

BFG540; BFG540/X; BFG540/XR

NPN 9 GHz wideband transistor

Rev. 05 — 21 November 2007

Product data sheet

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NXP Semiconductors

NPN 9 GHz wideband transistor

**BFG540; BFG540/X;
BFG540/XR**

FEATURES

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

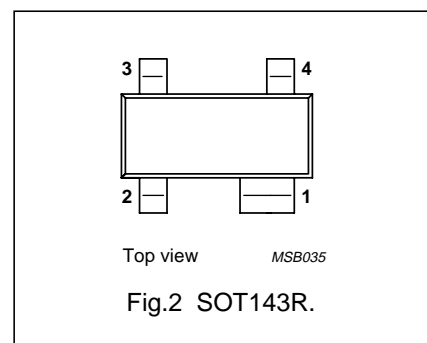
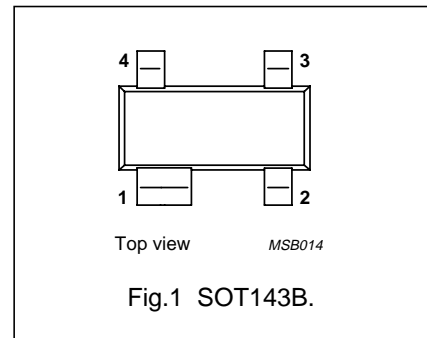
DESCRIPTION

NPN silicon planar epitaxial transistors, intended for wideband applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT1, CT2, DECT, etc.), radar detectors, satellite TV tuners (SATV), MATV/CATV amplifiers and repeater amplifiers in fibre-optical systems.

The transistors are mounted in plastic SOT143B and SOT143R packages.

PINNING

| PIN | DESCRIPTION |
|-----------------------------|-------------|
| BFG540 (Fig.1) Code: %MG | |
| 1 | collector |
| 2 | base |
| 3 | emitter |
| 4 | emitter |
| BFG540/X (Fig.1) Code: %MM | |
| 1 | collector |
| 2 | emitter |
| 3 | base |
| 4 | emitter |
| BFG540/XR (Fig.2) Code: %MR | |
| 1 | collector |
| 2 | emitter |
| 3 | base |
| 4 | emitter |



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QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--------------|-------------------------------|--|------|------|------|------|
| V_{CBO} | collector-base voltage | open emitter | – | – | 20 | V |
| V_{CES} | collector-emitter voltage | $R_{BE} = 0$ | – | – | 15 | V |
| I_C | DC collector current | | – | – | 120 | mA |
| P_{tot} | total power dissipation | $T_s \leq 60\text{ °C}$; note 1 | – | – | 400 | mW |
| h_{FE} | DC current gain | $I_C = 40\text{ mA}$; $V_{CE} = 8\text{ V}$; $T_j = 25\text{ °C}$ | 100 | 120 | 250 | |
| C_{re} | feedback capacitance | $I_C = 0$; $V_{CE} = 8\text{ V}$; $f = 1\text{ MHz}$ | – | 0.5 | – | pF |
| f_T | transition frequency | $I_C = 40\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 1\text{ GHz}$; $T_{amb} = 25\text{ °C}$ | – | 9 | – | GHz |
| G_{UM} | maximum unilateral power gain | $I_C = 40\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ °C}$ | – | 18 | – | dB |
| | | $I_C = 40\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 2\text{ GHz}$; $T_{amb} = 25\text{ °C}$ | – | 11 | – | dB |
| $ S_{21} ^2$ | insertion power gain | $I_C = 40\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ °C}$ | 15 | 16 | – | dB |
| F | noise figure | $\Gamma_s = \Gamma_{opt}$; $I_C = 10\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ °C}$ | – | 1.3 | 1.8 | dB |
| | | $\Gamma_s = \Gamma_{opt}$; $I_C = 40\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 900\text{ MHz}$; $T_{amb} = 25\text{ °C}$ | – | 1.9 | 2.4 | dB |
| | | $\Gamma_s = \Gamma_{opt}$; $I_C = 10\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 2\text{ GHz}$; $T_{amb} = 25\text{ °C}$ | – | 2.1 | – | dB |

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 60134).

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|-----------|---------------------------|----------------------------------|------|------|------|
| V_{CBO} | collector-base voltage | open emitter | – | 20 | V |
| V_{CES} | collector-emitter voltage | $R_{BE} = 0$ | – | 15 | V |
| V_{EBO} | emitter-base voltage | open collector | – | 2.5 | V |
| I_C | DC collector current | | – | 120 | mA |
| P_{tot} | total power dissipation | $T_s \leq 60\text{ °C}$; note 1 | – | 400 | mW |
| T_{stg} | storage temperature | | –65 | +150 | °C |
| T_j | junction temperature | | – | 150 | °C |

Note

- T_s is the temperature at the soldering point of the collector pin.

THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---------------|---|----------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $T_s \leq 60\text{ °C}$; note 1 | 290 | K/W |

Note

- T_s is the temperature at the soldering point of the collector pin.

