

# DATA SHEET

## **BFG520; BFG520/X; BFG520/XR** NPN 9 GHz wideband transistor

Product specification  
File under Discrete Semiconductors, SC14

September 1995

**NPN 9 GHz wideband transistor**

**BFG520; BFG520/X; BFG520/XR**

**FEATURES**

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

**DESCRIPTION**

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

The transistors are encapsulated in 4-pin, dual-emitter plastic SOT143 and SOT143R envelopes.

**PINNING**

| PIN                         | DESCRIPTION |
|-----------------------------|-------------|
| BFG520 (Fig.1) Code: N36    |             |
| 1                           | collector   |
| 2                           | base        |
| 3                           | emitter     |
| 4                           | emitter     |
| BFG520/X (Fig.1) Code: N42  |             |
| 1                           | collector   |
| 2                           | emitter     |
| 3                           | base        |
| 4                           | emitter     |
| BFG520/XR (Fig.2) Code: N48 |             |
| 1                           | collector   |
| 2                           | emitter     |
| 3                           | base        |
| 4                           | emitter     |

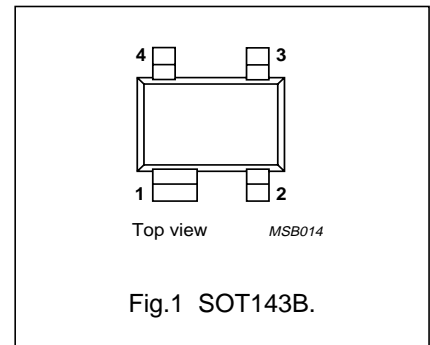


Fig.1 SOT143B.

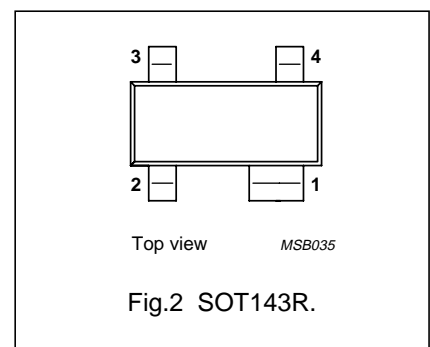


Fig.2 SOT143R.

**QUICK REFERENCE DATA**

| SYMBOL       | PARAMETER                     | CONDITIONS   | MIN. | TYP. | MAX. | UNIT |
|--------------|-------------------------------|--|------|------|------|------|
| $V_{CB0}$    | collector-base voltage        | open emitter   | –    | –    | 20   | V    |
| $V_{CEO}$    | collector-emitter voltage     | open base  | –    | –    | 15   | V    |
| $I_C$        | DC collector current          |  | –    | –    | 70   | mA   |
| $P_{tot}$    | total power dissipation       | up to $T_s = 88\text{ }^\circ\text{C}$ ; note 1  | –    | –    | 300  | mW   |
| $h_{FE}$     | DC current gain               | $I_C = 20\text{ mA}$ ; $V_{CE} = 6\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$  | 60   | 120  | 250  |      |
| $C_{re}$     | feedback capacitance          | $I_C = 0$ ; $V_{CB} = 6\text{ V}$ ; $f = 1\text{ MHz}$   | –    | 0.3  | –    | pF   |
| $f_T$        | transition frequency          | $I_C = 20\text{ mA}$ ; $V_{CE} = 6\text{ V}$ ; $f = 1\text{ GHz}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$                               | –    | 9    | –    | GHz  |
| $G_{UM}$     | maximum unilateral power gain | $I_C = 20\text{ mA}$ ; $V_{CE} = 6\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$                             | –    | 19   | –    | dB   |
|              |                               | $I_C = 20\text{ mA}$ ; $V_{CE} = 6\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$                               | –    | 13   | –    | dB   |
| $ S_{21} ^2$ | insertion power gain          | $I_C = 20\text{ mA}$ ; $V_{CE} = 6\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$                             | 17   | 18   | –    | dB   |
| F            | noise figure                  | $\Gamma_s = \Gamma_{opt}$ ; $I_C = 5\text{ mA}$ ; $V_{CE} = 6\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$  | –    | 1.1  | 1.6  | dB   |
|              |                               | $\Gamma_s = \Gamma_{opt}$ ; $I_C = 20\text{ mA}$ ; $V_{CE} = 6\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$ | –    | 1.6  | 2.1  | dB   |
|              |                               | $\Gamma_s = \Gamma_{opt}$ ; $I_C = 5\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ }^\circ\text{C}$    | –    | 1.9  | –    | dB   |

## NPN 9 GHz wideband transistor

## BFG520; BFG520/X; BFG520/XR

**LIMITING VALUES**

In accordance with the Absolute Maximum 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                           | –    | 15   | V    |
| $V_{EBO}$ | emitter-base voltage      | open collector                      | –    | 2.5  | V    |
| $I_C$     | DC collector current      |                                     | –    | 70   | mA   |
| $P_{tot}$ | total power dissipation   | up to $T_s = 88\text{ °C}$ ; note 1 | –    | 300  | mW   |
| $T_{stg}$ | storage temperature       |                                     | –65  | 150  | °C   |
| $T_j$     | junction temperature      |                                     | –    | 175  | °C   |

**THERMAL RESISTANCE**

| SYMBOL        | PARAMETER   | CONDITIONS                          | THERMAL RESISTANCE |
|---------------|---|-------------------------------------|--------------------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | up to $T_s = 88\text{ °C}$ ; note 1 | 290 K/W            |

**Note**

- $T_s$  is the temperature at the soldering point of the collector tab.

## NPN 9 GHz wideband transistor

## BFG520; BFG520/X; BFG520/XR

## CHARACTERISTICS

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

| SYMBOL       | PARAMETER                               | CONDITIONS   | MIN. | TYP. | MAX. | UNIT |
|--------------|---|--|------|------|------|------|
| $I_{CBO}$    | collector cut-off current               | $I_E = 0; V_{CB} = 6\text{ V}$   | –    | –    | 50   | nA   |
| $h_{FE}$     | DC current gain                         | $I_C = 20\text{ mA}; V_{CE} = 6\text{ V}$  | 60   | 120  | 250  |      |
| $C_e$        | emitter capacitance                     | $I_C = i_c = 0; V_{EB} = 0.5\text{ V}; f = 1\text{ MHz}$   | –    | 1    | –    | pF   |
| $C_c$        | collector capacitance                   | $I_E = i_e = 0; V_{CB} = 6\text{ V}; f = 1\text{ MHz}$   | –    | 0.6  | –    | pF   |
| $C_{re}$     | feedback capacitance                    | $I_C = 0; V_{CB} = 6\text{ V}; f = 1\text{ MHz}$   | –    | 0.3  | –    | pF   |
| $f_T$        | transition frequency                    | $I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; f = 1\text{ GHz};$<br>$T_{amb} = 25\text{ °C}$                               | –    | 9    | –    | GHz  |
| $G_{UM}$     | maximum unilateral power gain (note 1)  | $I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; f = 900\text{ MHz};$<br>$T_{amb} = 25\text{ °C}$                             | –    | 19   | –    | dB   |
|              |   | $I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; f = 2\text{ GHz};$<br>$T_{amb} = 25\text{ °C}$                               | –    | 13   | –    | dB   |
| $ S_{21} ^2$ | insertion power gain                    | $I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; f = 900\text{ MHz};$<br>$T_{amb} = 25\text{ °C}$                             | 17   | 18   | –    | dB   |
| F            | noise figure                            | $\Gamma_s = \Gamma_{opt}; I_C = 5\text{ mA}; V_{CE} = 6\text{ V};$<br>$f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$     | –    | 1.1  | 1.6  | dB   |
|              |   | $\Gamma_s = \Gamma_{opt}; I_C = 20\text{ mA}; V_{CE} = 6\text{ V};$<br>$f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$    | –    | 1.6  | 2.1  | dB   |
|              |   | $\Gamma_s = \Gamma_{opt}; I_C = 5\text{ mA}; V_{CE} = 6\text{ V};$<br>$f = 2\text{ GHz}; T_{amb} = 25\text{ °C}$       | –    | 1.9  | –    | dB   |
| $P_{L1}$     | output power at 1 dB gain compression   | $I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; R_L = 50\text{ }\Omega;$<br>$f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$     | –    | 17   | –    | dBm  |
| ITO          | third order intercept point             | note 2   | –    | 26   | –    | dBm  |
| $V_o$        | output voltage                          | note 3   | –    | 275  | –    | mV   |
| $d_2$        | second order intermodulation distortion | $I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; V_o = 75\text{ mV};$<br>$T_{amb} = 25\text{ °C}; f_{(p+q)} = 810\text{ MHz}$ | –    | –50  | –    | dB   |

