

# BFG67; BFG67/X; BFG67/XR

NPN 8 GHz wideband transistors

Rev. 05 — 23 November 2007

Product data sheet

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NXP Semiconductors

# NPN 8 GHz wideband transistors

# BFG67; BFG67/X; BFG67/XR

## FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability.

## APPLICATIONS

Wideband applications in the GHz range, such as satellite TV tuners and portable RF communications equipment.

## DESCRIPTION

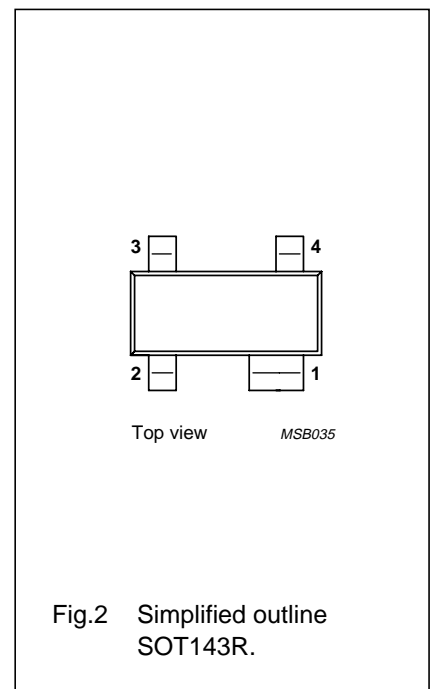
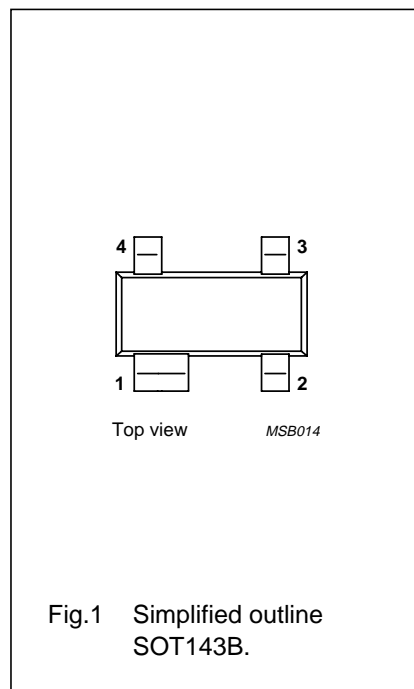
NPN silicon transistor in a 4-pin, dual-emitter SOT143B plastic package. Available with in-line emitter pinning (BFG67) and cross emitter pinning (BFG67/X). Version with reverse pinning (BFG67/XR) also available on request.

## MARKING

| TYPE NUMBER      | CODE |
|------------------|------|
| BFG67 (Fig.1)    | V3%  |
| BFG67/X (Fig.1)  | %MV  |
| BFG67/XR (Fig.2) | V26  |

## PINNING

| PIN | DESCRIPTION |           |           |
|-----|-------------|-----------|-----------|
|     | BFG67       | BFG67/X   | BFG67/XR  |
| 1   | collector   | collector | collector |
| 2   | base        | emitter   | emitter   |
| 3   | emitter     | base      | base      |
| 4   | emitter     | emitter   | emitter   |



## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                     | CONDITIONS  | TYP. | MAX. | UNIT |
|-----------|-------------------------------|---|------|------|------|
| $V_{CE0}$ | collector-emitter voltage     | open base   | –    | 10   | V    |
| $I_C$     | collector current (DC)        |   | –    | 50   | mA   |
| $P_{tot}$ | total power dissipation       | $T_s \leq 65\text{ }^\circ\text{C}$   | –    | 300  | mW   |
| $C_{re}$  | feedback capacitance          | $I_C = i_c = 0; V_{CB} = 8\text{ V}; f = 1\text{ MHz}$  | 0.5  | –    | pF   |
| $f_T$     | transition frequency          | $I_C = 15\text{ mA}; V_{CE} = 8\text{ V}; f = 500\text{ MHz}$   | 8    | –    | GHz  |
| $G_{UM}$  | maximum unilateral power gain | $I_C = 15\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ }^\circ\text{C}; f = 1\text{ GHz}$                         | 17   | –    | dB   |
| F         | noise figure                  | $\Gamma_s = \Gamma_{opt}; I_C = 5\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ }^\circ\text{C}; f = 1\text{ GHz}$ | 1.3  | –    | dB   |
|           |                               | $\Gamma_s = \Gamma_{opt}; I_C = 5\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ }^\circ\text{C}; f = 2\text{ GHz}$ | 2.2  | –    | dB   |

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**LIMITING VALUES**

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

| SYMBOL           | PARAMETER                 | CONDITIONS                                | MIN. | MAX. | UNIT |
|------------------|---------------------------|---|------|------|------|
| V <sub>CBO</sub> | collector-base voltage    | open emitter                              | –    | 20   | V    |
| V <sub>CEO</sub> | collector-emitter voltage | open base                                 | –    | 10   | V    |
| V <sub>EBO</sub> | emitter-base voltage      | open collector                            | –    | 2.5  | V    |
| I <sub>C</sub>   | collector current (DC)    |   | –    | 50   | mA   |
| P <sub>tot</sub> | total power dissipation   | T <sub>s</sub> ≤ 65 °C; see Fig.3; note 1 | –    | 380  | mW   |
| T <sub>stg</sub> | storage temperature range |   | –65  | 150  | °C   |
| T <sub>j</sub>   | junction temperature      |   | –    | 175  | °C   |

**Note**

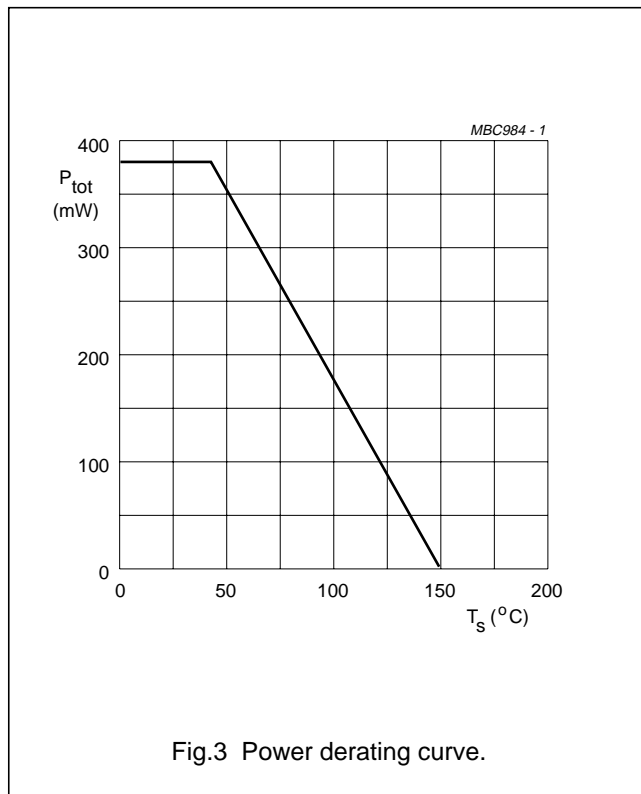
1. T<sub>s</sub> is the temperature at the soldering point of the collector pin.