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CHARACTERISTICS

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

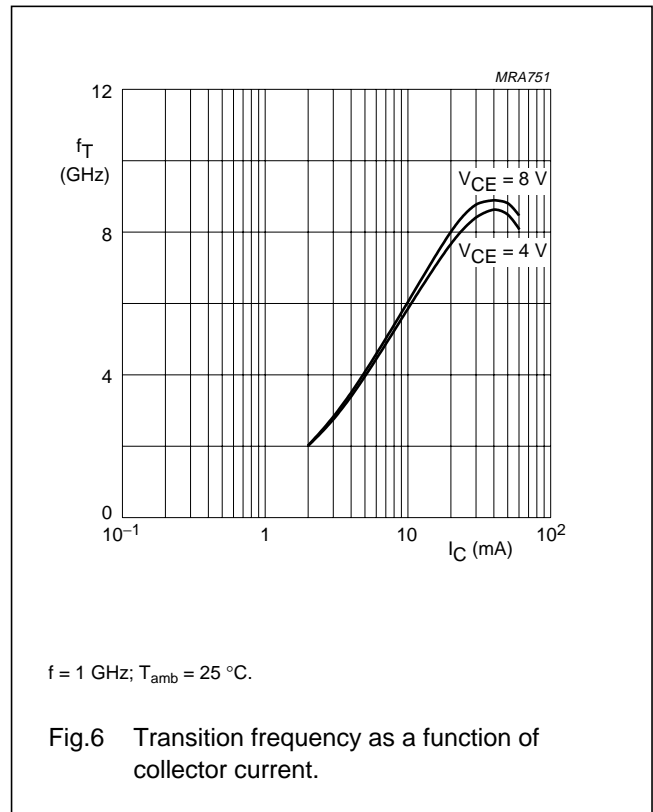
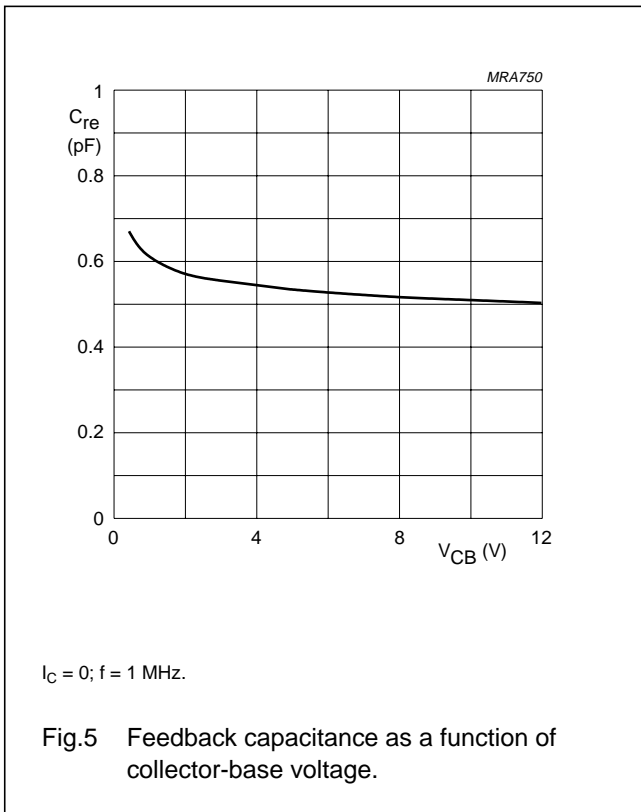
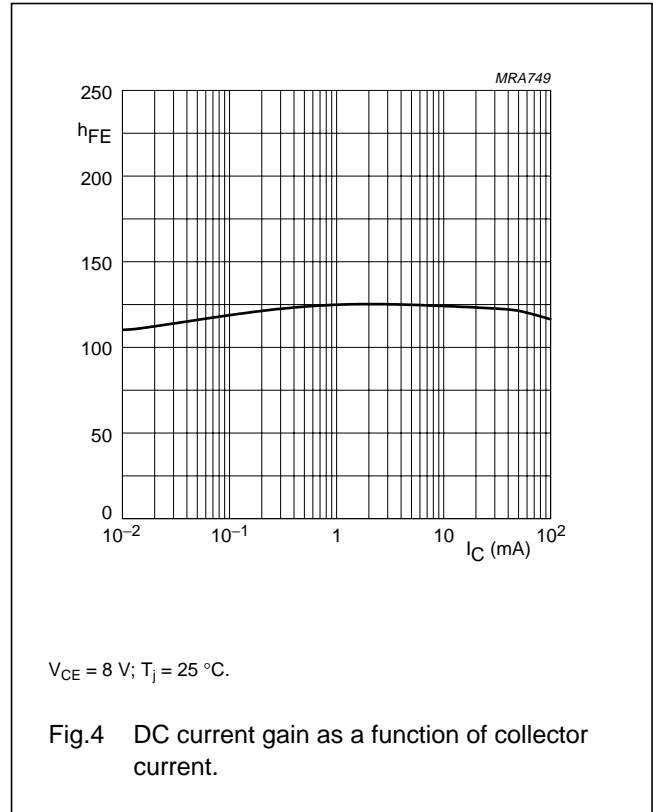
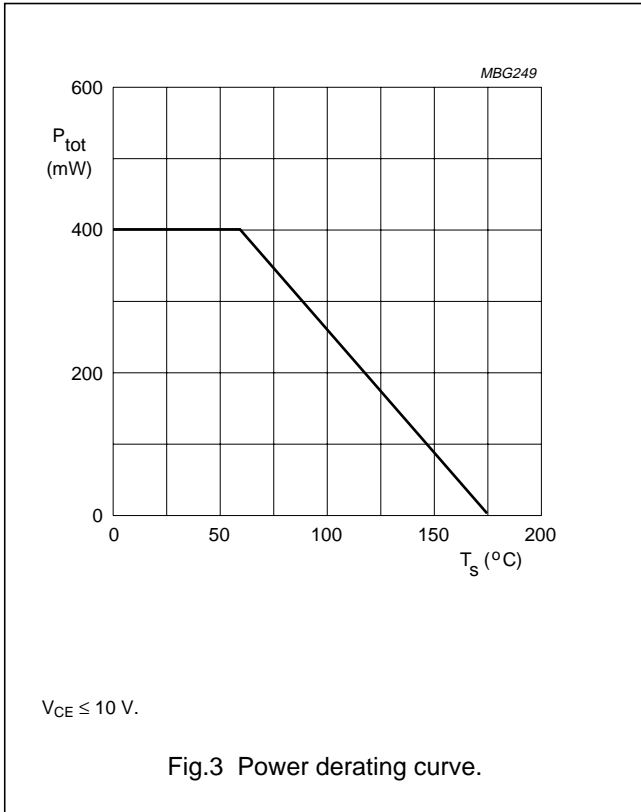
| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--------------|---|--|------|------|------|------|
| I_{CBO} | collector cut-off current | $I_E = 0; V_{CB} = 8\text{ V}$ | – | – | 50 | nA |
| h_{FE} | DC current gain | $I_C = 40\text{ mA}; V_{CE} = 8\text{ V}$ | 60 | 120 | 250 | |
| C_e | emitter capacitance | $I_C = I_C = 0; V_{EB} = 0.5\text{ V}; f = 1\text{ MHz}$ | – | 2 | – | pF |
| C_c | collector capacitance | $I_E = I_E = 0; V_{CB} = 8\text{ V}; f = 1\text{ MHz}$ | – | 0.9 | – | pF |
| C_{re} | feedback capacitance | $I_C = 0; V_{CB} = 8\text{ V}; f = 1\text{ MHz}$ | – | 0.5 | – | pF |
| f_T | transition frequency | $I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; f = 1\text{ GHz}; T_{amb} = 25\text{ °C}$ | – | 9 | – | GHz |
| G_{UM} | maximum unilateral power gain (note 1) | $I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$ | – | 18 | – | dB |
| | | $I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; f = 2\text{ GHz}; T_{amb} = 25\text{ °C}$ | – | 11 | – | dB |
| $ S_{21} ^2$ | insertion power gain | $I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$ | 15 | 16 | – | dB |
| F | noise figure | $\Gamma_s = \Gamma_{opt}; I_C = 10\text{ mA}; V_{CE} = 8\text{ V}; f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$ | – | 1.3 | 1.8 | dB |
| | | $\Gamma_s = \Gamma_{opt}; I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$ | – | 1.9 | 2.4 | dB |
| | | $\Gamma_s = \Gamma_{opt}; I_C = 10\text{ mA}; V_{CE} = 8\text{ V}; f = 2\text{ GHz}; T_{amb} = 25\text{ °C}$ | – | 2.1 | – | dB |
| PL_1 | output power at 1 dB gain compression | $I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; R_L = 50\text{ }\Omega; f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$ | – | 21 | – | dBm |
| ITO | third order intercept point | note 2 | – | 34 | – | dBm |
| V_O | output voltage | note 3 | – | 500 | – | mV |
| d_2 | second order intermodulation distortion | note 4 | – | –50 | – | dB |