## Notes

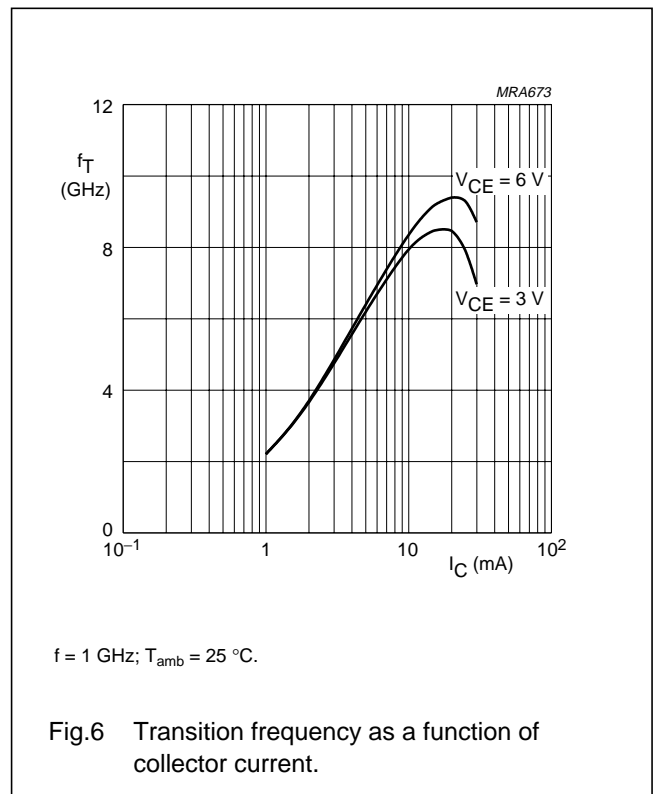
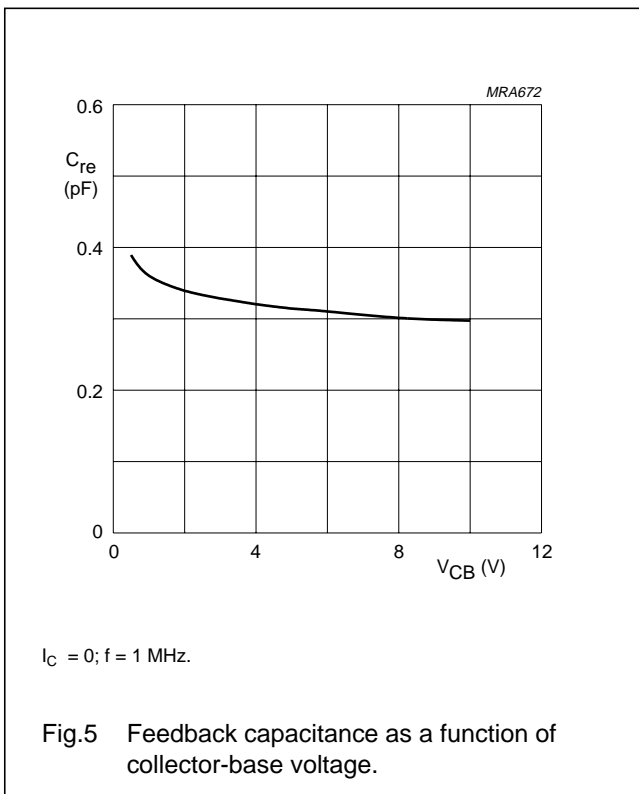
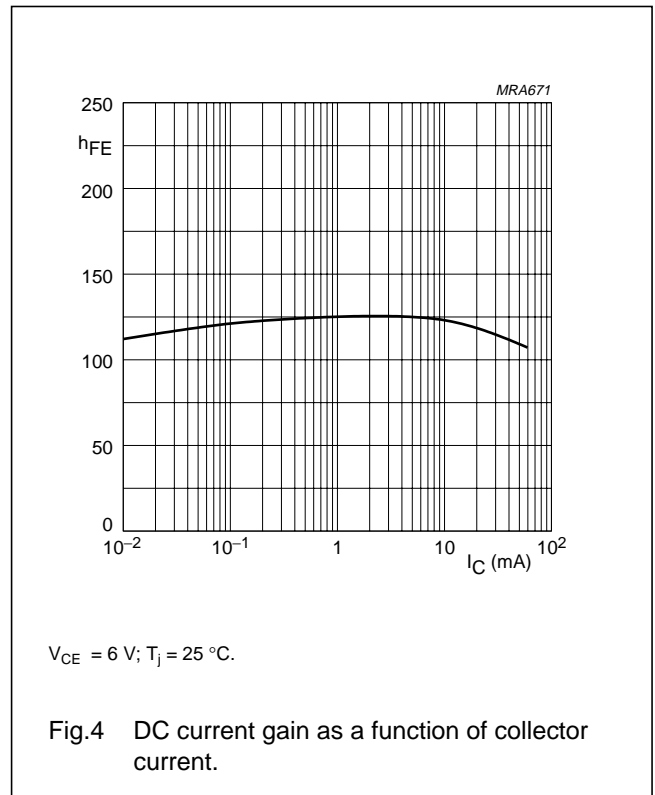
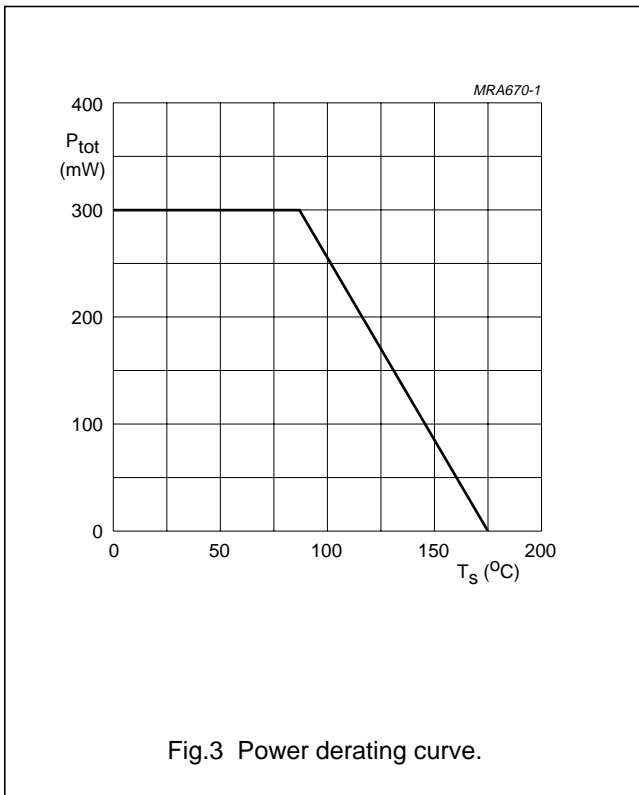
1.  $G_{UM}$  is the maximum unilateral power gain, assuming  $S_{12}$  is zero and

$$G_{UM} = 10 \log \left( \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)} \right) \text{dB.}$$