**THERMAL CHARACTERISTICS**

| SYMBOL              | PARAMETER   | CONDITIONS | VALUE | UNIT |
|---------------------|---|------------|-------|------|
| R <sub>th j-s</sub> | thermal resistance from junction to soldering point | note 1     | 290   | K/W  |

**Note**

1. T<sub>s</sub> is the temperature at the soldering point of the collector pin.



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## BFG67; BFG67/X; BFG67/XR

**CHARACTERISTICS**

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

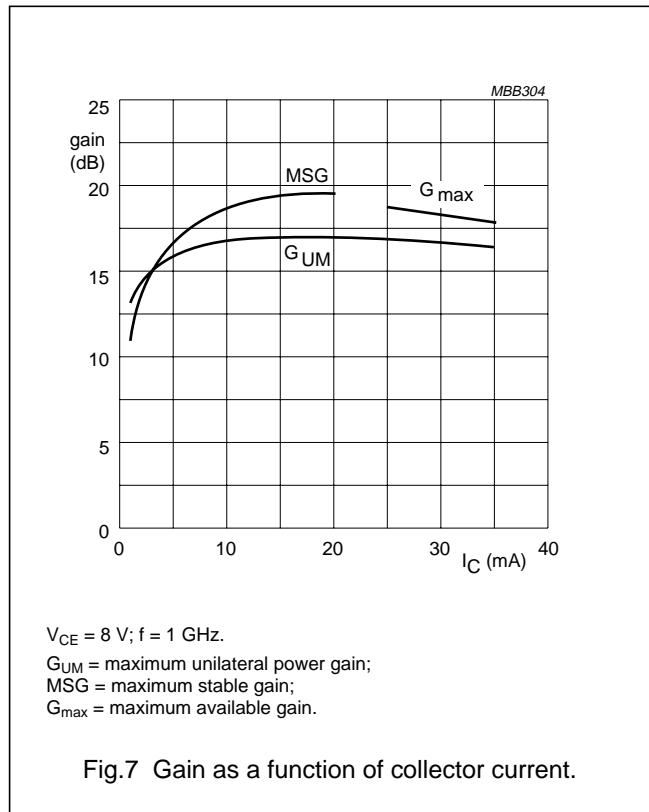
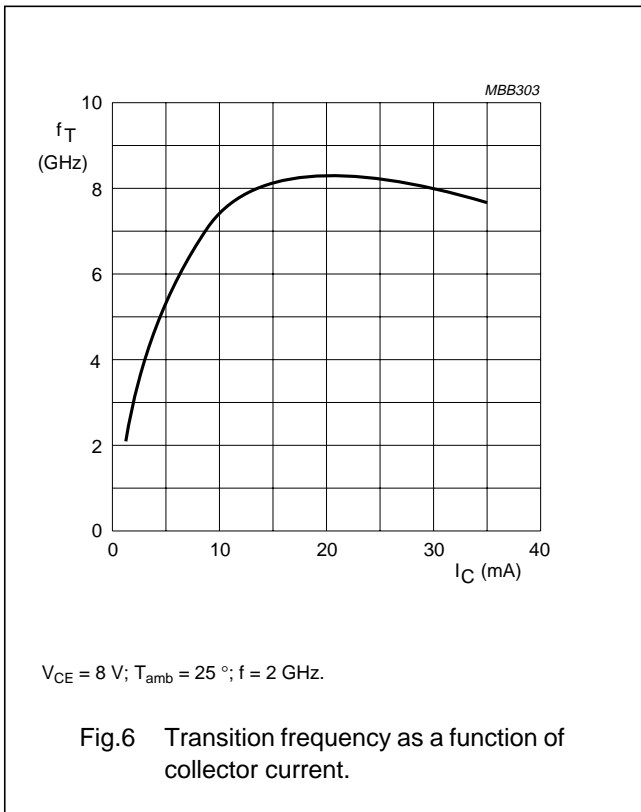
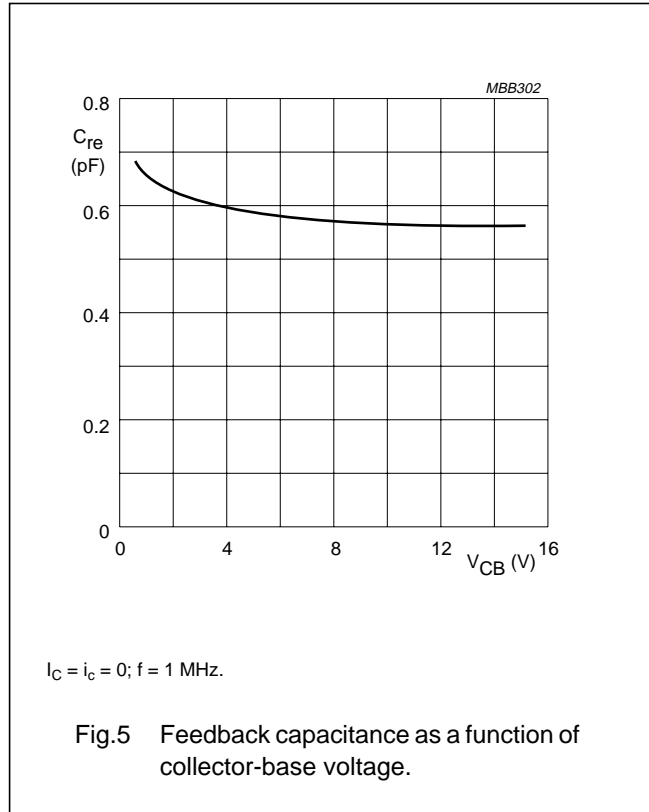
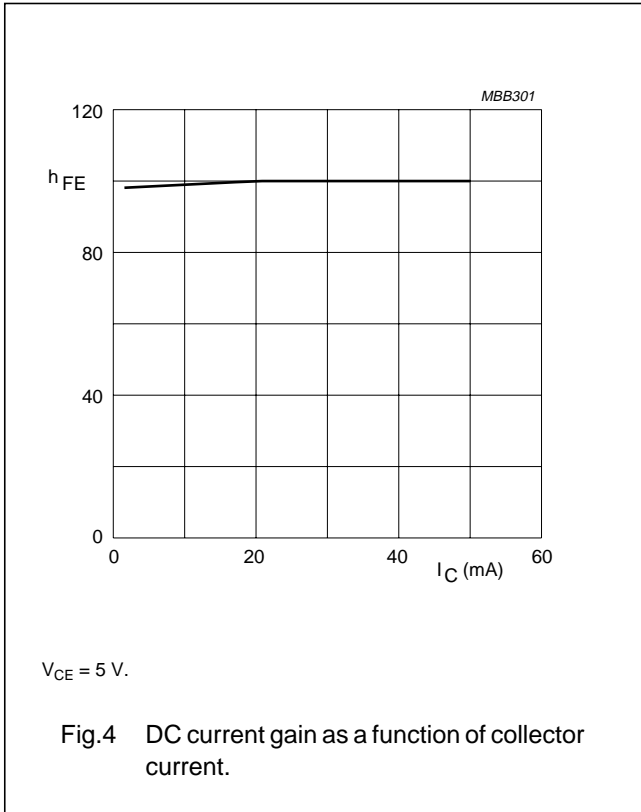
| SYMBOL    | PARAMETER                             | CONDITIONS   | MIN. | TYP. | MAX. | UNIT |
|-----------|---------------------------------------|--|------|------|------|------|
| $I_{CBO}$ | collector leakage current             | $V_{CB} = 5\text{ V}; I_E = 0$   | –    | –    | 50   | nA   |
| $h_{FE}$  | DC current gain                       | $I_C = 15\text{ mA}; V_{CE} = 5\text{ V}$  | 60   | 100  | –    |      |
| $f_T$     | transition frequency                  | $I_C = 15\text{ mA}; V_{CE} = 8\text{ V}; f = 500\text{ MHz}$  | –    | 8    | –    | GHz  |
| $C_c$     | collector capacitance                 | $I_E = i_e = 0; V_{CB} = 8\text{ V}; f = 1\text{ MHz}$   | –    | 0.7  | –    | pF   |
| $C_e$     | emitter capacitance                   | $I_C = i_c = 0; V_{EB} = 0.5\text{ V}; f = 1\text{ MHz}$   | –    | 1.3  | –    | pF   |
| $C_{re}$  | feedback capacitance                  | $I_C = i_c = 0; V_{CB} = 8\text{ V}; f = 1\text{ MHz}$   | –    | 0.5  | –    | pF   |
| $G_{UM}$  | maximum unilateral power gain; note 1 | $I_C = 15\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ °C}; f = 1\text{ GHz}$                          | –    | 17   | –    | dB   |
|           |                                       | $I_C = 15\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ °C}; f = 2\text{ GHz}$                          | –    | 10   | –    | dB   |
| F         | noise figure                          | $\Gamma_s = \Gamma_{opt}; I_C = 5\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ °C}; f = 1\text{ GHz}$  | –    | 1.3  | –    | dB   |
|           |                                       | $\Gamma_s = \Gamma_{opt}; I_C = 15\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ °C}; f = 1\text{ GHz}$ | –    | 1.7  | –    | dB   |
|           |                                       | $I_C = 5\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ °C}; f = 2\text{ GHz}; Z_S = 60\ \Omega$         | –    | 2.5  | –    | dB   |
|           |                                       | $I_C = 15\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ °C}; f = 2\text{ GHz}; Z_S = 60\ \Omega$        | –    | 3    | –    | dB   |

