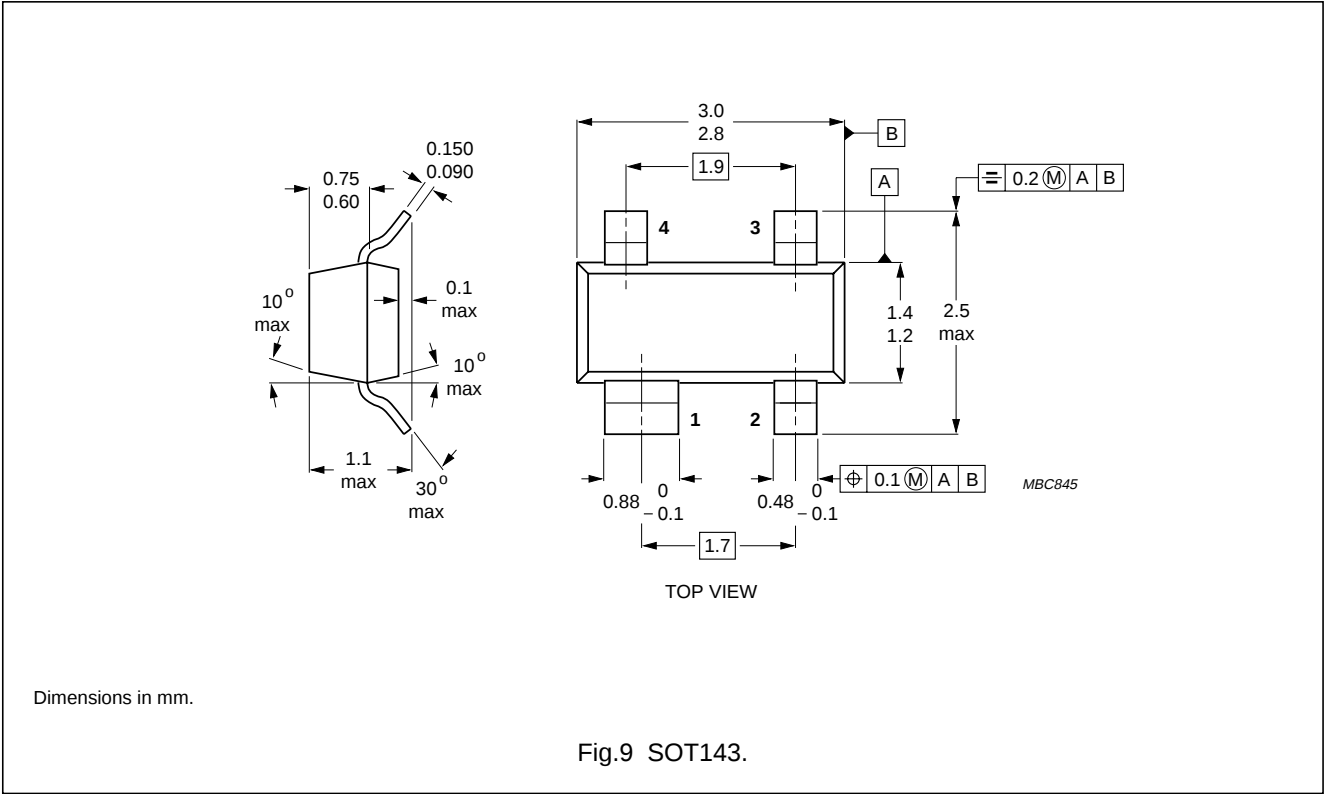
The components are situated on one side of the copper-clad PTFE microfibre-glass board, the other side is not etched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through metallization.

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

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PACKAGE OUTLINE



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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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