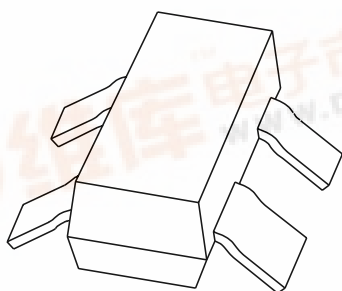


**DISCRETE SEMICONDUCTORS**

# DATA SHEET



## **BFG505; BFG505/X** NPN 9 GHz wideband transistors

Product specification  
Supersedes data of September 1995

1998 Oct 02

## NPN 9 GHz wideband transistors

## BFG505; BFG505/X

## FEATURES

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

## APPLICATIONS

RF front end applications 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).

## DESCRIPTION

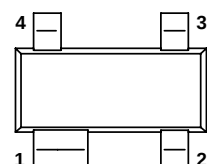
NPN silicon planar epitaxial transistor in a 4-pin dual-emitter SOT143B plastic package.

## MARKING

| TYPE NUMBER | CODE |
|-------------|------|
| BFG505      | N33  |
| BFG505/X    | N39  |

## PINNING

| PIN | DESCRIPTION |           |
|-----|-------------|-----------|
|     | BFG505      | BFG505/X  |
| 1   | collector   | collector |
| 2   | base        | emitter   |
| 3   | emitter     | base      |
| 4   | emitter     | emitter   |



Top view

MSB014

Fig.1 Simplified outline SOT143B.

## 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    |
| $I_C$        | collector current (DC)        |                                                                                                                                | —    | —    | 18   | mA   |
| $P_{tot}$    | total power dissipation       | $T_s \leq 130\text{ }^{\circ}\text{C}$                                                                                         | —    | —    | 150  | mW   |
| $h_{FE}$     | DC current gain               | $V_{CE} = 6\text{ V}; I_C = 5\text{ mA}$                                                                                       | 60   | 120  | 250  |      |
| $C_{re}$     | feedback capacitance          | $V_{CB} = 6\text{ V}; I_C = I_c = 0; f = 1\text{ MHz}$                                                                         | —    | 0.2  | —    | pF   |
| $f_T$        | transition frequency          | $V_{CE} = 6\text{ V}; I_C = 5\text{ mA}; f = 1\text{ GHz}$                                                                     | —    | 9    | —    | GHz  |
| $G_{UM}$     | maximum unilateral power gain | $V_{CE} = 6\text{ V}; I_C = 5\text{ mA}; T_{amb} = 25\text{ }^{\circ}\text{C}; f = 900\text{ MHz}$                             | —    | 20   | —    | dB   |
|              |                               | $V_{CE} = 6\text{ V}; I_C = 5\text{ mA}; T_{amb} = 25\text{ }^{\circ}\text{C}; f = 2\text{ GHz}$                               | —    | 13   | —    | dB   |
| $ S_{21} ^2$ | insertion power gain          | $V_{CE} = 6\text{ V}; I_C = 5\text{ mA}; T_{amb} = 25\text{ }^{\circ}\text{C}; f = 900\text{ MHz}$                             | 16   | 17   | —    | dB   |
| F            | noise figure                  | $\Gamma_s = \Gamma_{opt}; V_{CE} = 6\text{ V}; I_C = 1.25\text{ mA}; T_{amb} = 25\text{ }^{\circ}\text{C}; f = 900\text{ MHz}$ | —    | 1.2  | 1.7  | dB   |
|              |                               | $\Gamma_s = \Gamma_{opt}; V_{CE} = 6\text{ V}; I_C = 5\text{ mA}; T_{amb} = 25\text{ }^{\circ}\text{C}; f = 900\text{ MHz}$    | —    | 1.6  | 2.1  | dB   |
|              |                               | $\Gamma_s = \Gamma_{opt}; V_{CE} = 6\text{ V}; I_C = 1.25\text{ mA}; T_{amb} = 25\text{ }^{\circ}\text{C}; f = 2\text{ GHz}$   | —    | 1.9  | —    | dB   |

## NPN 9 GHz wideband transistors

BFG505; BFG505/X

## 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                  |
| $V_{CES}$ | collector-emitter voltage | $R_{BE} = 0$                                               | –    | 15   | V                  |
| $V_{EBO}$ | emitter-base voltage      | open collector                                             | –    | 2.5  | V                  |
| $I_C$     | collector current (DC)    |                                                            | –    | 18   | mA                 |
| $P_{tot}$ | total power dissipation   | $T_s \leq 130\text{ }^{\circ}\text{C}$ ; see Fig.2; note 1 | –    | 150  | mW                 |
| $T_{stg}$ | storage temperature range |                                                            | –65  | 150  | $^{\circ}\text{C}$ |
| $T_j$     | junction temperature      |                                                            | –    | 175  | $^{\circ}\text{C}$ |