Notes

- 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.
- $V_{CE} = 8\text{ V}; I_C = 40\text{ mA}; R_L = 50\text{ }\Omega; T_{amb} = 25\text{ °C};$
 $f_p = 900\text{ MHz}; f_q = 902\text{ MHz};$
measured at $f_{(2p-q)} = 898\text{ MHz}$ and $f_{(2q-p)} = 904\text{ MHz}.$
- $d_{im} = -60\text{ dB (DIN 45004B)}; I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; Z_L = Z_S = 75\text{ }\Omega; T_{amb} = 25\text{ °C};$
 $V_p = V_O; V_q = V_O - 6\text{ dB}; V_r = V_O - 6\text{ dB};$
 $f_p = 795.25\text{ MHz}; f_q = 803.25\text{ MHz}; f_r = 805.25\text{ MHz};$
measured at $f_{(p+q-r)} = 793.25\text{ MHz}.$
- $I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; V_O = 275\text{ mV}; T_{amb} = 25\text{ °C};$
 $f_p = 250\text{ MHz}; f_q = 560\text{ MHz};$ measured at $f_{(p+q)} = 810\text{ MHz}.$

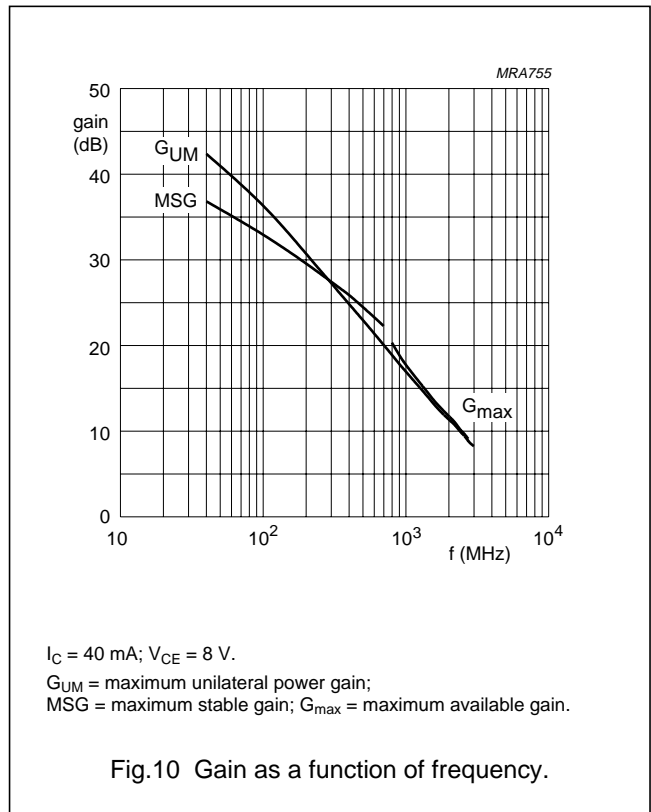
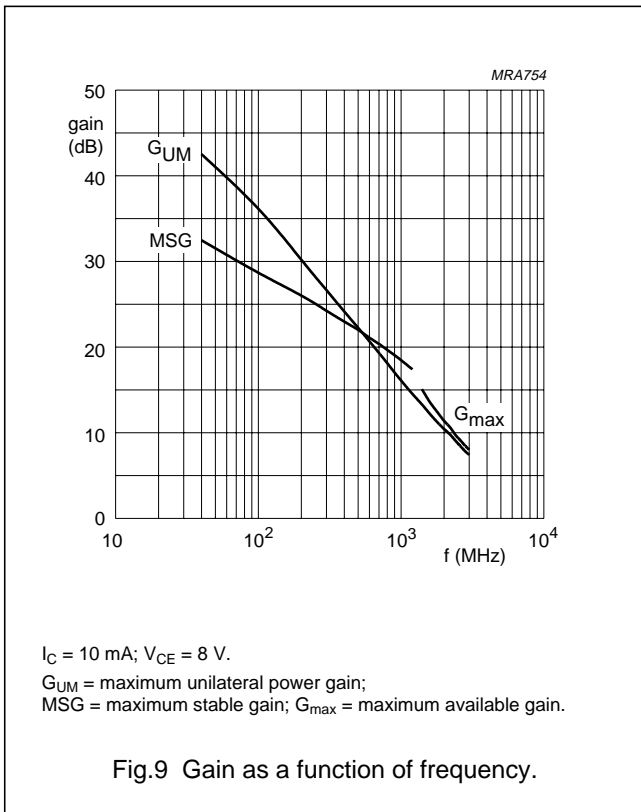
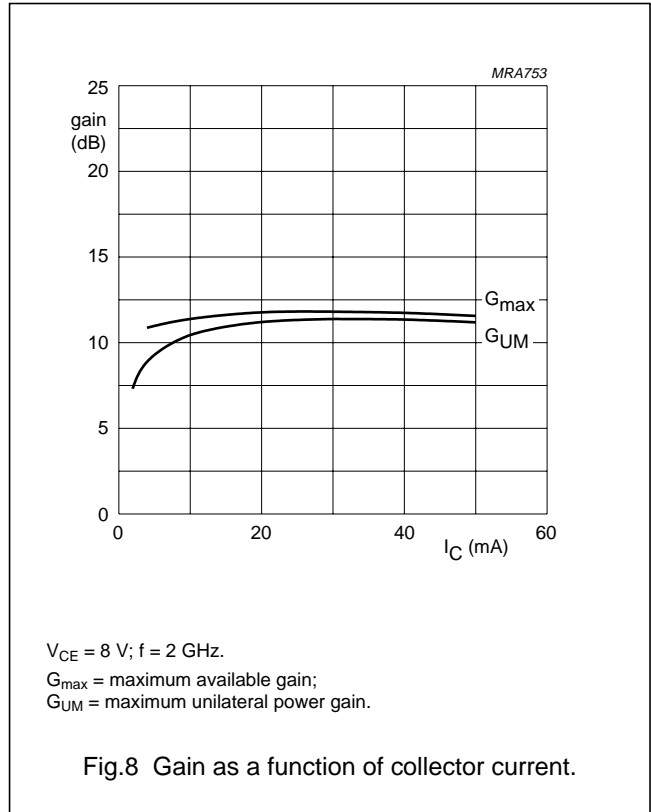
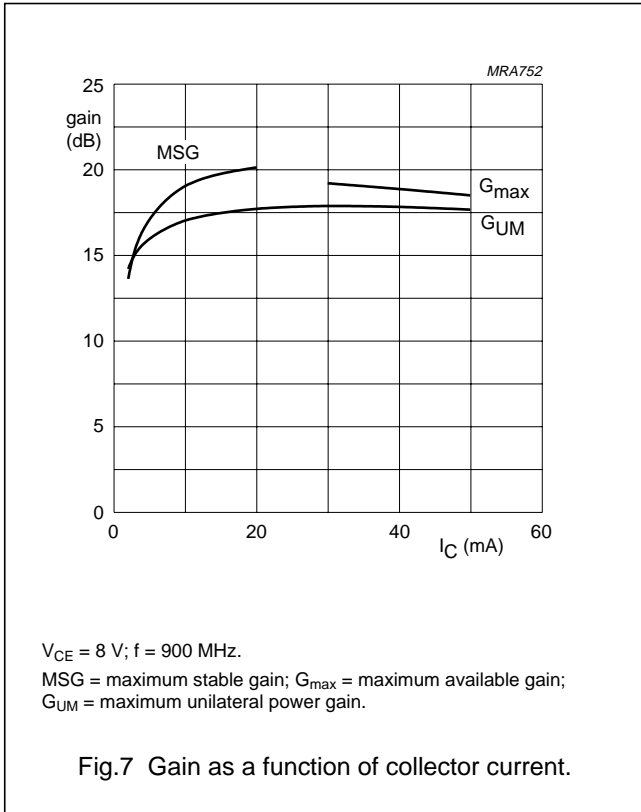
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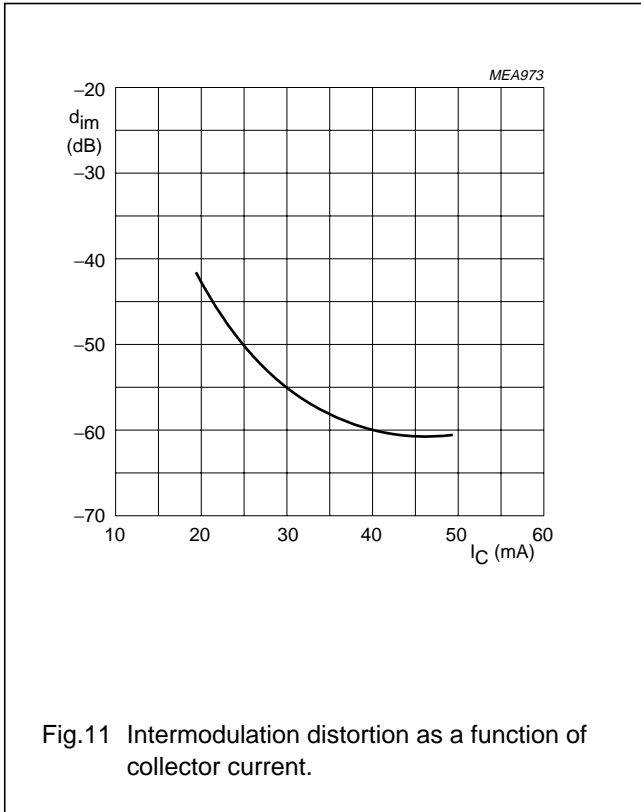


Fig.11 Intermodulation distortion as a function of collector current.