**Note**

1.  $G_{UM}$  is the maximum unilateral power gain, assuming  $S_{12}$  is zero and  $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$  dB.

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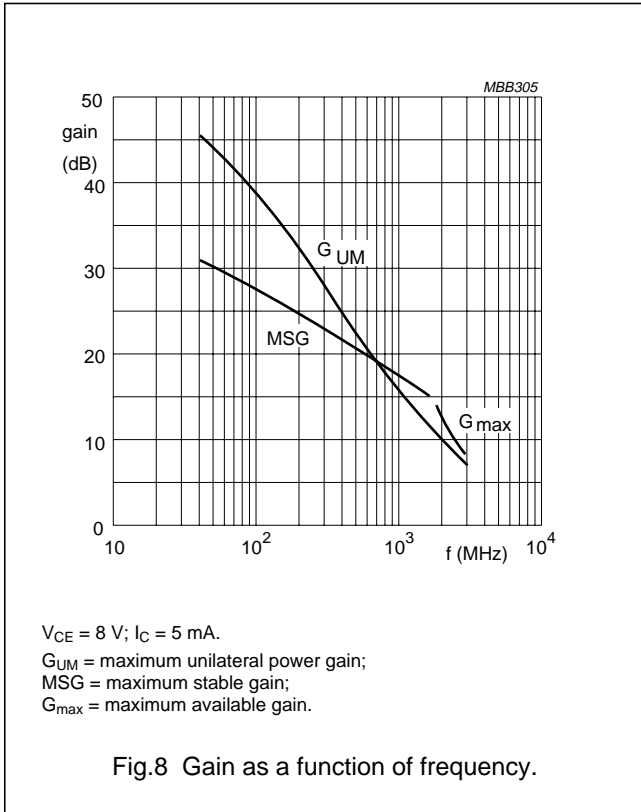


Fig.8 Gain as a function of frequency.

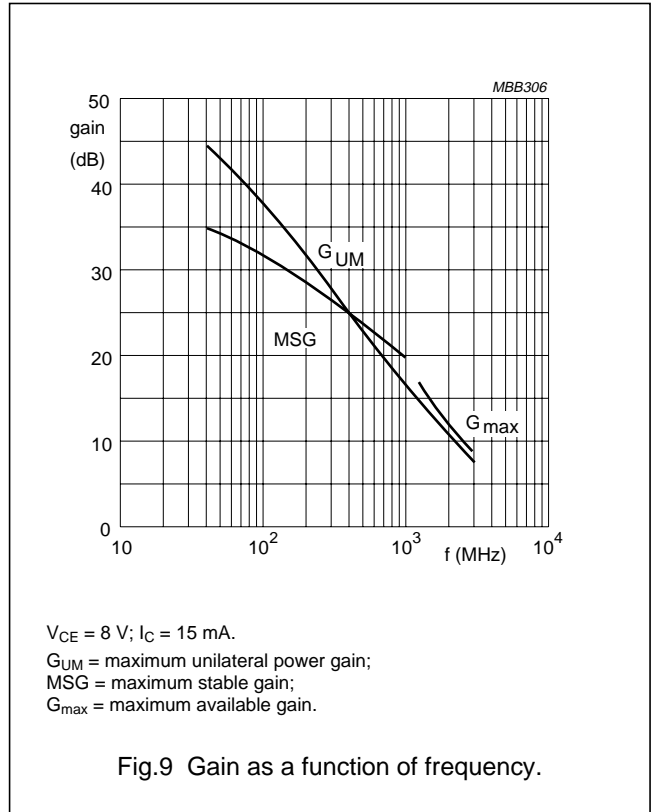


Fig.9 Gain as a function of frequency.