## 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 | note 1     | 290   | K/W  |

## Note

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

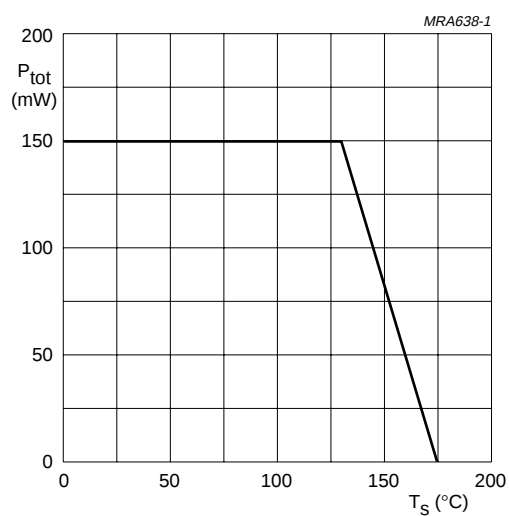


Fig.2 Power derating curve.

## NPN 9 GHz wideband transistors

## BFG505; BFG505/X

## CHARACTERISTICS

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

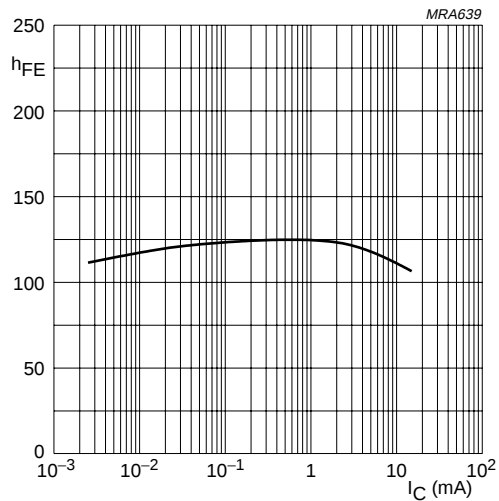
| SYMBOL       | PARAMETER                             | CONDITIONS                                                                                                            | MIN. | TYP. | MAX. | UNIT |
|--------------|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $I_{CBO}$    | collector cut-off current             | $V_{CB} = 6\text{ V}; I_E = 0$                                                                                        | –    | –    | 50   | nA   |
| $h_{FE}$     | DC current gain                       | $I_C = 5\text{ mA}; V_{CE} = 6\text{ V};$ see Fig.3                                                                   | 60   | 120  | 250  |      |
| $C_e$        | emitter capacitance                   | $I_C = i_c = 0\text{ V}; V_{EB} = 0.5\text{ V}; f = 1\text{ MHz}$                                                     | –    | 0.4  | –    | pF   |
| $C_c$        | collector capacitance                 | $V_{CB} = 6\text{ V}; I_E = i_e = 0; f = 1\text{ MHz}$                                                                | –    | 0.3  | –    | pF   |
| $C_{re}$     | feedback capacitance                  | $I_C = 0; V_{CB} = 6\text{ V}; f = 1\text{ MHz};$ see Fig.4                                                           | –    | 0.2  | –    | pF   |
| $f_T$        | transition frequency                  | $I_C = 5\text{ mA}; V_{CE} = 6\text{ V}; f = 1\text{ GHz};$ see Fig.5                                                 | –    | 9    | –    | GHz  |
| $G_{UM}$     | maximum unilateral power gain; note 1 | $I_C = 5\text{ mA}; V_{CE} = 6\text{ V};$<br>$T_{amb} = 25\text{ °C}; f = 900\text{ MHz}$                             | –    | 20   | –    | dB   |
|              |                                       | $I_C = 5\text{ mA}; V_{CE} = 6\text{ V};$<br>$T_{amb} = 25\text{ °C}; f = 2\text{ GHz}$                               | –    | 13   | –    | dB   |
| $ S_{21} ^2$ | insertion power gain                  | $I_C = 5\text{ mA}; V_{CE} = 6\text{ V};$<br>$T_{amb} = 25\text{ °C}; f = 900\text{ MHz}$                             | 16   | 17   | –    | dB   |
| F            | noise figure                          | $\Gamma_s = \Gamma_{opt}; I_C = 1.25\text{ mA}; V_{CE} = 6\text{ V};$<br>$T_{amb} = 25\text{ °C}; f = 900\text{ MHz}$ | –    | 1.2  | 1.7  | dB   |
|              |                                       | $\Gamma_s = \Gamma_{opt}; I_C = 5\text{ mA}; V_{CE} = 6\text{ V};$<br>$T_{amb} = 25\text{ °C}; f = 900\text{ MHz}$    | –    | 1.6  | 2.1  | dB   |
|              |                                       | $\Gamma_s = \Gamma_{opt}; I_C = 1.25\text{ mA}; V_{CE} = 6\text{ V};$<br>$T_{amb} = 25\text{ °C}; f = 2\text{ GHz}$   | –    | 1.9  | –    | dB   |
| $P_{L1}$     | output power at 1 dB gain compression | $I_C = 5\text{ mA}; V_{CE} = 6\text{ V}; R_L = 50\text{ }\Omega;$<br>$T_{amb} = 25\text{ °C}; f = 900\text{ MHz}$     | –    | 4    | –    | dBm  |
| ITO          | third order intercept point           | note 2                                                                                                                | –    | 10   | –    | dBm  |