2.  $I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; R_L = 50\text{ }\Omega; f = 900\text{ MHz}; T_{amb} = 25\text{ °C};$   
 $f_p = 900\text{ MHz}; f_q = 902\text{ MHz};$   
measured at  $f_{(2p-q)} = 898\text{ MHz}$  and  $f_{(2q-p)} = 904\text{ MHz}.$
3.  $d_{im} = -60\text{ dB}$  (DIN 45004B);  
 $V_p = V_o; V_q = V_o - 6\text{ dB}; V_r = V_o - 6\text{ dB};$   
 $f_p = 795.25\text{ MHz}; f_q = 803.25\text{ MHz}; f_r = 805.25\text{ MHz};$   
measured at  $f_{(p+q-r)} = 793.25\text{ MHz}$

NPN 9 GHz wideband transistor

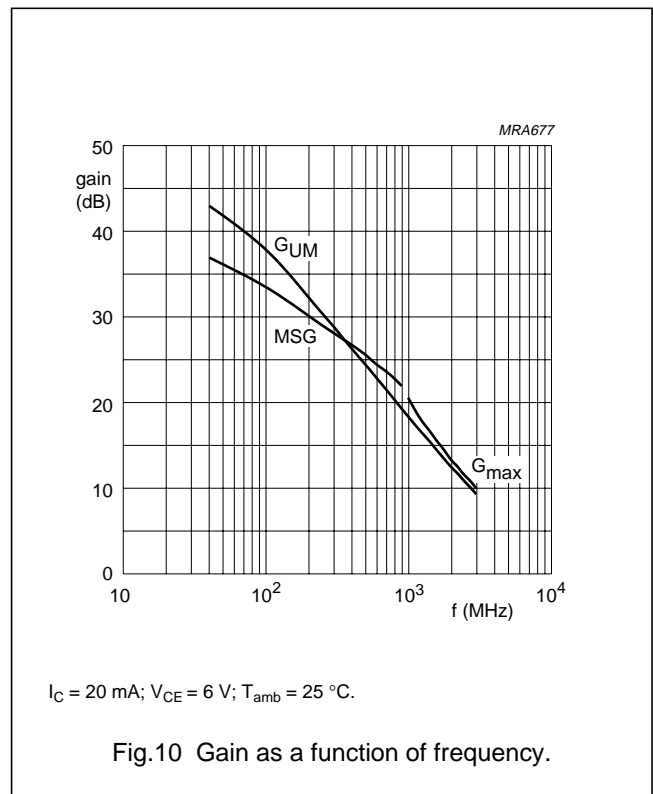
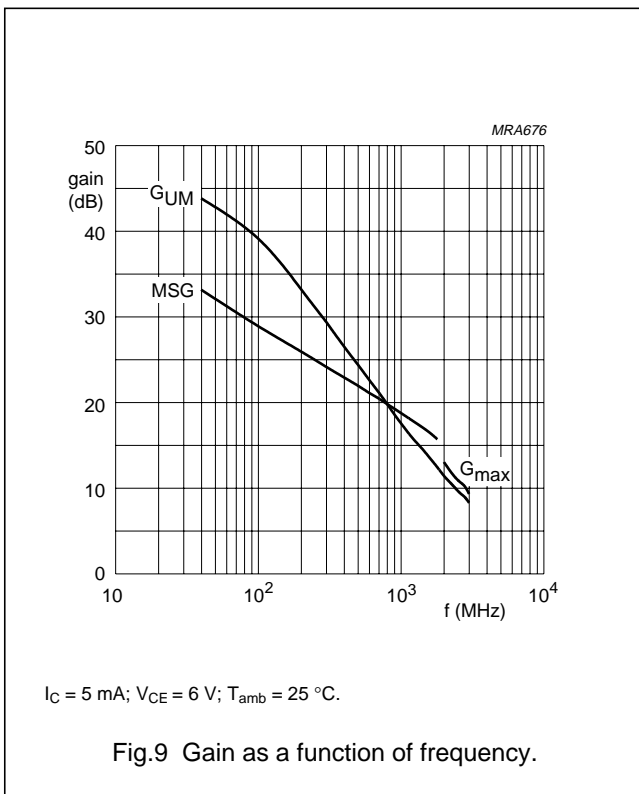
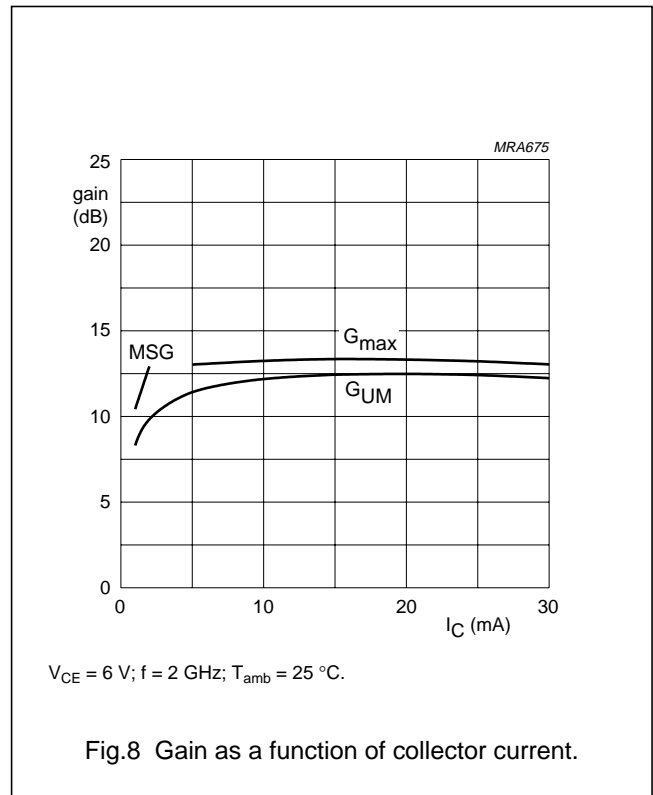
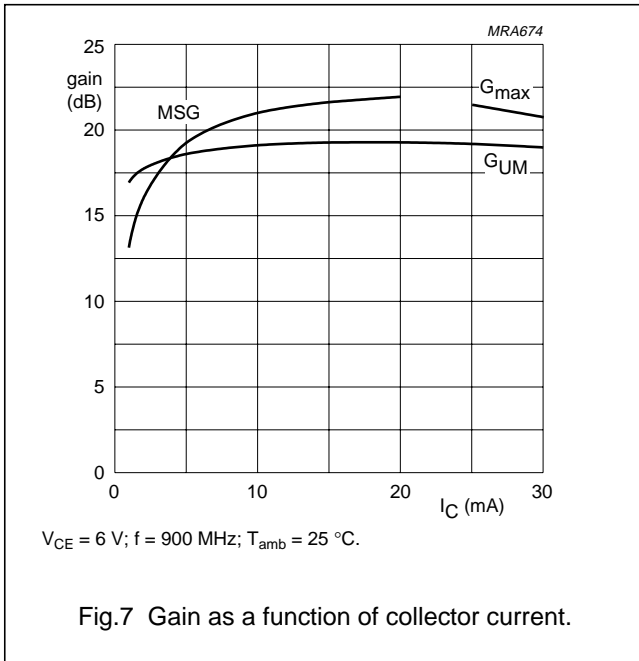
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NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

In Figs 7 to 10,  $G_{UM}$  = maximum unilateral power gain;  $MSG$  = maximum stable gain;  $G_{max}$  = maximum available gain.



NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR

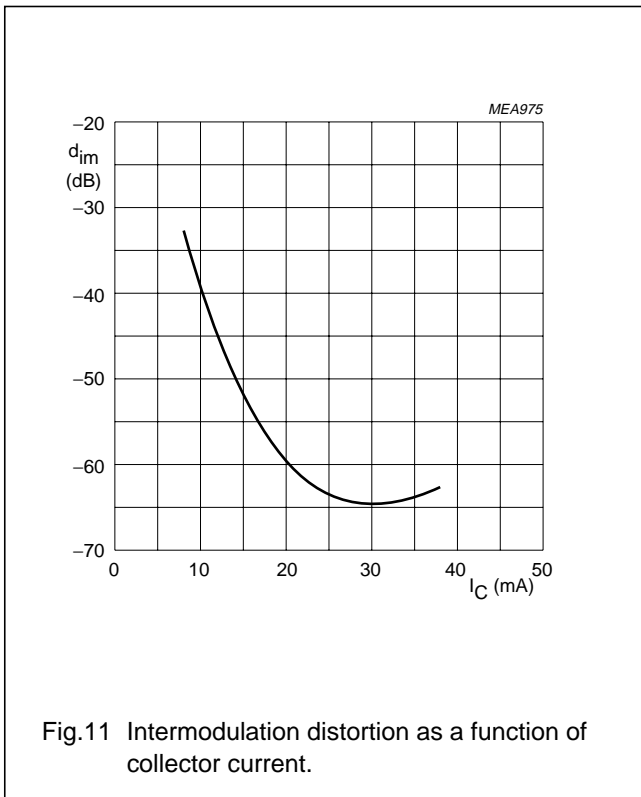


Fig.11 Intermodulation distortion as a function of collector current.

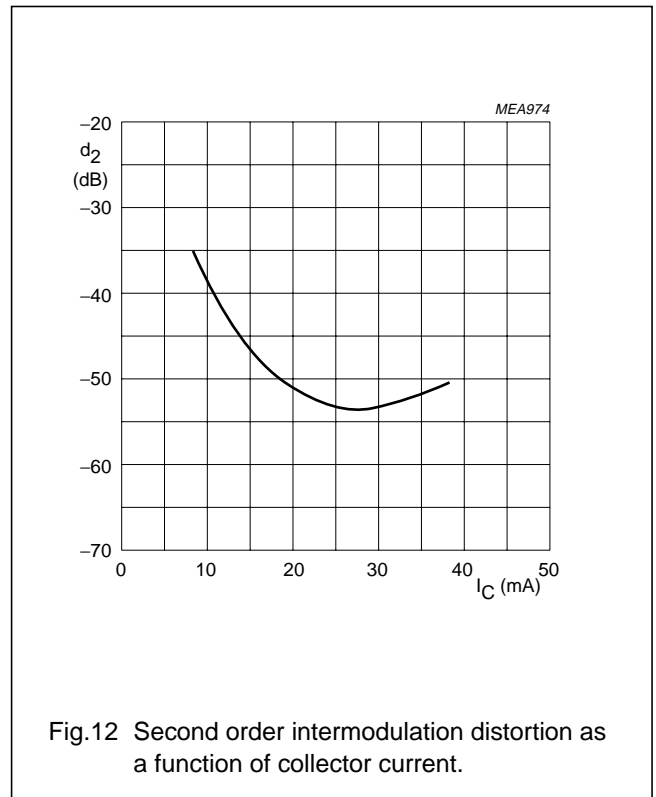
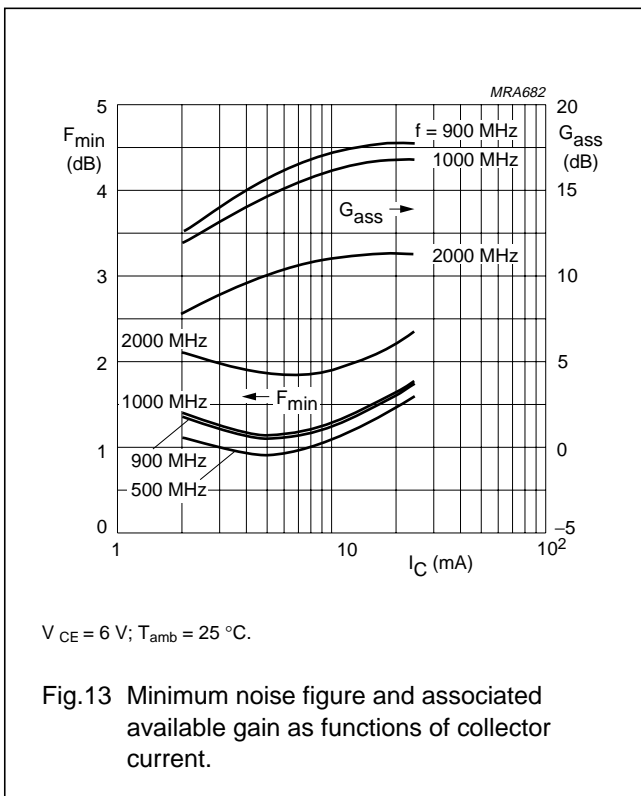
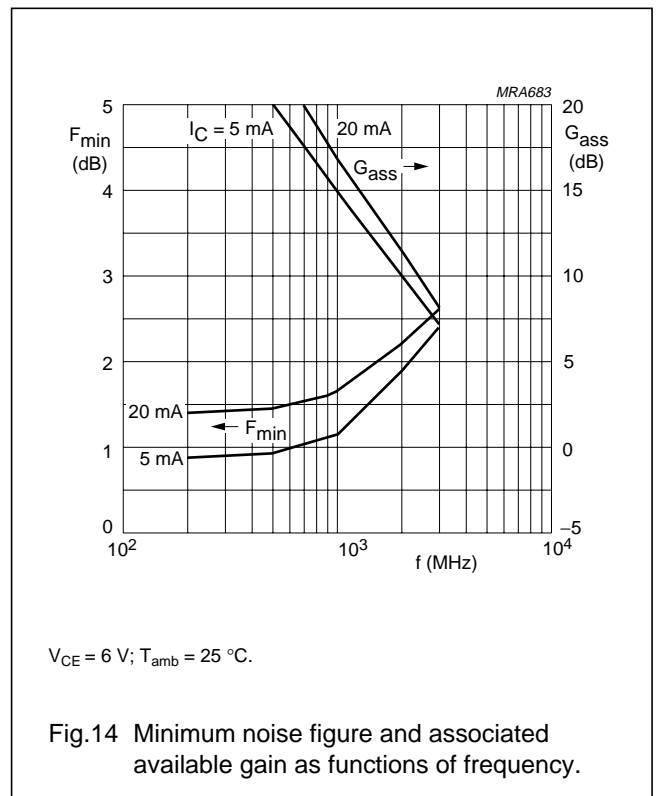


Fig.12 Second order intermodulation distortion as a function of collector current.