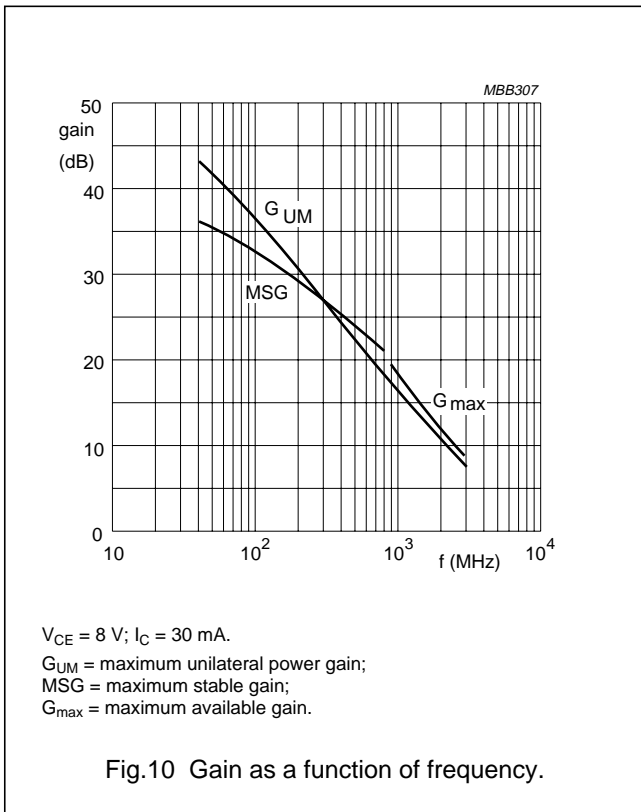


Fig.10 Gain as a function of frequency.

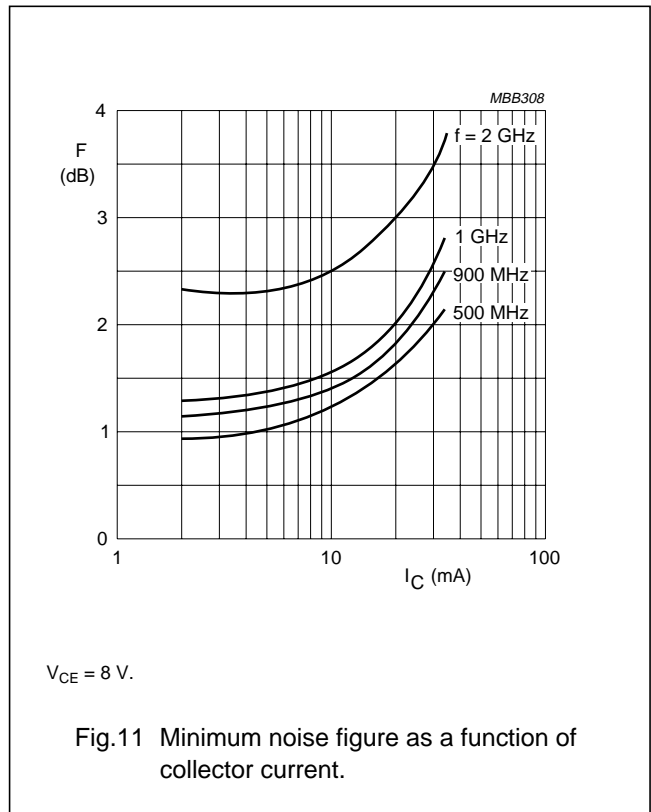
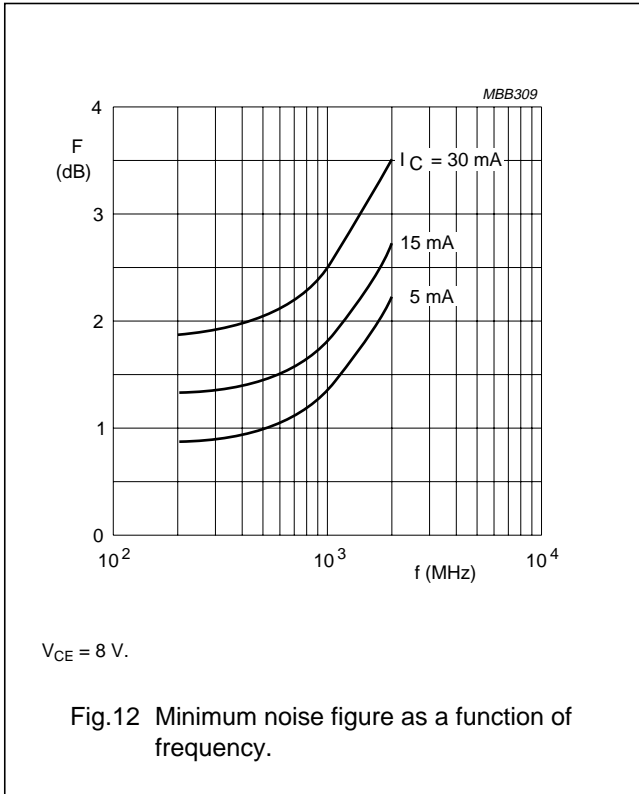


Fig.11 Minimum noise figure as a function of collector current.

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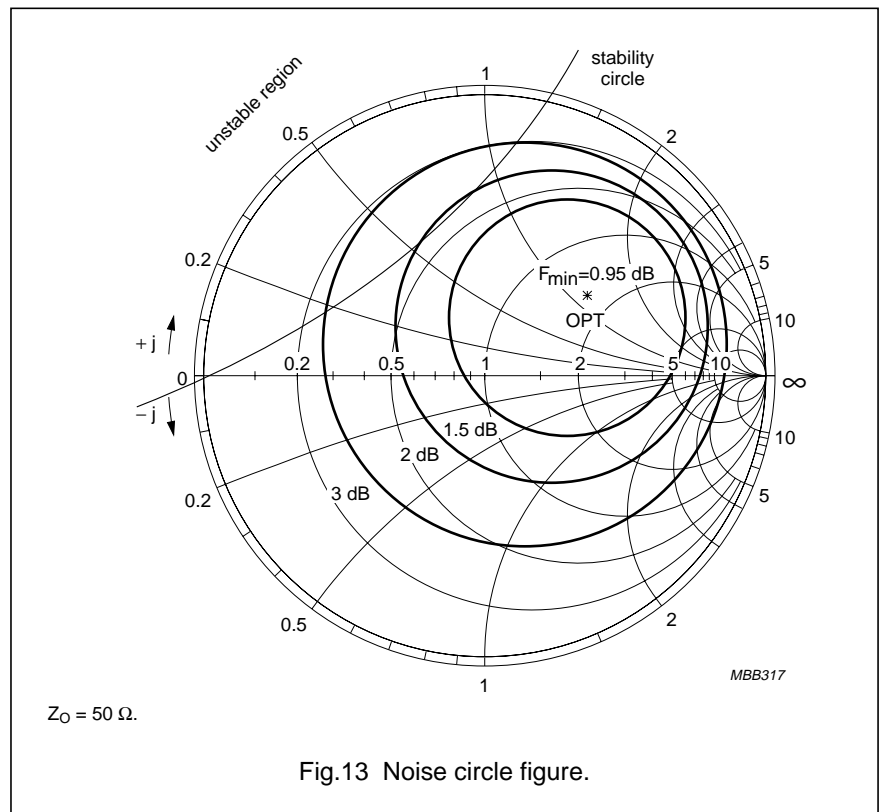