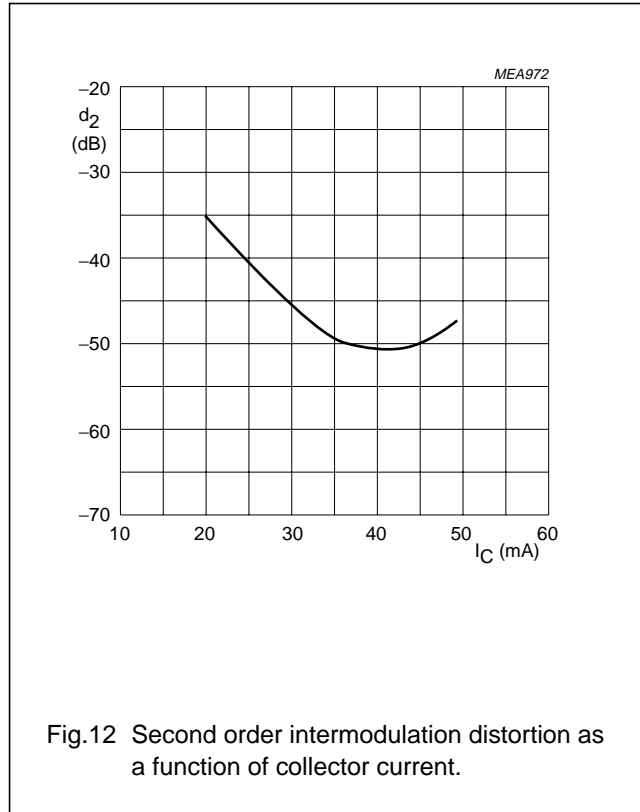
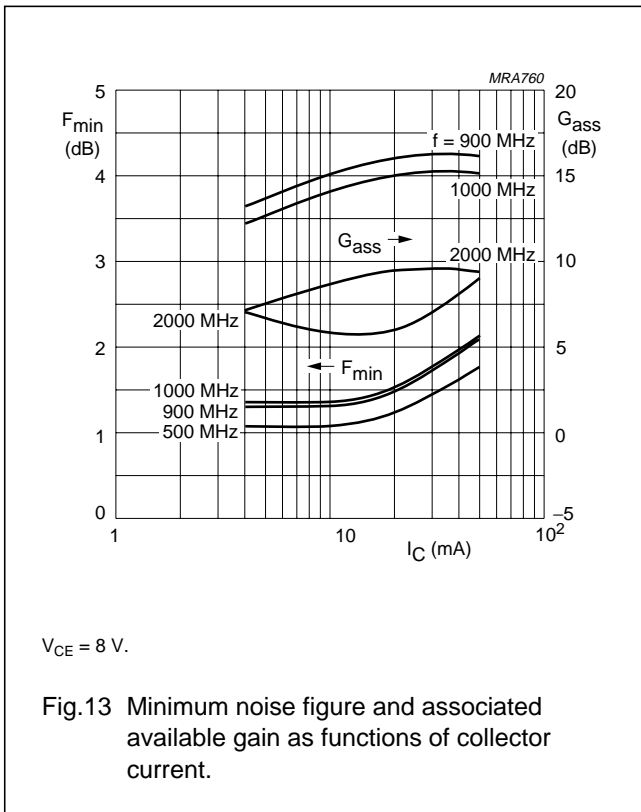
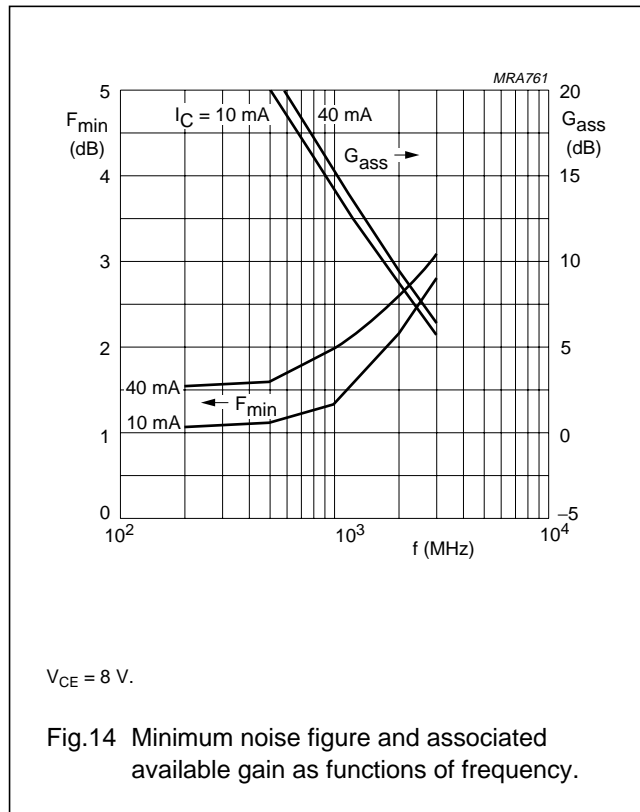


Fig.12 Second order intermodulation distortion as a function of collector current.



$V_{CE} = 8$ V.

Fig.13 Minimum noise figure and associated available gain as functions of collector current.

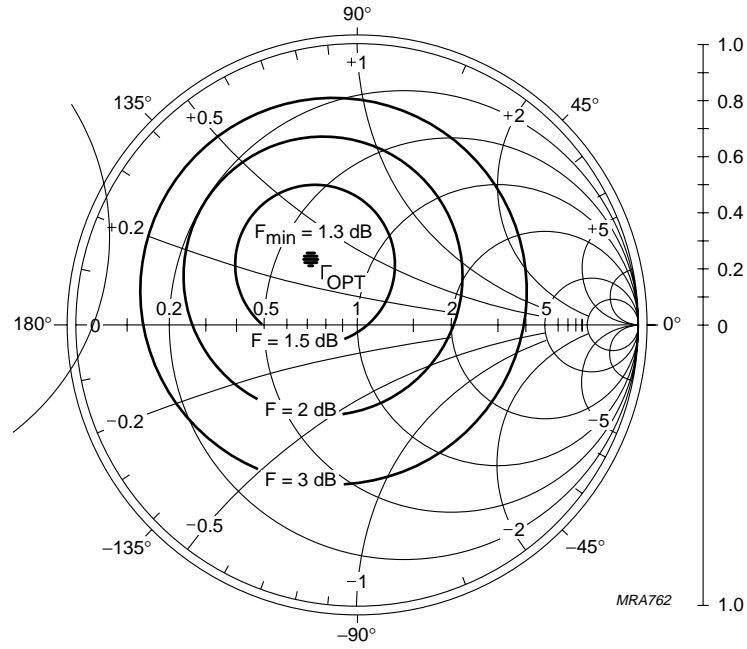


$V_{CE} = 8$ V.