$V_{CE} = 6 V$ ;  $T_{amb} = 25\text{ }^\circ\text{C}$ .

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

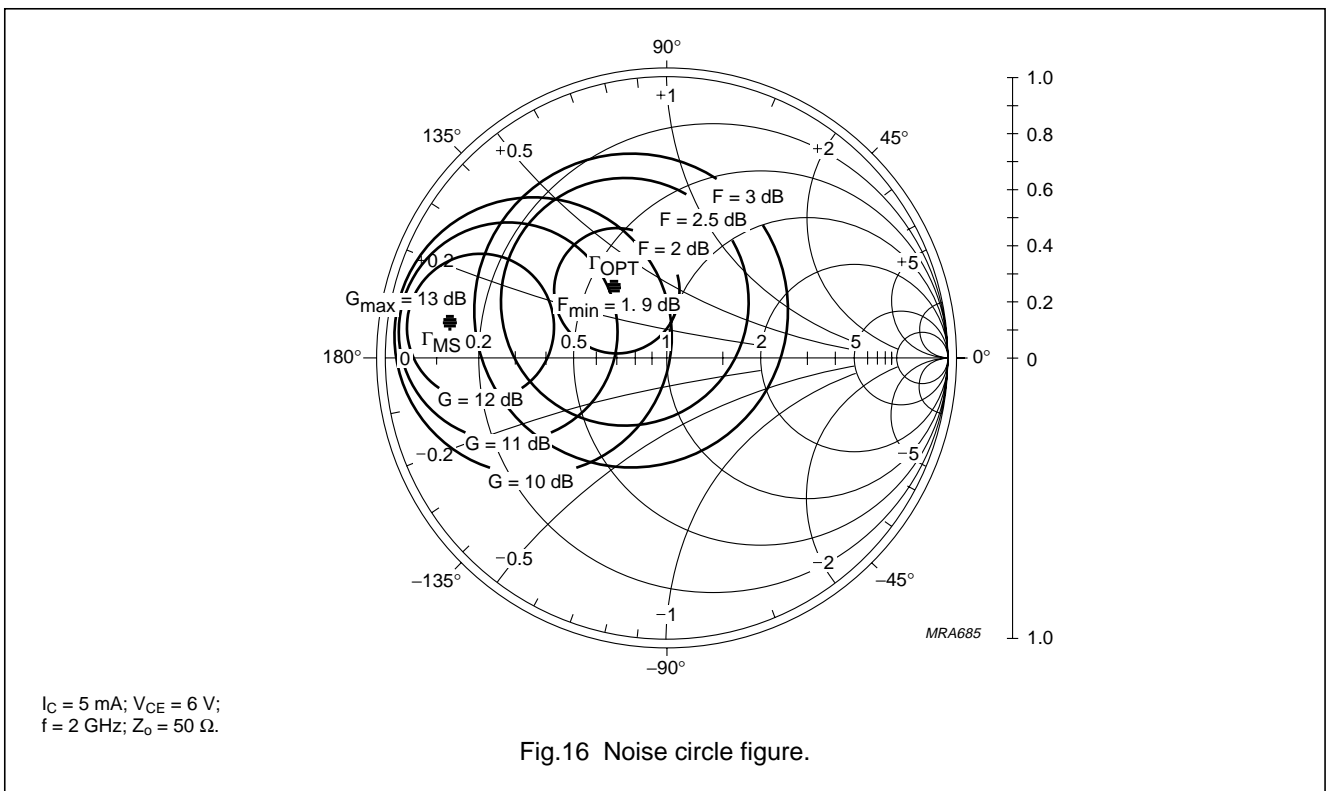
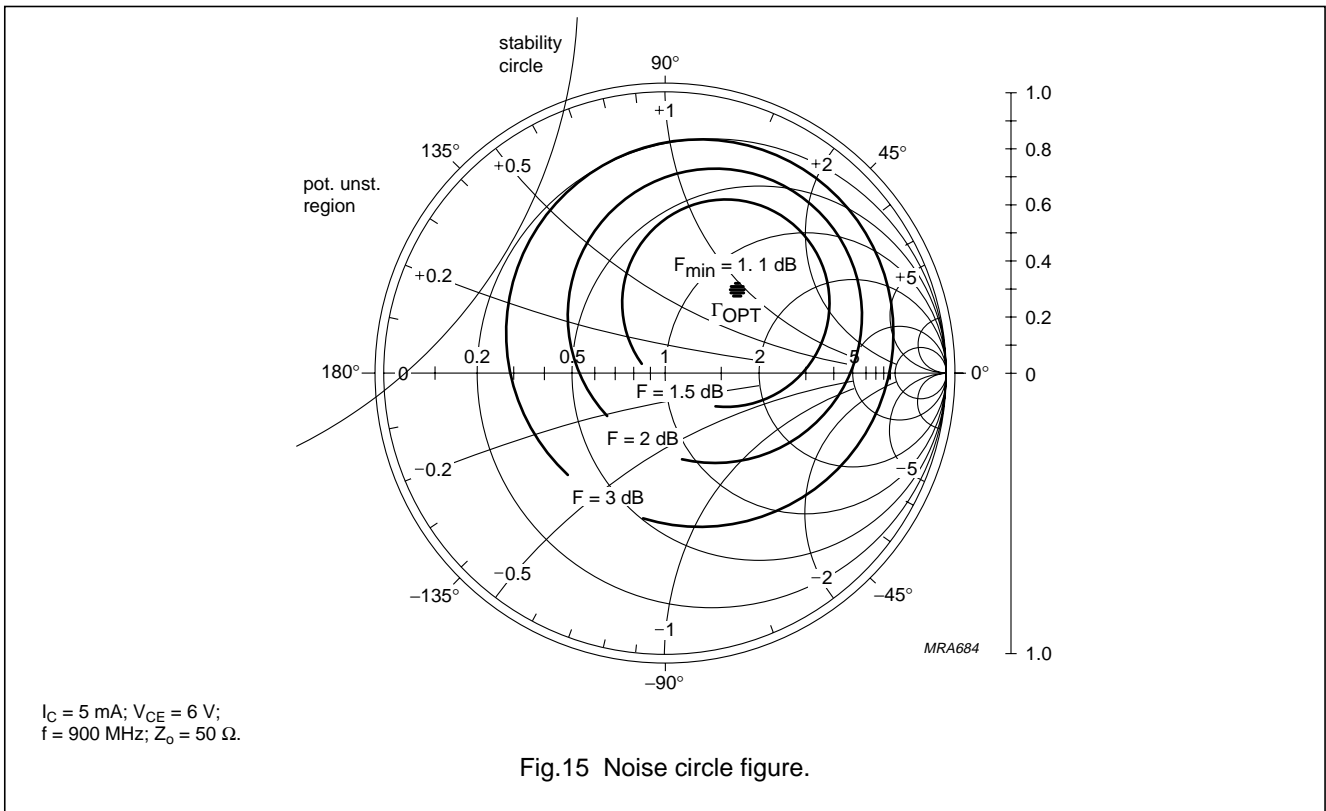


$V_{CE} = 6 V$ ;  $T_{amb} = 25\text{ }^\circ\text{C}$ .