**BFG67/X**

| f (MHz) | V <sub>CE</sub> (V) | I <sub>C</sub> (mA) |
|---------|---------------------|---------------------|
| 500     | 8                   | 5                   |

**Noise Parameters**

| F <sub>min</sub> (dB) | Gamma (opt) |       | R <sub>n</sub> /50 |
|-----------------------|-------------|-------|--------------------|
|                       | (mag)       | (ang) |                    |
| 0.95                  | 0.455       | 33.8  | 0.288              |



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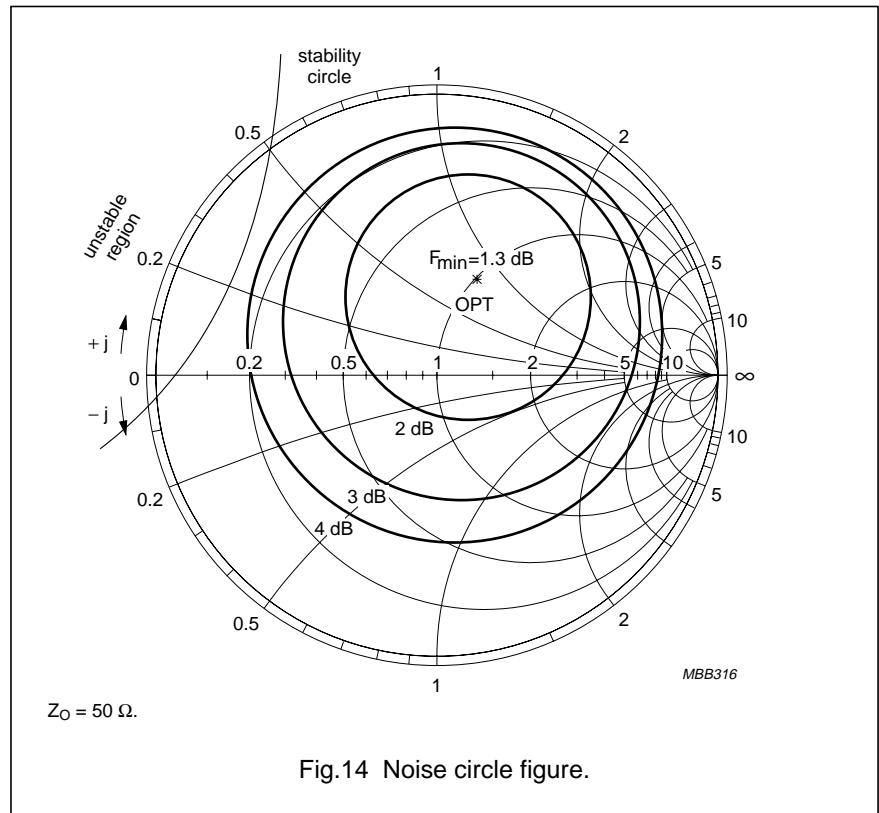
BFG67; BFG67/X; BFG67/XR

**BFG67/X**

| f (MHz) | V <sub>CE</sub> (V) | I <sub>C</sub> (mA) |
|---------|---------------------|---------------------|
| 1000    | 8                   | 5                   |

**Noise Parameters**

| F <sub>min</sub> (dB) | Gamma (opt) |       | R <sub>n</sub> /50 |
|-----------------------|-------------|-------|--------------------|
|                       | (mag)       | (ang) |                    |
| 1.3                   | 0.375       | 65.9  | 0.304              |



**BFG67/X**

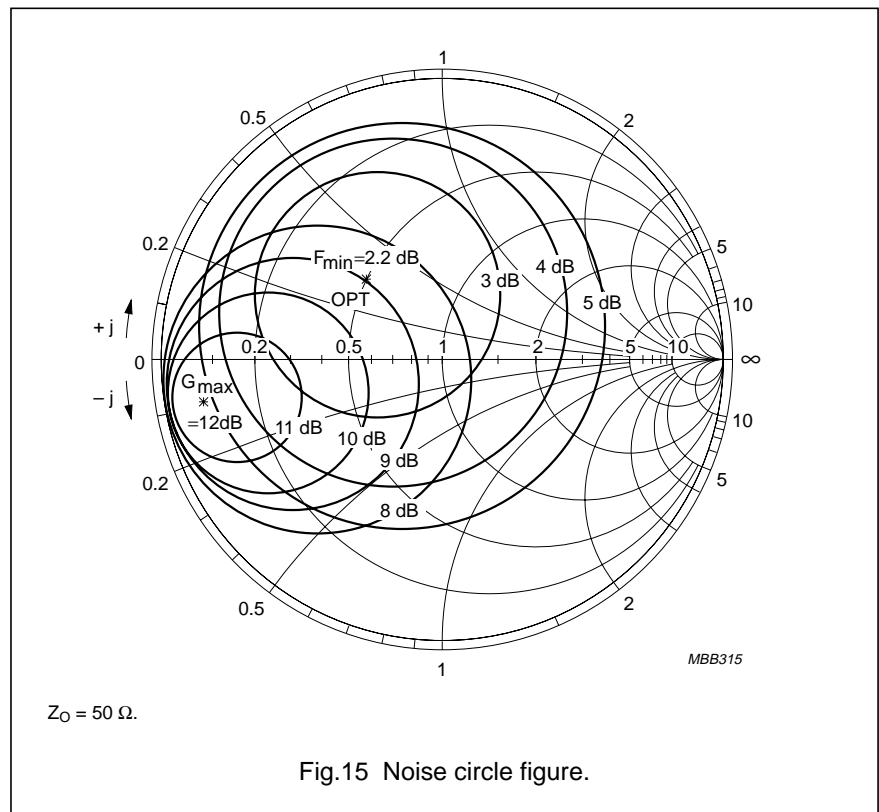
| f (MHz) | V <sub>CE</sub> (V) | I <sub>C</sub> (mA) |
|---------|---------------------|---------------------|
| 2000    | 8                   | 5                   |

**Noise Parameters**

| F <sub>min</sub> (dB) | Gamma (opt) |       | R <sub>n</sub> /50 |
|-----------------------|-------------|-------|--------------------|
|                       | (mag)       | (ang) |                    |
| 2.2                   | 0.391       | 136.5 | 0.184              |

