

# BFG10; BFG10/X

NPN 2 GHz RF power transistor

Rev. 05 — 22 November 2007

Product data sheet

## IMPORTANT NOTICE

Dear customer,

As from October 1st, 2006 Philips Semiconductors has a new trade name - NXP Semiconductors, which will be used in future data sheets together with new contact details.

In data sheets where the previous Philips references remain, please use the new links as shown below.

<http://www.philips.semiconductors.com> use <http://www.nxp.com>

<http://www.semiconductors.philips.com> use <http://www.nxp.com> (Internet)

[sales.addresses@www.semiconductors.philips.com](mailto:sales.addresses@www.semiconductors.philips.com) use [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com) (email)

The copyright notice at the bottom of each page (or elsewhere in the document, depending on the version)

- © Koninklijke Philips Electronics N.V. (year). All rights reserved -  
is replaced with:  
- © NXP B.V. (year). All rights reserved. -

If you have any questions related to the data sheet, please contact our nearest sales office via e-mail or phone (details via [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)). Thank you for your cooperation and understanding,

NXP Semiconductors

## NPN 2 GHz RF power transistor

## BFG10; BFG10/X

## FEATURES

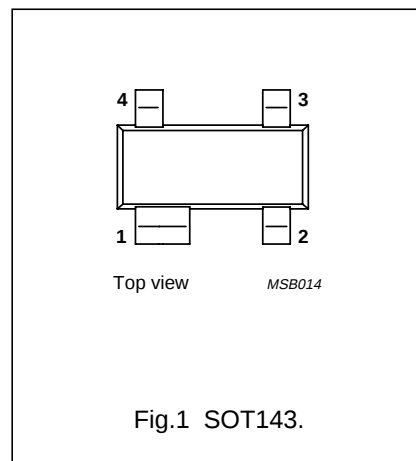
- High power gain
- High efficiency
- Small size discrete power amplifier
- 1.9 GHz operating area
- Gold metallization ensures excellent reliability.

## 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.

## NPN 2 GHz RF power transistor

## BFG10; BFG10/X

## 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            |

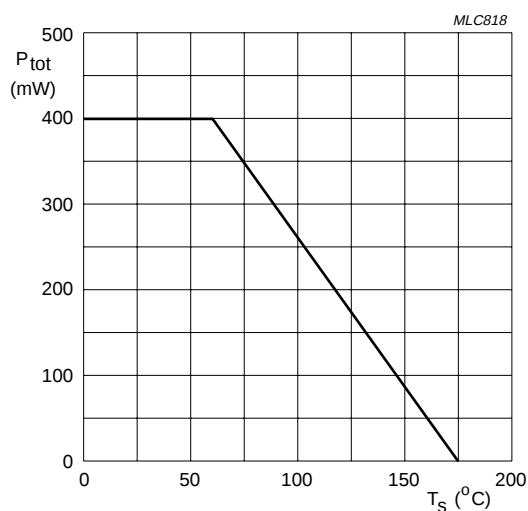
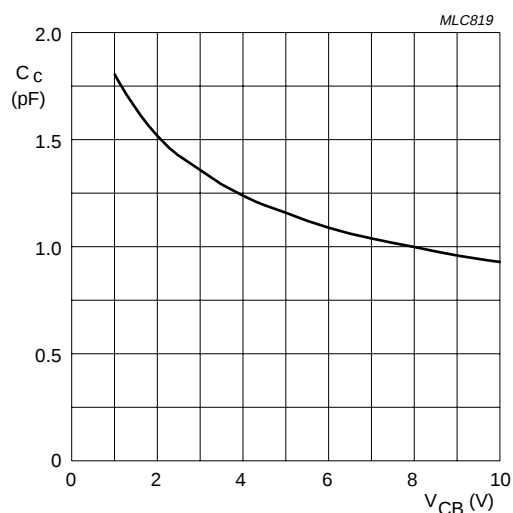