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

NPN 9 GHz wideband transistor

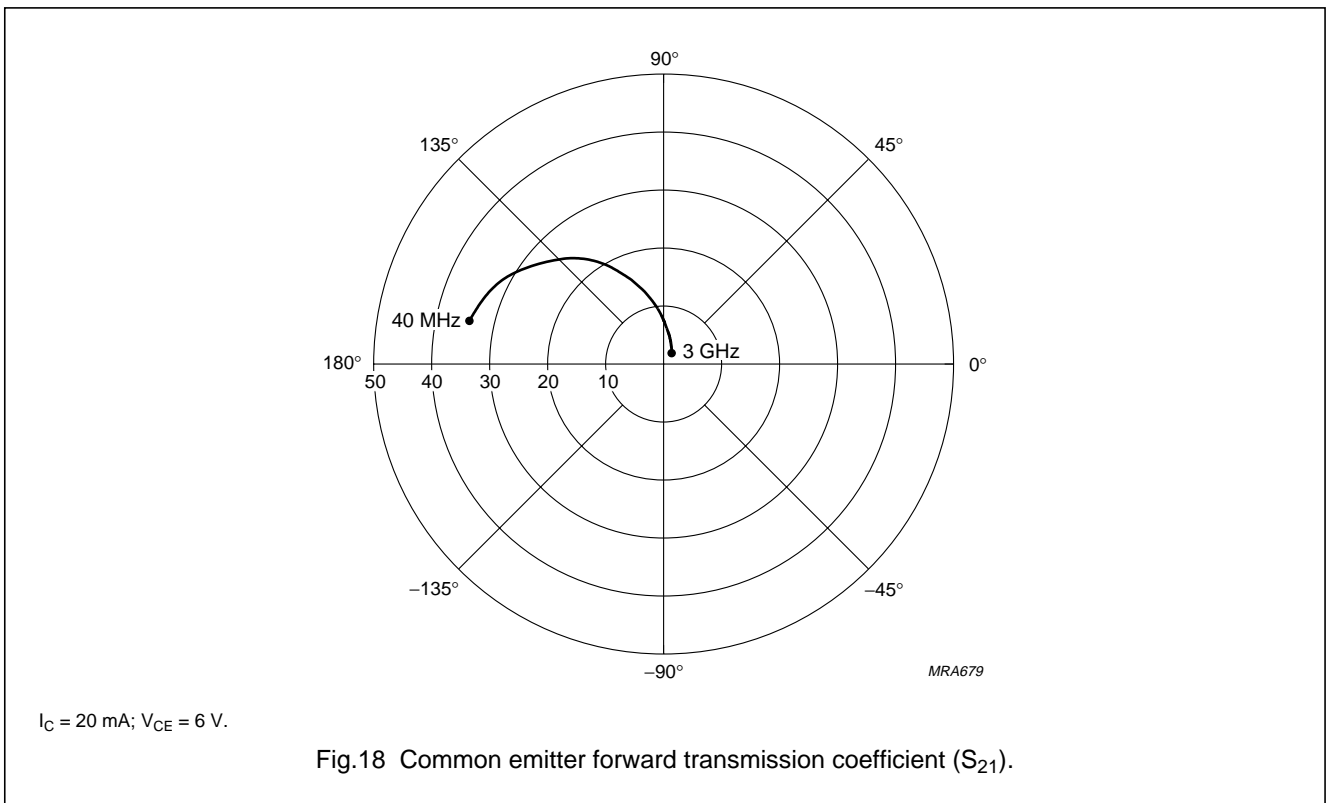
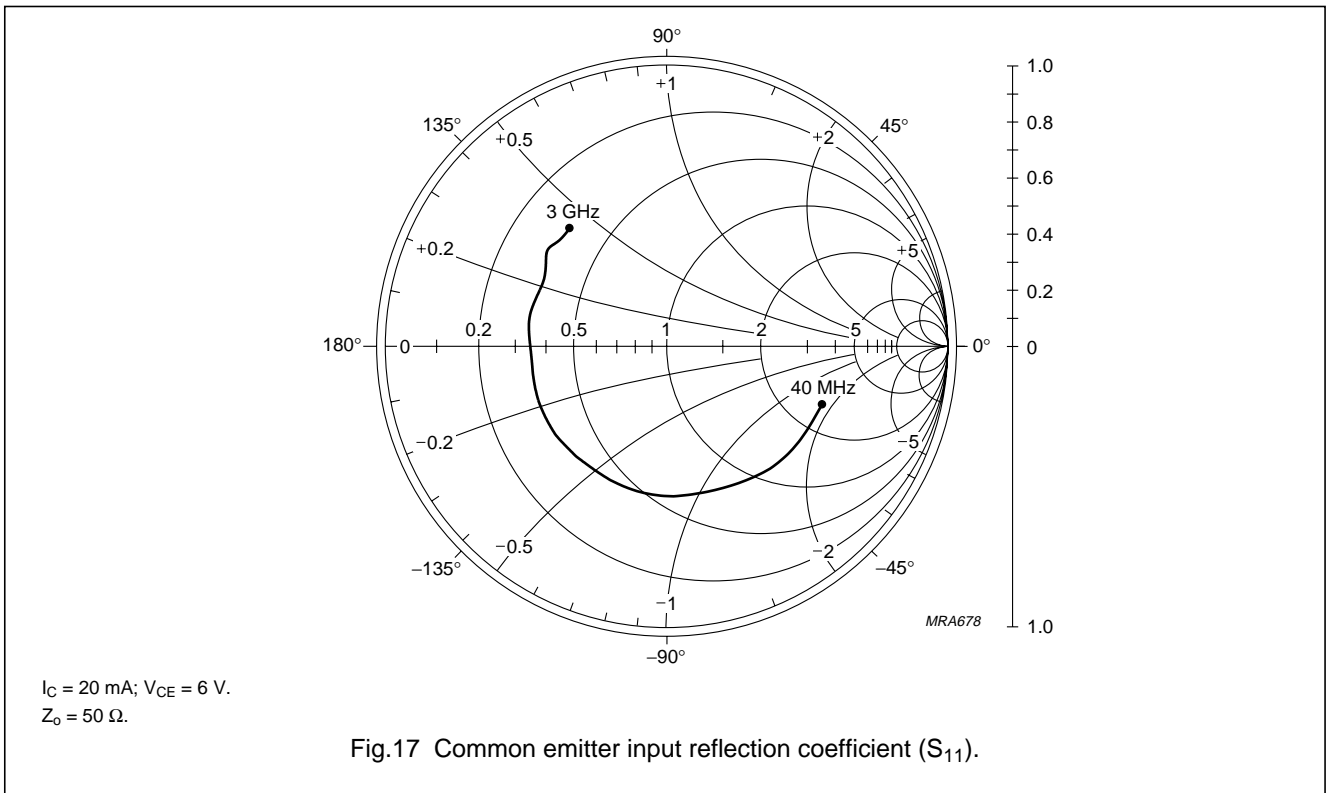