**Average Gain Parameters**

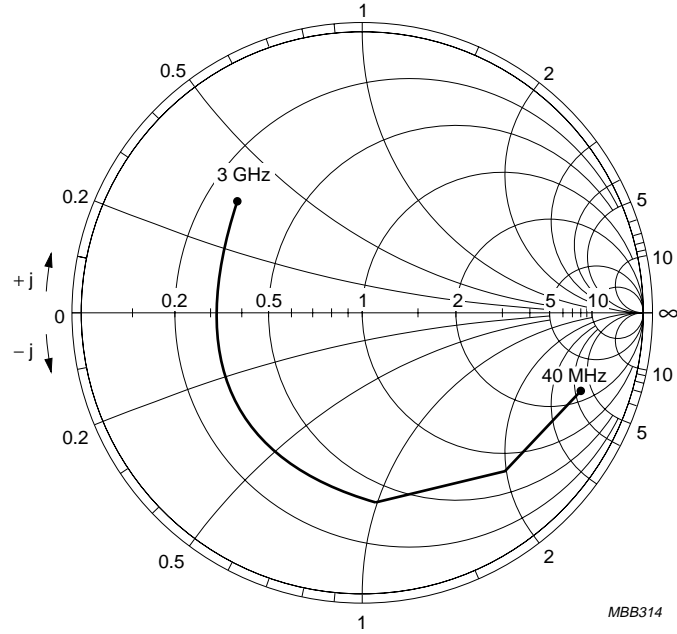
| G <sub>MAX</sub> (dB) | Gamma (max) |       |
|-----------------------|-------------|-------|
|                       | (mag)       | (ang) |
| 12                    | 0.839       | -170  |





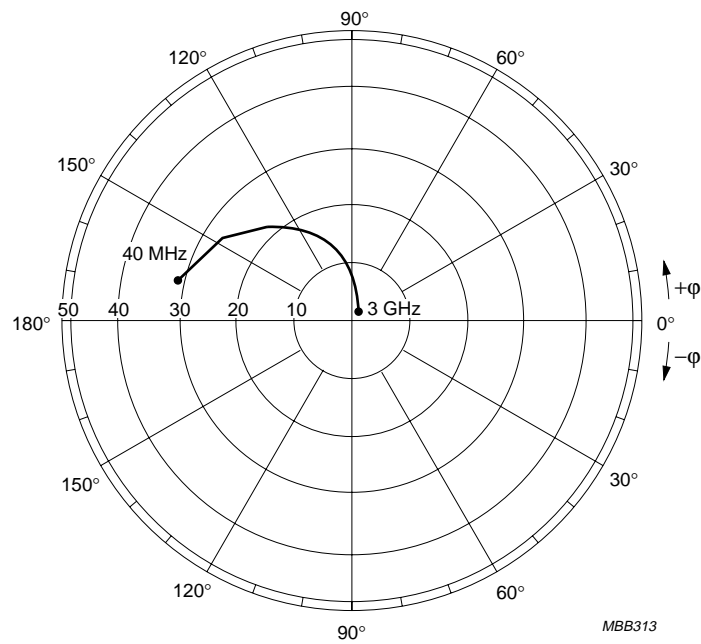
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$V_{CE} = 8\text{ V}$ ;  $I_C = 15\text{ mA}$ ;  $Z_O = 50\ \Omega$ .

Fig.16 Common emitter input reflection coefficient ( $S_{11}$ ).

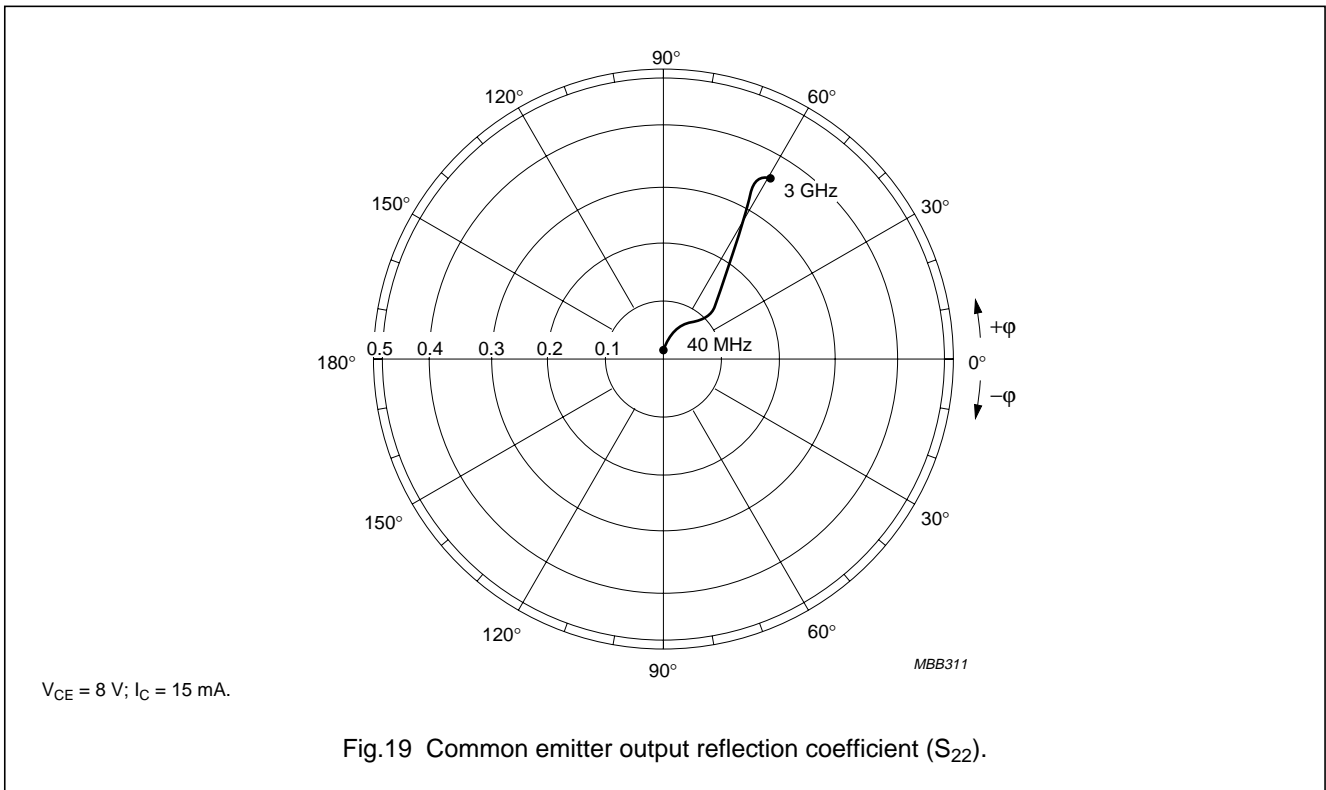
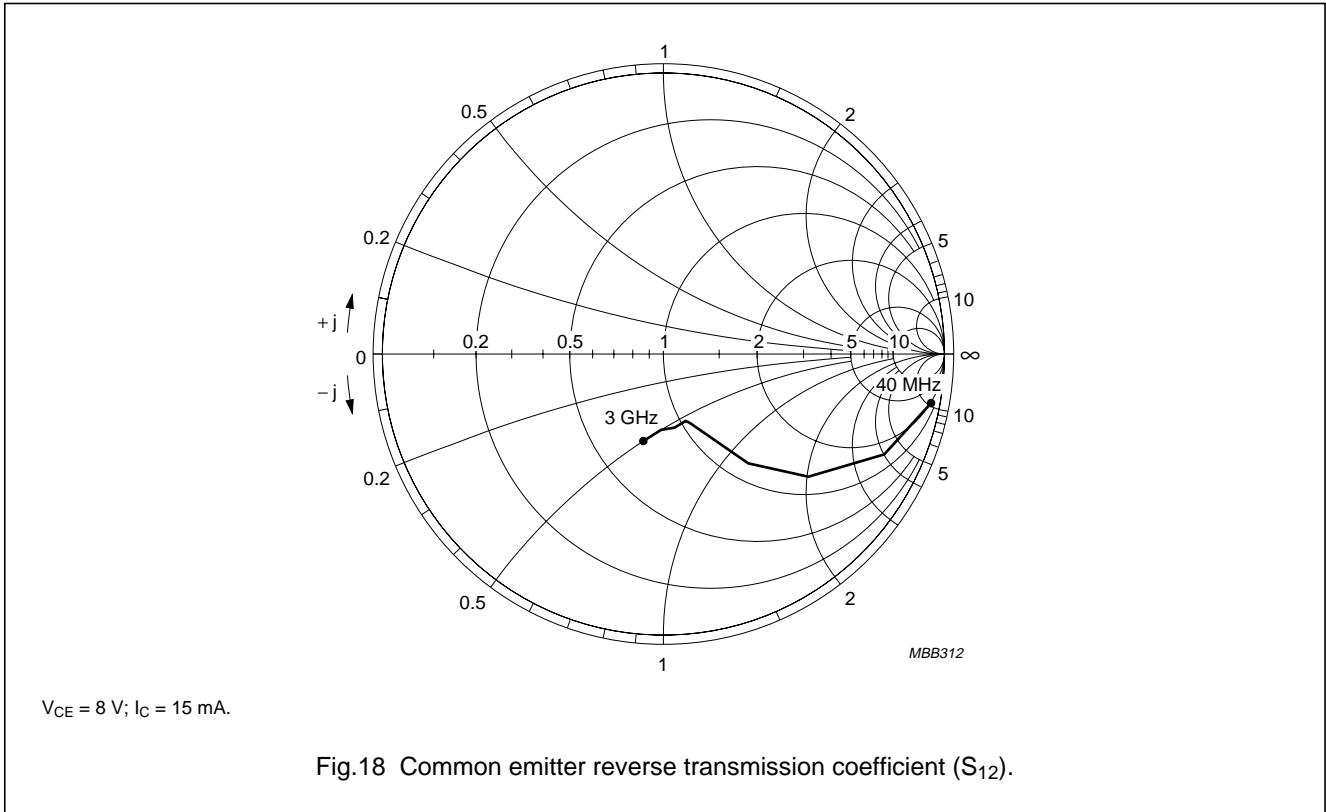