Fig. 2 Power derating curve



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

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

NPN 2 GHz RF power transistor

BFG10; BFG10/X

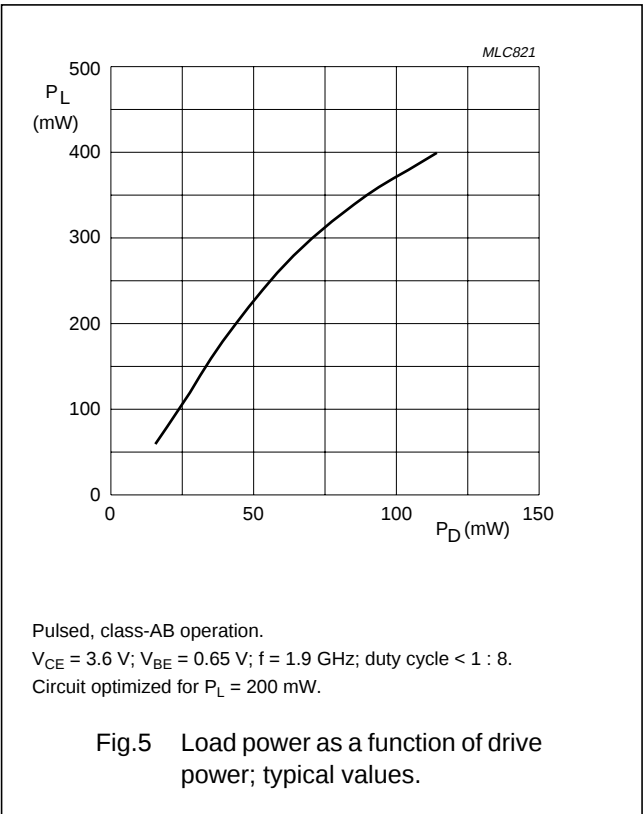
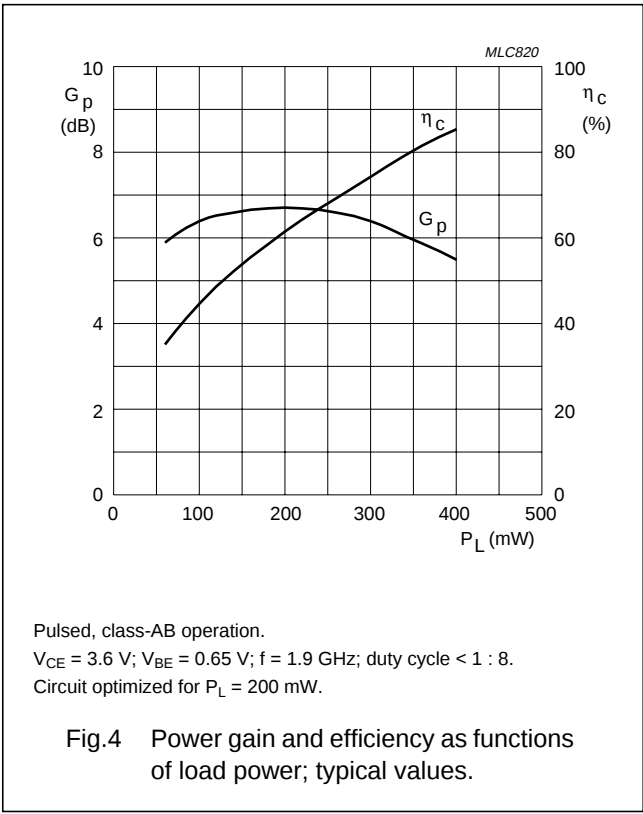
APPLICATION INFORMATION

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.