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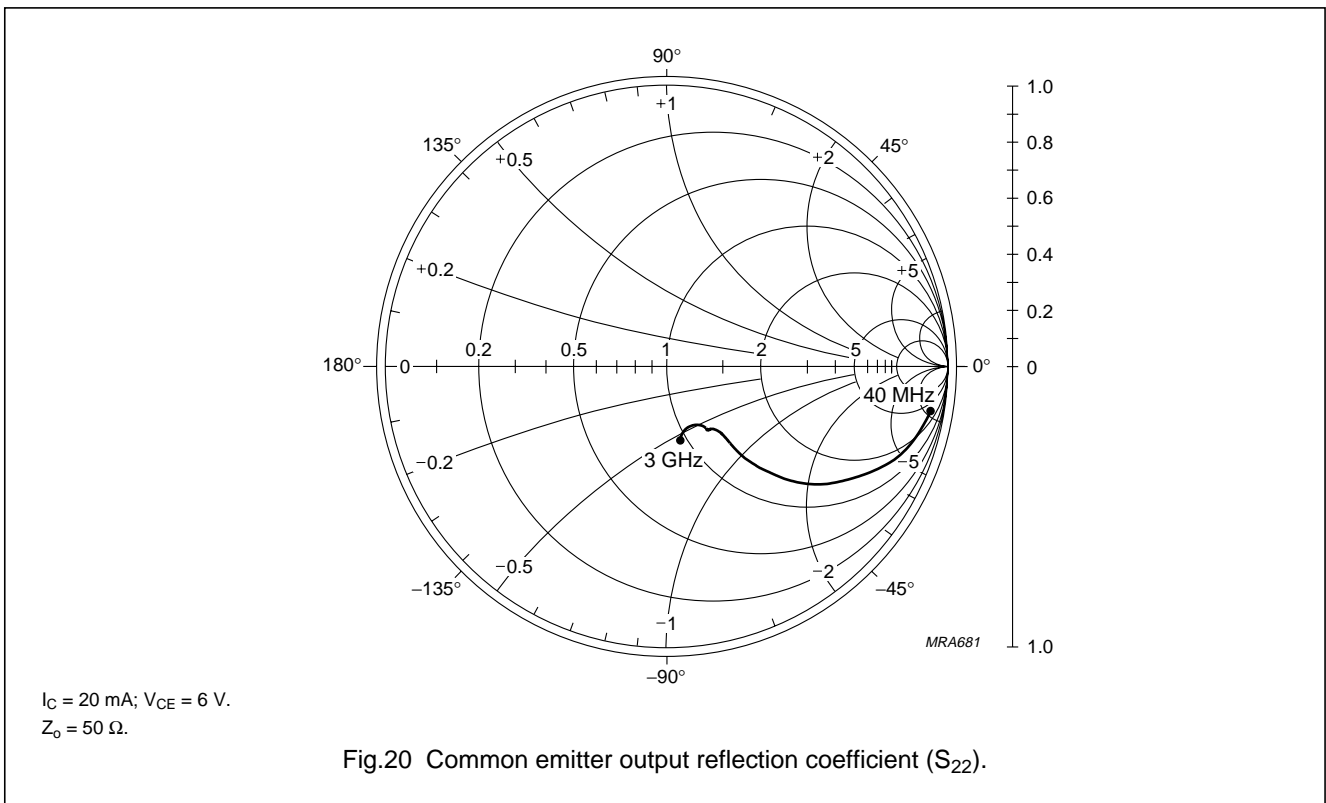
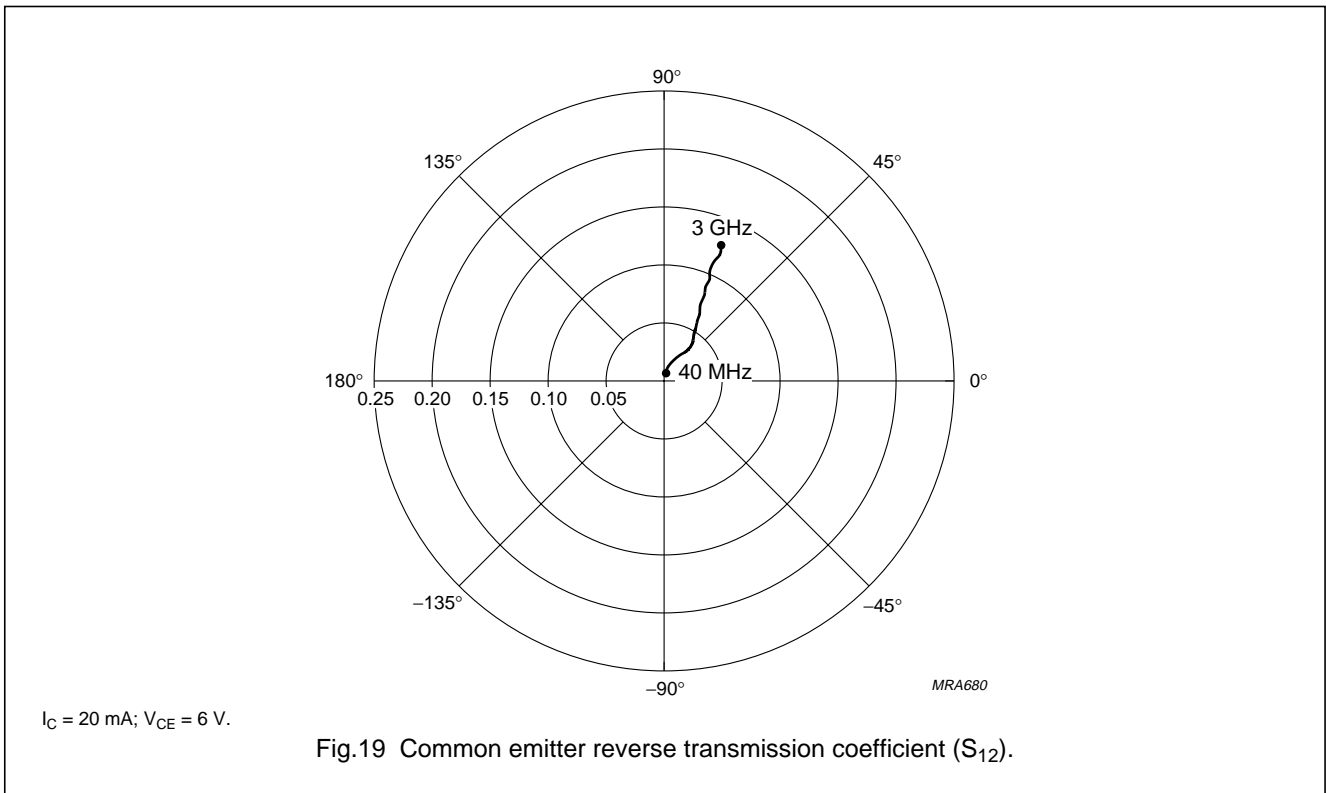
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BFG520; BFG520/X; BFG520/XR



NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/XR



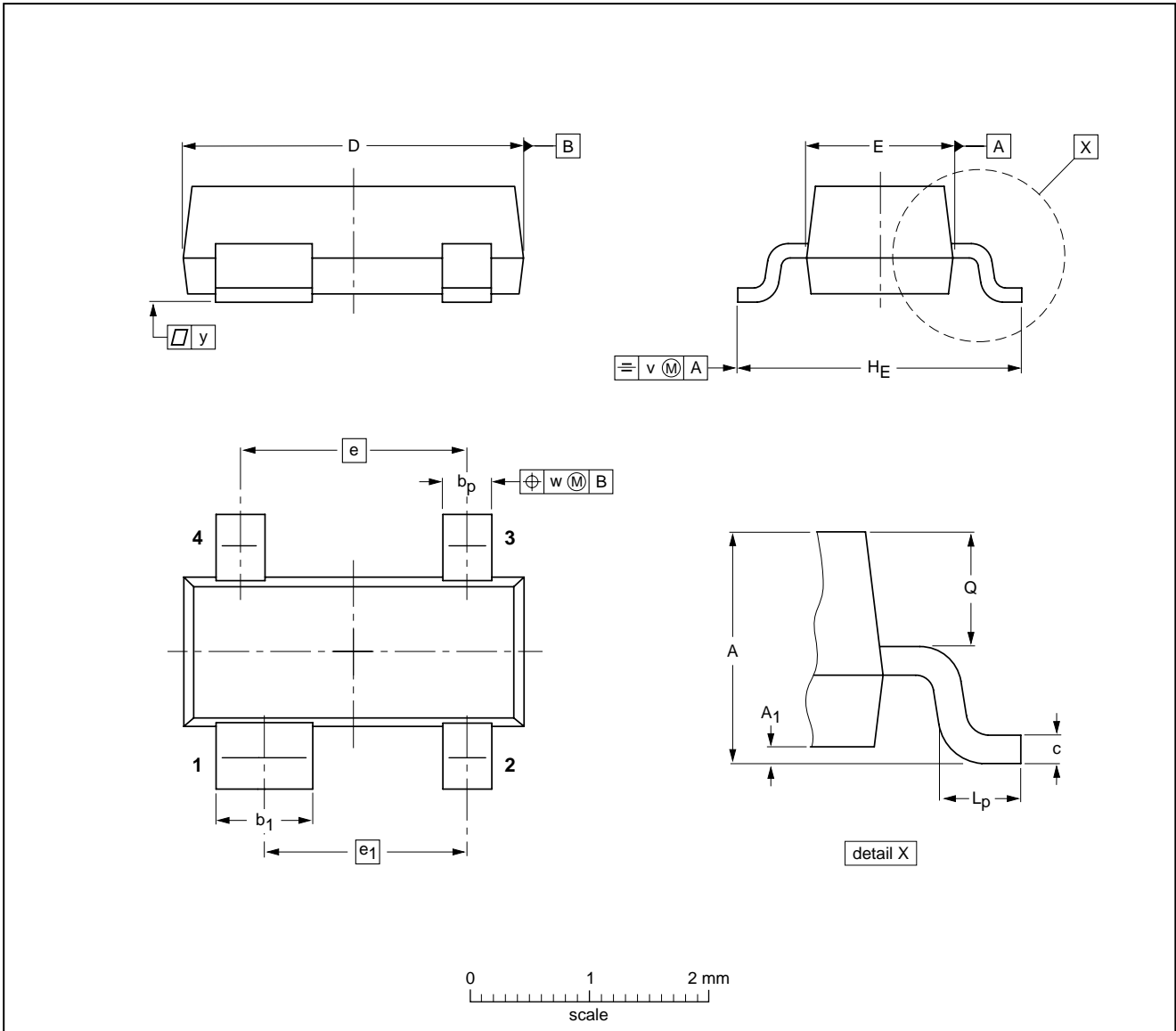
NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/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 |

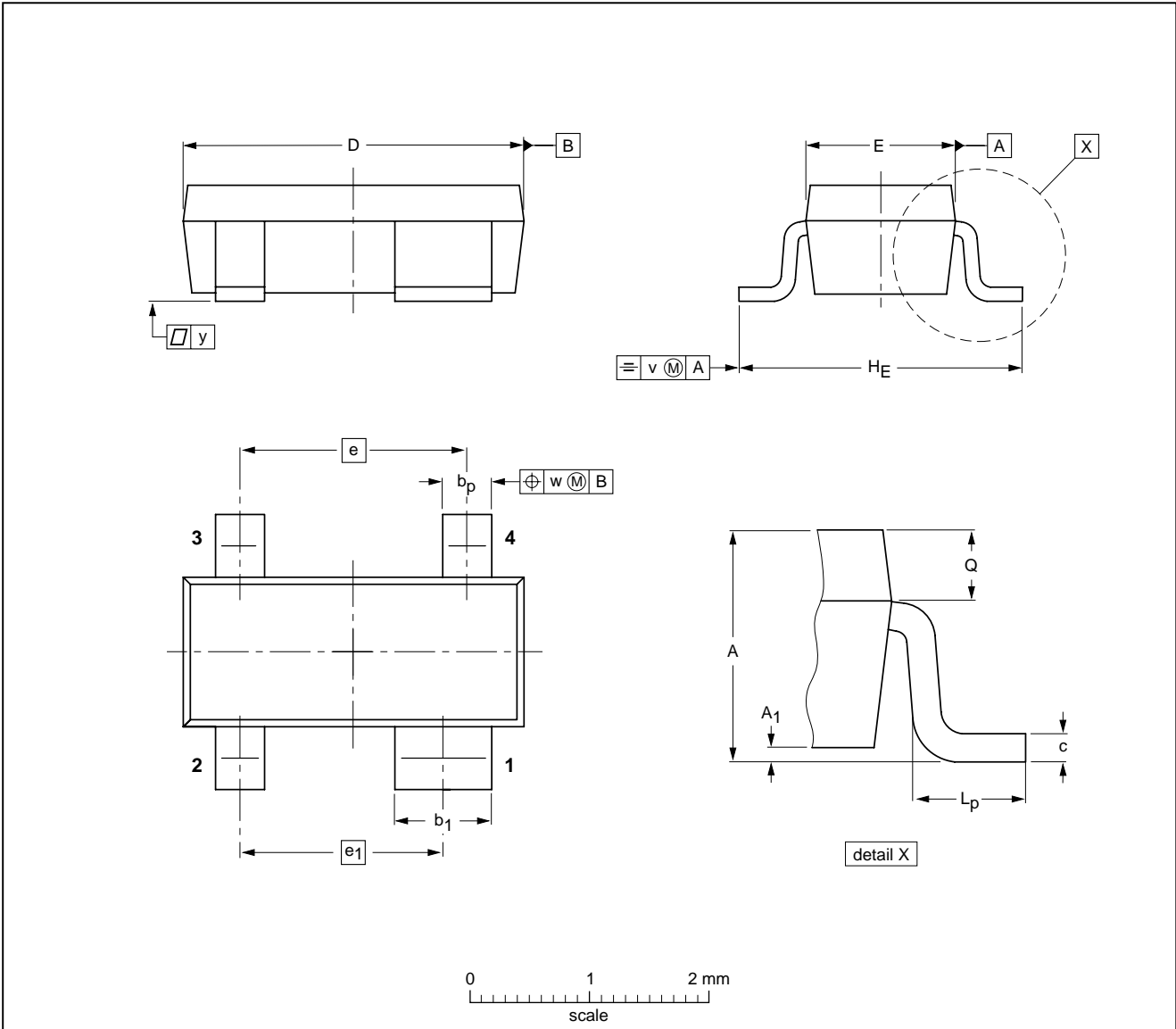
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|-----------------|------------|-------|------|--|---------------------|------------|
|                 | IEC        | JEDEC | EIAJ |  |                     |            |
| SOT143B         |            |       |      |  |                     | 97-02-28   |

NPN 9 GHz wideband transistor

BFG520; BFG520/X; BFG520/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   |

## NPN 9 GHz wideband transistor

## BFG520; BFG520/X; BFG520/XR

**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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