$V_{CE} = 8\text{ V}$ ;  $I_C = \text{mA}$ ;  $Z_O = 50\ \Omega$ .

Fig.17 Common emitter forward transmission coefficient ( $S_{21}$ ).

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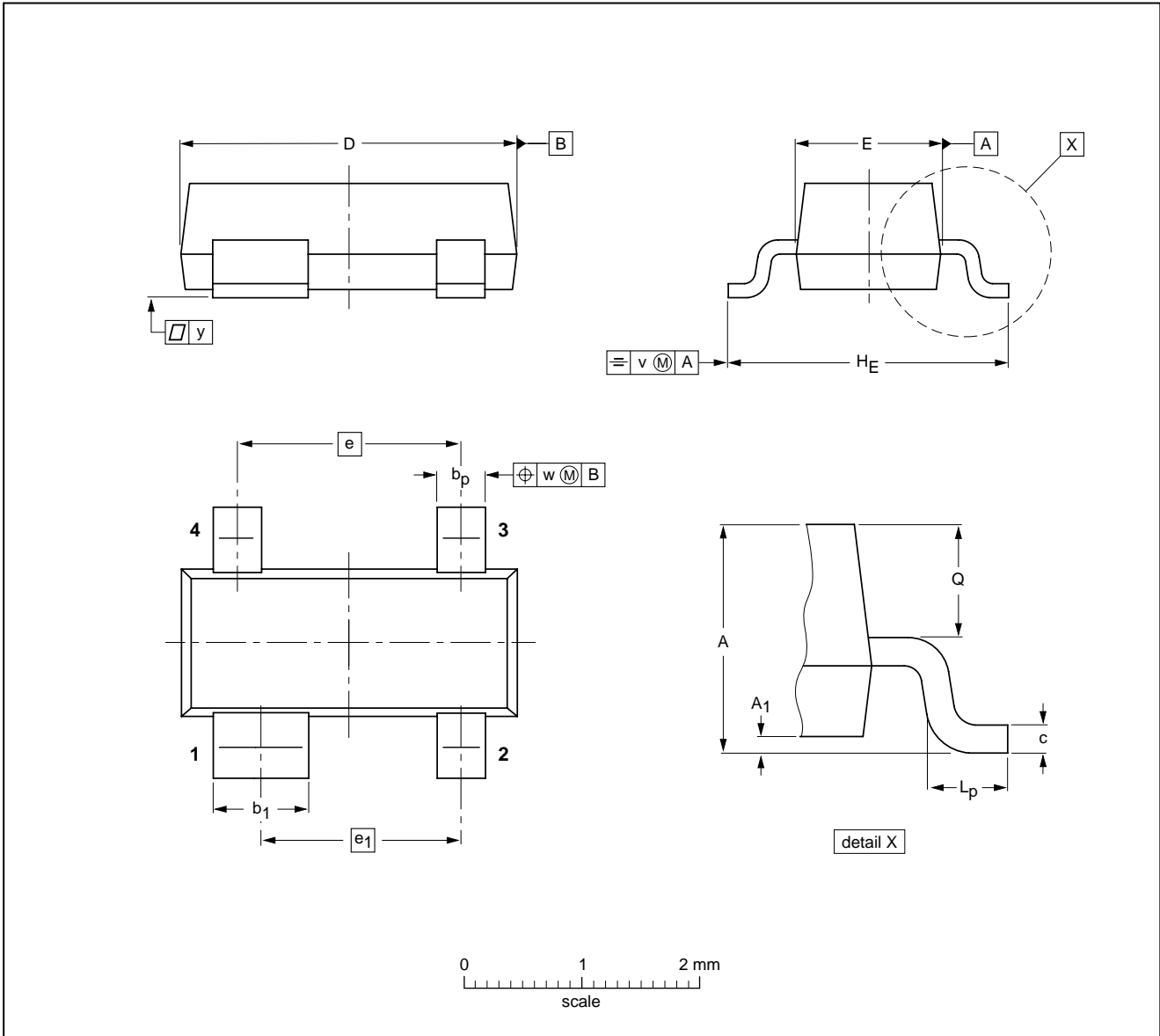
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BFG67; BFG67/X; BFG67/XR