Fig.14 Minimum noise figure and associated available gain as functions of frequency.

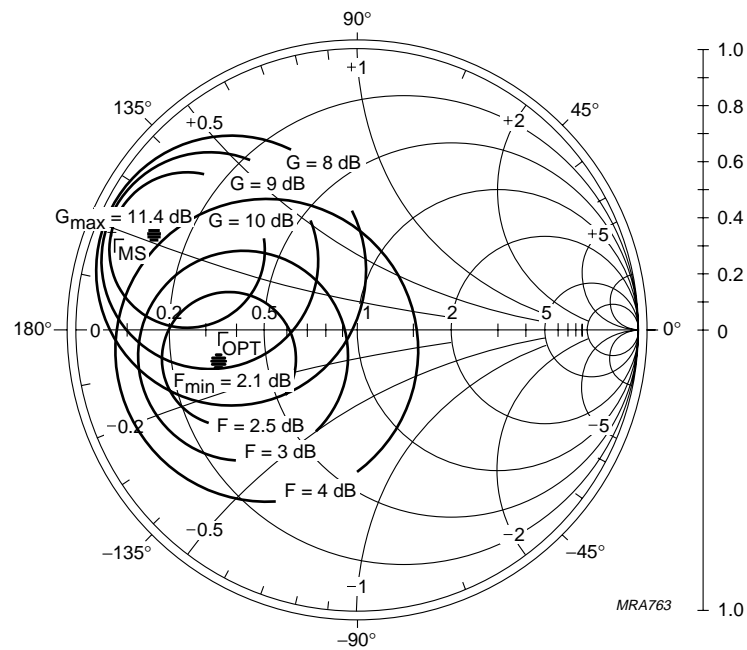
NPN 9 GHz wideband transistor

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BFG540/XR



$I_C = 10 \text{ mA}$; $V_{CE} = 8 \text{ V}$; $Z_0 = 50 \Omega$; $f = 900 \text{ MHz}$.

Fig.15 Noise circle figure.

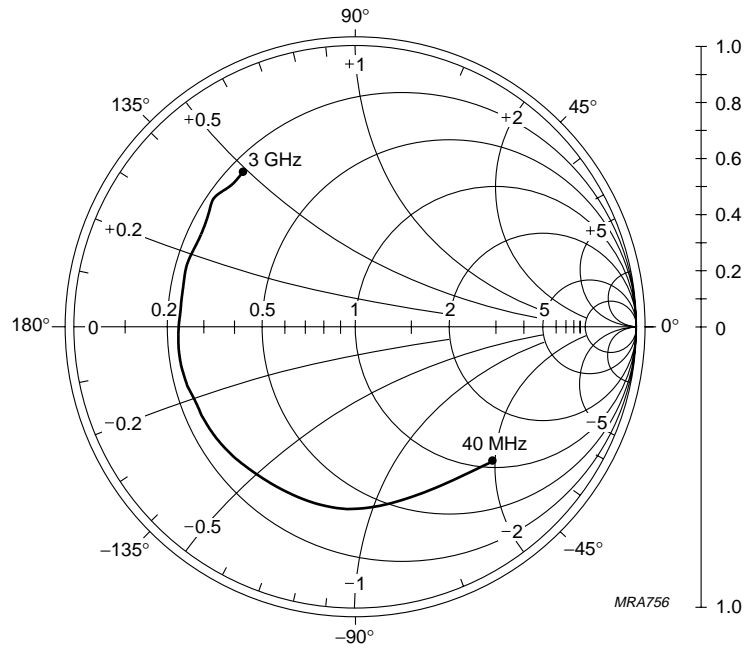


$I_C = 10 \text{ mA}$; $V_{CE} = 8 \text{ V}$; $Z_0 = 50 \Omega$; $f = 2 \text{ GHz}$.

Fig.16 Noise circle figure.

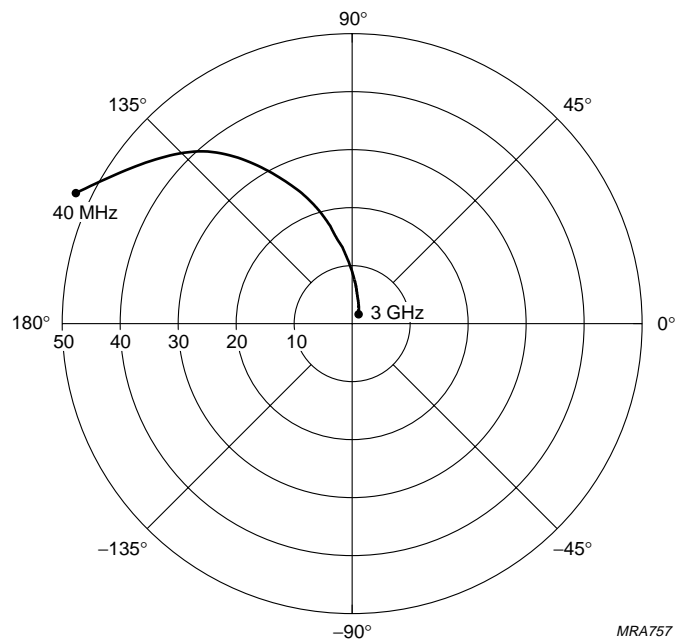
NPN 9 GHz wideband transistor

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BFG540/XR



$I_C = 40 \text{ mA}$; $V_{CE} = 8 \text{ V}$; $Z_0 = 50 \Omega$.

Fig.17 Common emitter input reflection coefficient (s_{11}).