## NPN 2 GHz RF power transistor

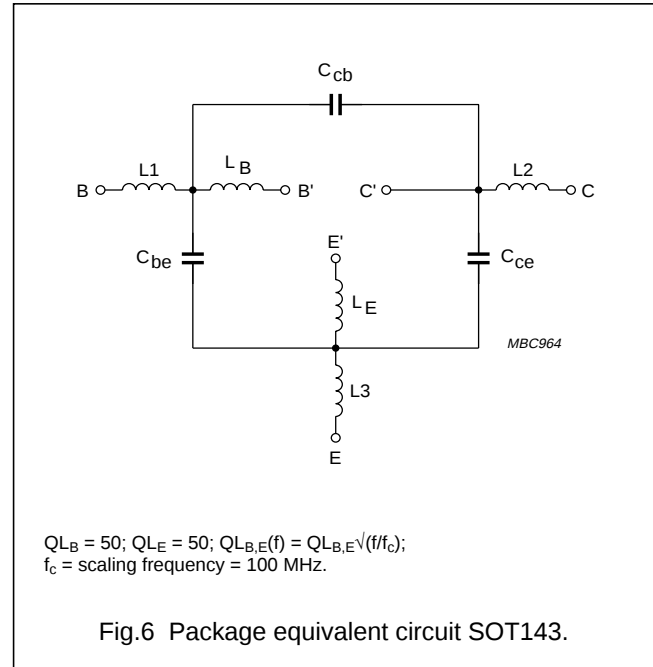
## BFG10; BFG10/X

## 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

## BFG10; BFG10/X

## Test circuit information

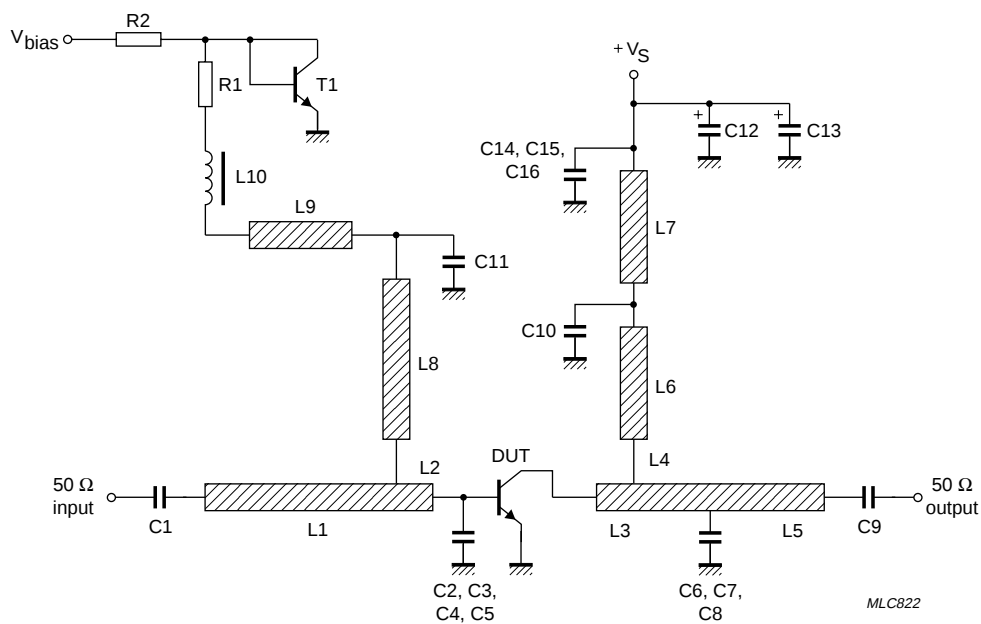


Fig.7 Common-emitter test circuit for class-AB operation at 1.9 GHz.

## NPN 2 GHz RF power transistor

## BFG10; BFG10/X

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

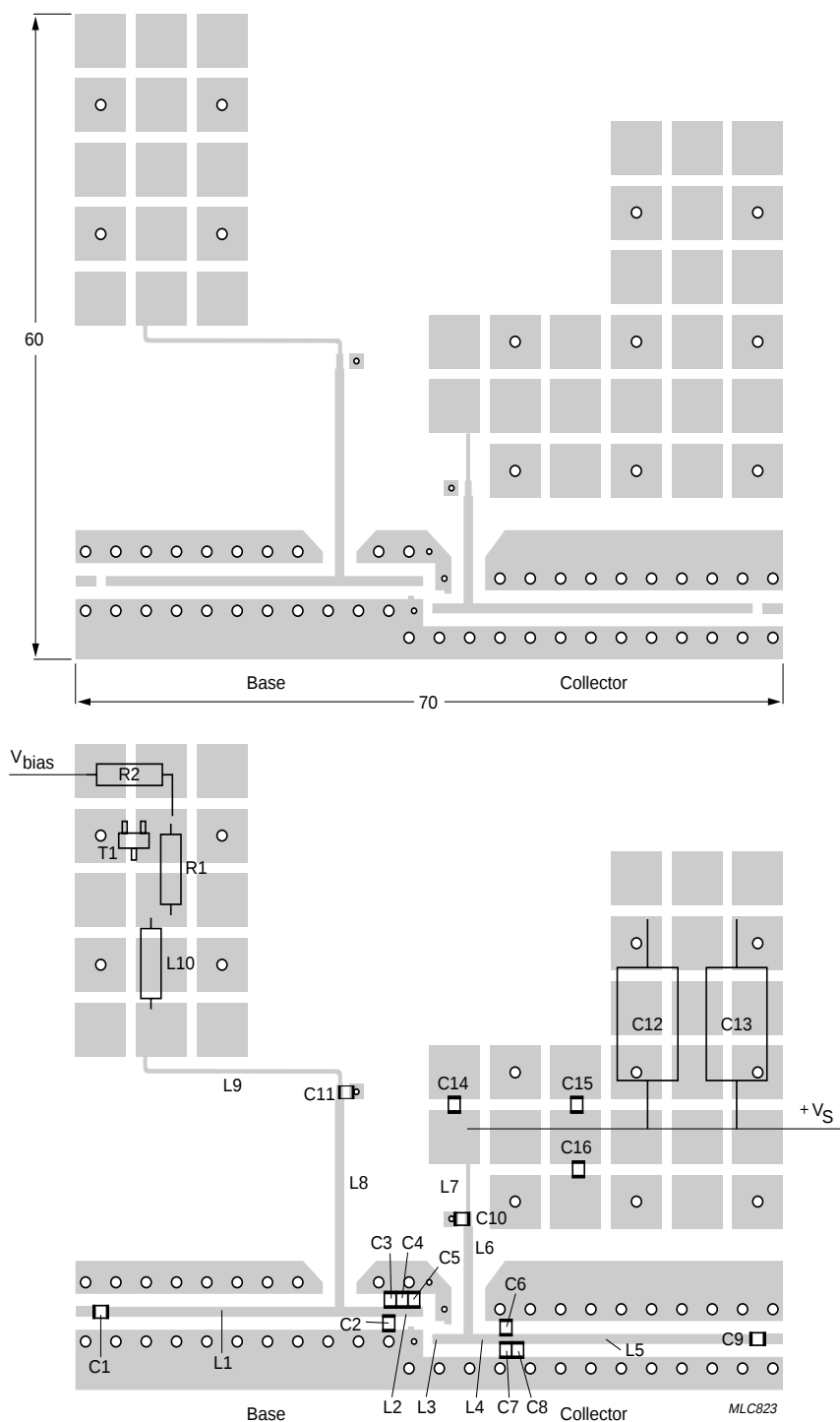
| COMPONENT              | DESCRIPTION                               | VALUE                | DIMENSIONS                      | CATALOGUE No.  |
|------------------------|-------------------------------------------|----------------------|---------------------------------|----------------|
| C1, C9, C10, 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 ( $\epsilon_r = 6$ ).