PACKAGE OUTLINES

Plastic surface mounted package; 4 leads

SOT143B



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | A <sub>1</sub><br>max | b <sub>p</sub> | b <sub>1</sub> | c            | D          | E          | e   | e <sub>1</sub> | H <sub>E</sub> | L <sub>p</sub> | Q            | v   | w   | y   |
|------|------------|-----------------------|----------------|----------------|--------------|------------|------------|-----|----------------|----------------|----------------|--------------|-----|-----|-----|
| mm   | 1.1<br>0.9 | 0.1                   | 0.48<br>0.38   | 0.88<br>0.78   | 0.15<br>0.09 | 3.0<br>2.8 | 1.4<br>1.2 | 1.9 | 1.7            | 2.5<br>2.1     | 0.45<br>0.15   | 0.55<br>0.45 | 0.2 | 0.1 | 0.1 |

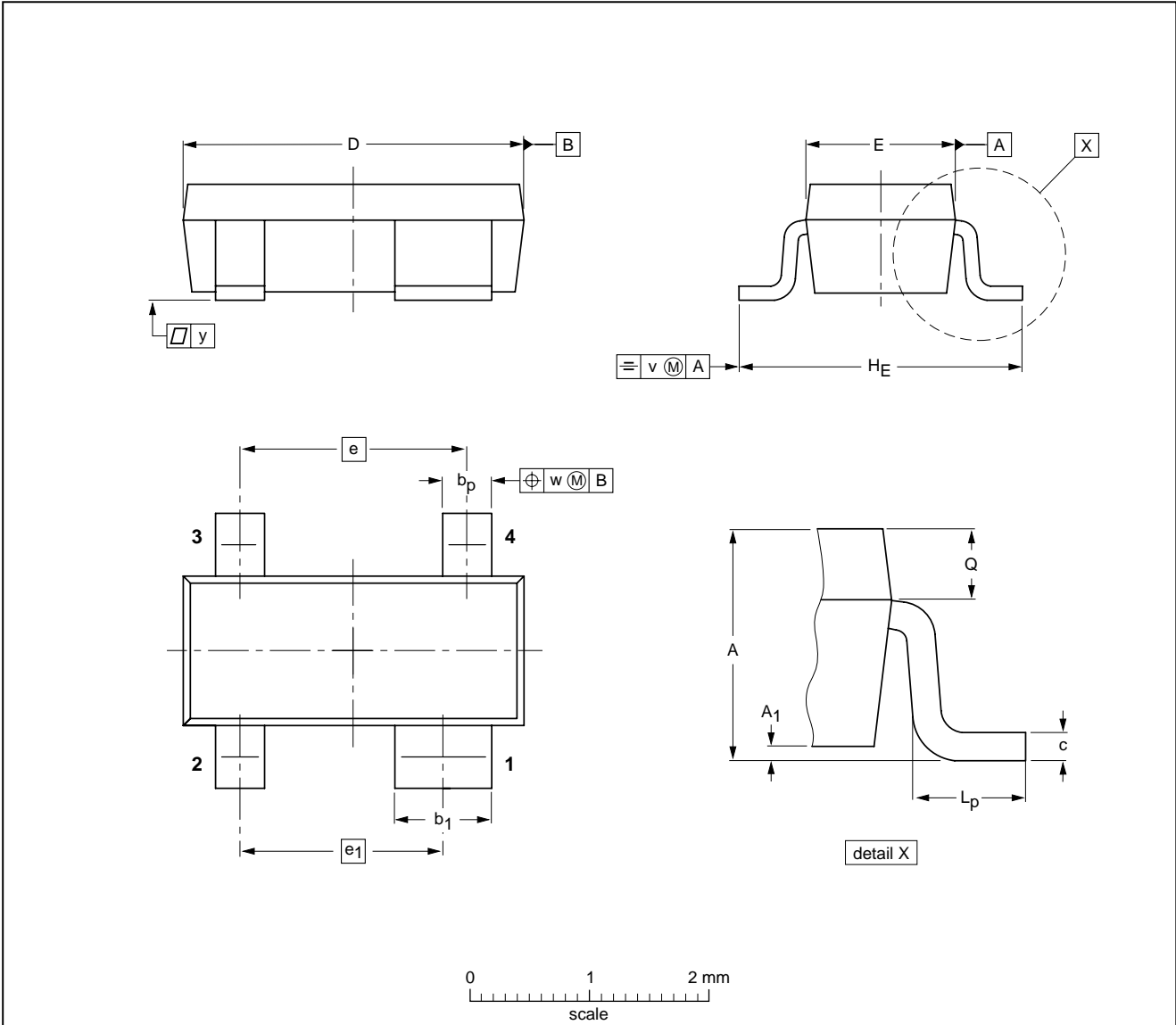
| OUTLINE<br>VERSION | REFERENCES |       |      |  | EUROPEAN<br>PROJECTION | ISSUE DATE |
|--------------------|------------|-------|------|--|------------------------|------------|
|                    | IEC        | JEDEC | EIAJ |  |                        |            |
| SOT143B            |            |       |      |  |                        | 97-02-28   |

NPN 8 GHz wideband transistors

BFG67; BFG67/X; BFG67/XR

Plastic surface mounted package; reverse pinning; 4 leads

SOT143R



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | A <sub>1</sub><br>max | b <sub>p</sub> | b <sub>1</sub> | c            | D          | E          | e   | e <sub>1</sub> | H <sub>E</sub> | L <sub>p</sub> | Q            | v   | w   | y   |
|------|------------|-----------------------|----------------|----------------|--------------|------------|------------|-----|----------------|----------------|----------------|--------------|-----|-----|-----|
| mm   | 1.1<br>0.9 | 0.1                   | 0.48<br>0.38   | 0.88<br>0.78   | 0.15<br>0.09 | 3.0<br>2.8 | 1.4<br>1.2 | 1.9 | 1.7            | 2.5<br>2.1     | 0.55<br>0.25   | 0.45<br>0.25 | 0.2 | 0.1 | 0.1 |

| OUTLINE VERSION | REFERENCES |       |      |  | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|-------|------|--|---------------------|------------|
|                 | IEC        | JEDEC | EIAJ |  |                     |            |
| SOT143R         |            |       |      |  |                     | 97-03-10   |

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### 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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## Revision history

**Table 1. Revision history**

| Document ID                      | Release date   | Data sheet status     | Change notice | Supersedes     |
|----------------------------------|--|-----------------------|---------------|----------------|
| BFG67_X_XR_N_5                   | 20071123   | Product data sheet    | -             | BFG67_X_XR_4   |
| Modifications:                   | • Page 2; Table Marking code; row 1 and 2 code changed |                       |               |                |
| BFG67_X_XR_4<br>(9397 750 04349) | 19981002   | Product specification | -             | BFG67_SERIES_3 |
| BFG67_SERIES_3                   | 19950901   | Product specification | -             | BFG67_SERIES_2 |
| BFG67_SERIES_2                   | -  | Product specification | -             | BFG67_SERIES_1 |
| BFG67_SERIES_1                   | -  | -                     | -             | -              |

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Date of release: 23 November 2007

Document identifier: BFG67\_X\_XR\_N\_5