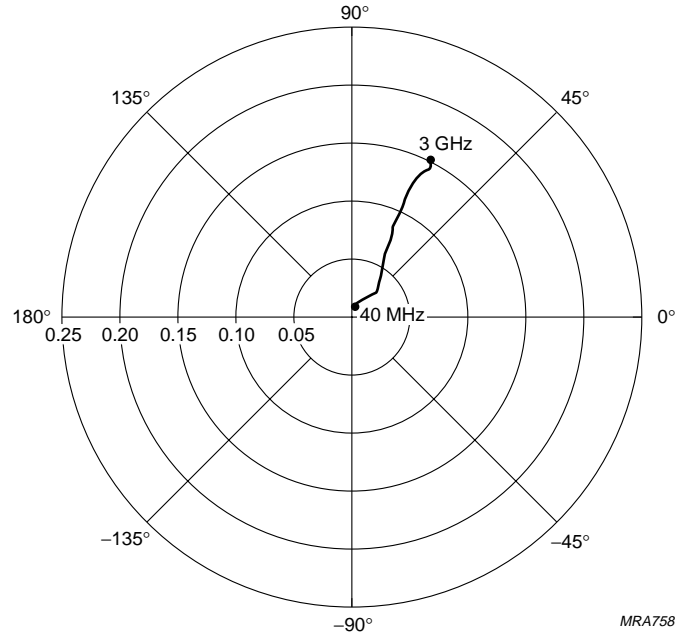


$I_C = 40 \text{ mA}$; $V_{CE} = 8 \text{ V}$.

Fig.18 Common emitter forward transmission coefficient (s_{21}).

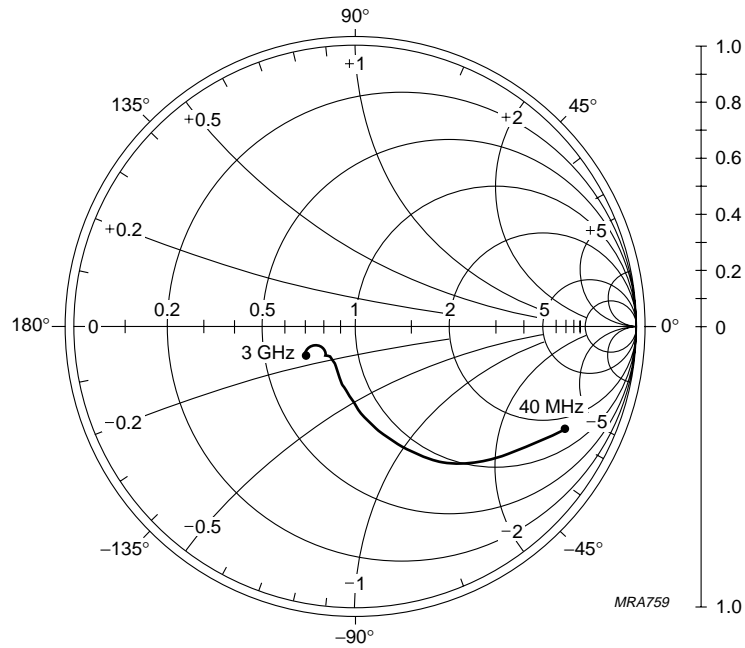
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BFG540/XR



$I_C = 40 \text{ mA}; V_{CE} = 8 \text{ V}.$

Fig.19 Common emitter reverse transmission coefficient (s_{12}).



$I_C = 40 \text{ mA}; V_{CE} = 8 \text{ V}; Z_0 = 50 \Omega.$

Fig.20 Common emitter output reflection coefficient (s_{22}).

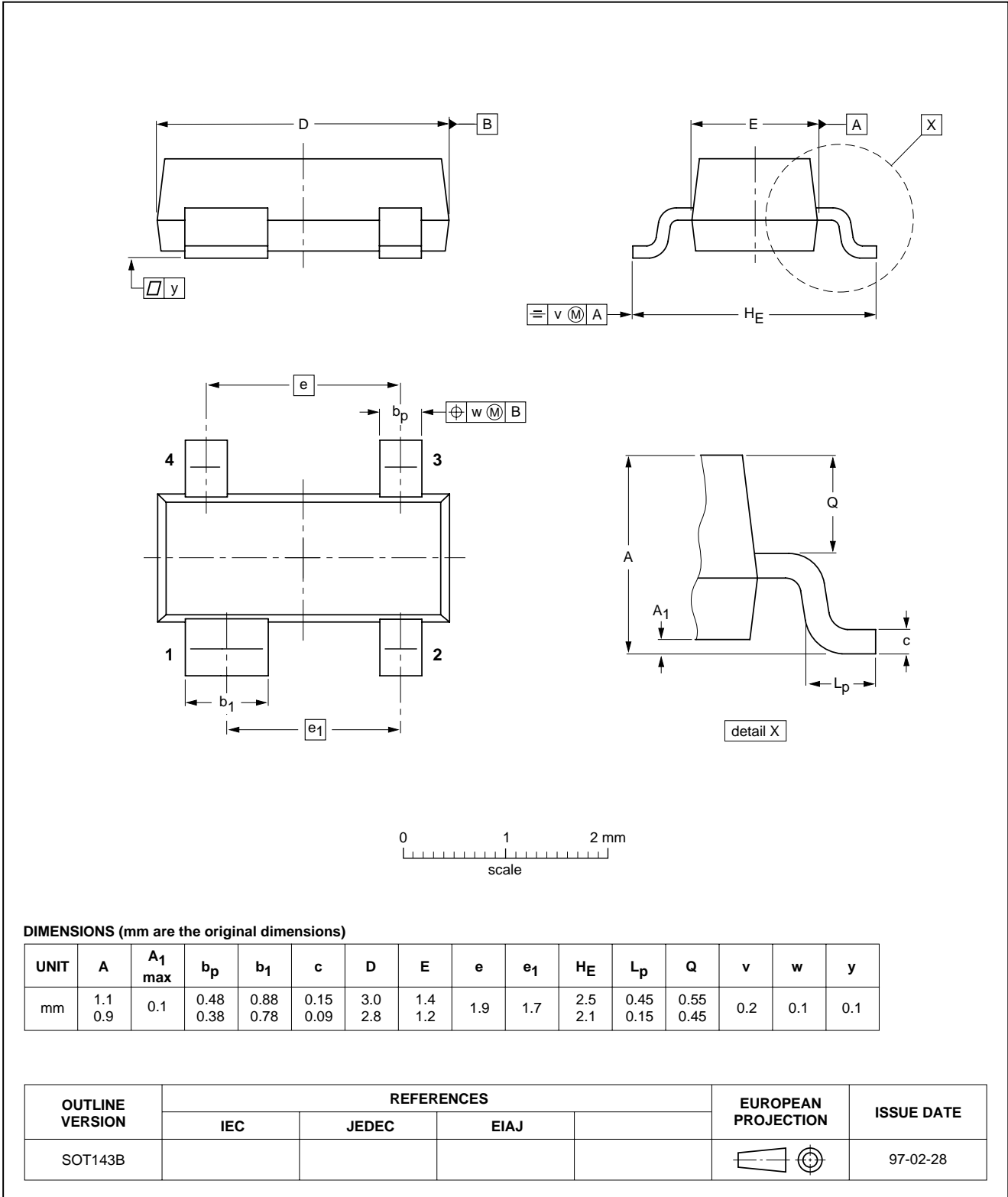
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PACKAGE OUTLINES