## NPN 2 GHz RF power transistor

## BFG10; BFG10/X



Dimensions in mm.

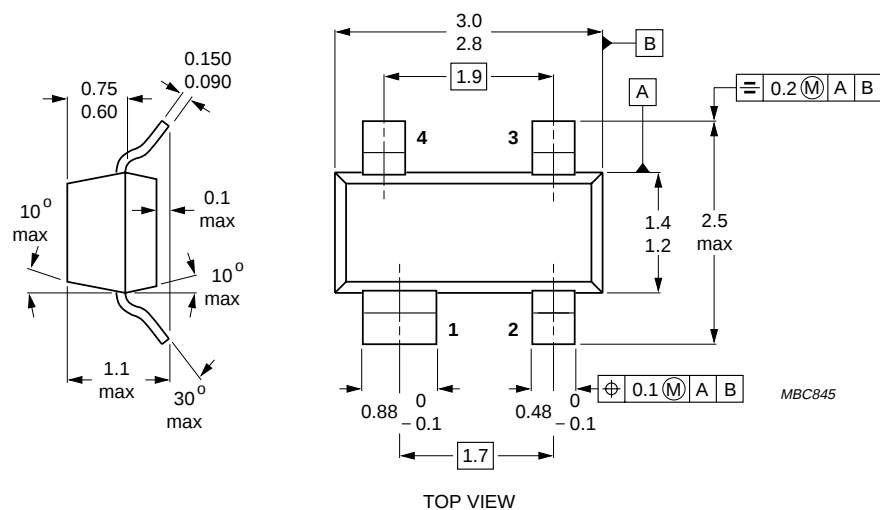
The components are situated on one side of the copper-clad PTFE microfiber-glass board, the other side is not etched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through metallization.

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

## NPN 2 GHz RF power transistor

BFG10; BFG10/X

## 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

### Definitions

**Draft** — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

**Short data sheet** — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

### Disclaimers

**General** — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

**Right to make changes** — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

**Suitability for use** — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or

malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

**Applications** — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

**Limiting values** — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) may cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of this document is not implied. Exposure to limiting values for extended periods may affect device reliability.

**Terms and conditions of sale** — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nxp.com/profile/terms>, including those pertaining to warranty, intellectual property rights infringement and limitation of liability, unless explicitly otherwise agreed to in writing by NXP Semiconductors. In case of any inconsistency or conflict between information in this document and such terms and conditions, the latter will prevail.

**No offer to sell or license** — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

### Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

## Contact information

For additional information, please visit: <http://www.nxp.com>

For sales office addresses, send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

## Revision history

### Revision history

| Document ID                                                                                          | Release date | Data sheet status     | Change notice | Supersedes |
|------------------------------------------------------------------------------------------------------|--------------|-----------------------|---------------|------------|
| BFG10X_N_5                                                                                           | 20071122     | Product data sheet    | -             | BFG10X_4   |
| Modifications: <ul style="list-style-type: none"><li>Marking table on page 2; changed code</li></ul> |              |                       |               |            |
| BFG10X_4                                                                                             | 19950831     | Product specification | -             | BFG10X_3   |
| BFG10X_3                                                                                             | 19950307     | -                     | -             | BFG10X_2   |
| BFG10X_2                                                                                             | -            | -                     | -             | BFG10X_1   |
| BFG10X_1                                                                                             | -            | -                     | -             | -          |

Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

founded by

**PHILIPS**

© NXP B.V. 2007.

All rights reserved.

For more information, please visit: <http://www.nxp.com>

For sales office addresses, please send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

Date of release: 22 November 2007

Document identifier: BFG10X\_N\_5