Plastic surface mounted package; 4 leads

SOT143B

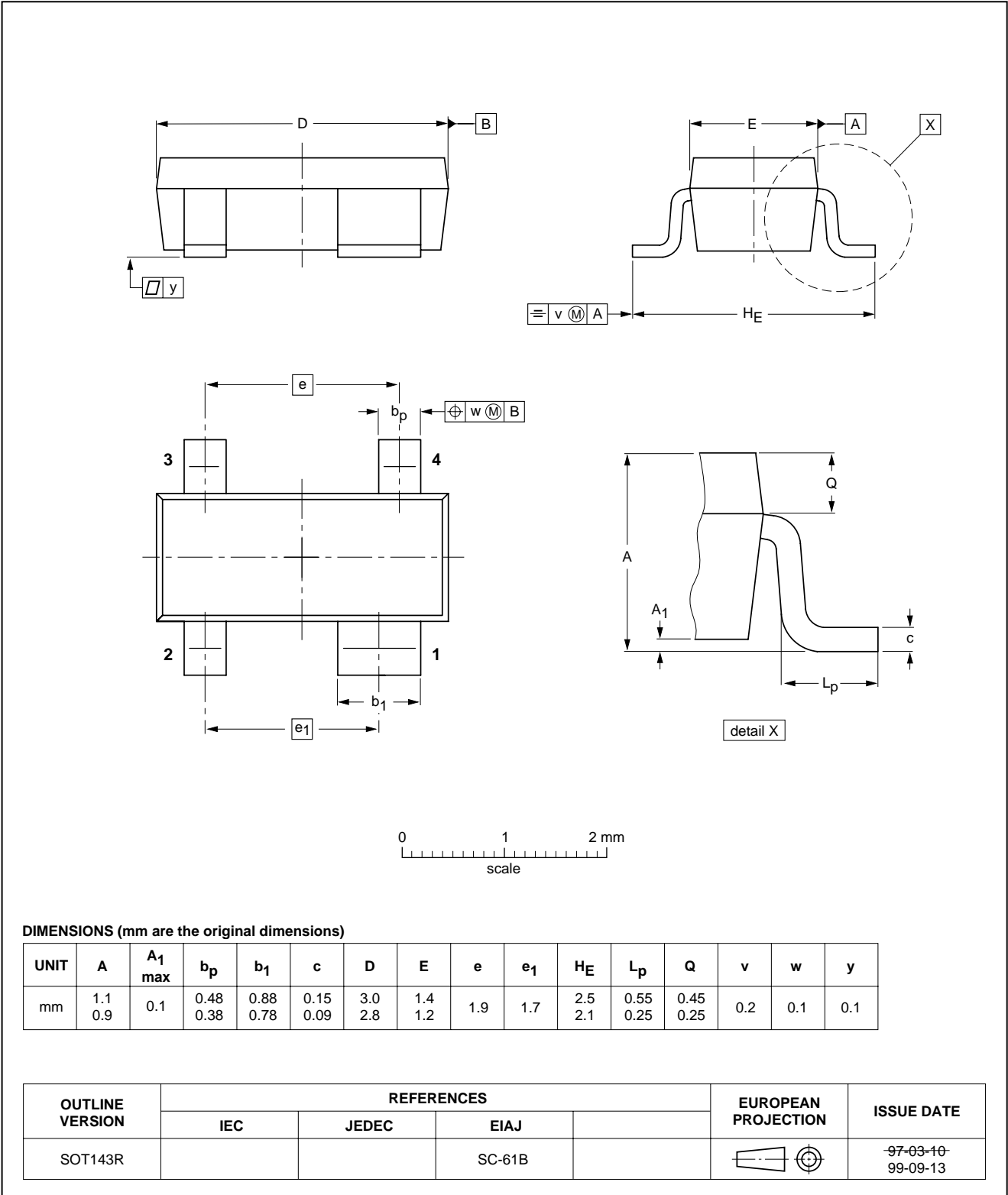


NPN 9 GHz wideband transistor

BFG540; BFG540/X;
BFG540/XR

Plastic surface mounted package; reverse pinning; 4 leads

SOT143R



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| Document status ^{[1][2]} | Product status ^[3] | Definition |
|-----------------------------------|-------------------------------|---|
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[2] The term 'short data sheet' is explained in section "Definitions".

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Revision history

Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|-----------------------------------|---|-----------------------|---------------|---------------|
| BFG540_X_XR_N_5 | 20071121 | Product data sheet | - | BFG540_X_XR_4 |
| Modifications: | • Pinning table on page 2; changed code | | | |
| BFG540_X_XR_4 (9397 750 07059) | 20000523 | Product specification | - | BFG540XR_3 |
| BFG540XR_3 (9397 750 03144) | 19950901 | Product specification | - | BFG540XR_2 |
| BFG540XR_2 | - | Product specification | - | BFG540XR_1 |
| BFG540XR_1 | - | - | - | - |

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Date of release: 21 November 2007

Document identifier: BFG540_X_XR_N_5