## 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.
- $V_{CE} = 6\text{ V}; I_C = 5\text{ mA}; R_L = 50\text{ }\Omega; T_{amb} = 25\text{ °C};$   
 $f_p = 900\text{ MHz}; f_q = 902\text{ MHz};$   
measured at  $2f_p - f_q = 898\text{ MHz}$  and  $2f_q - f_p = 904\text{ MHz}$ .

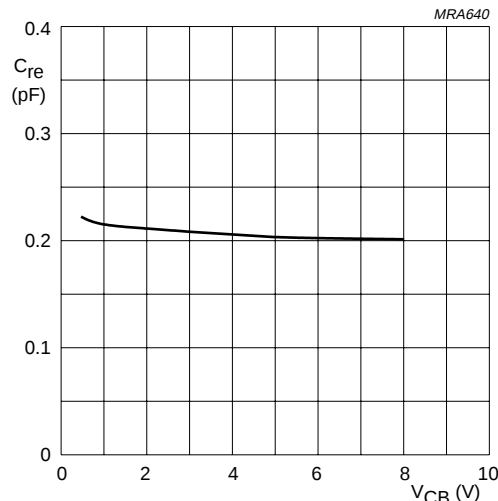
NPN 9 GHz wideband transistors

BFG505; BFG505/X



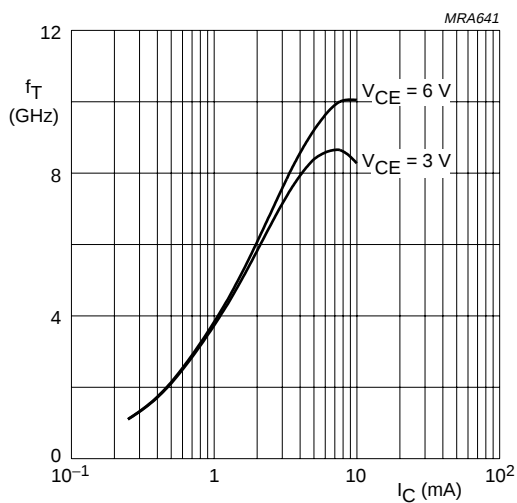
$V_{CE} = 6\text{ V}$ .

Fig.3 DC current gain as a function of collector current.



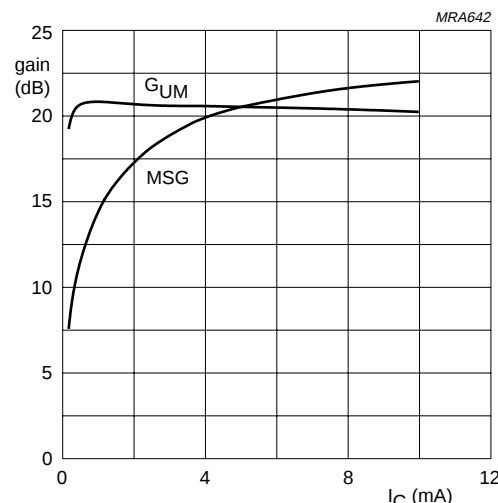
$I_C = 0$ ;  $f = 1\text{ MHz}$ .

Fig.4 Feedback capacitance as a function of collector-base voltage.



$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $f = 1\text{ GHz}$ .

Fig.5 Transition frequency as a function of collector current.

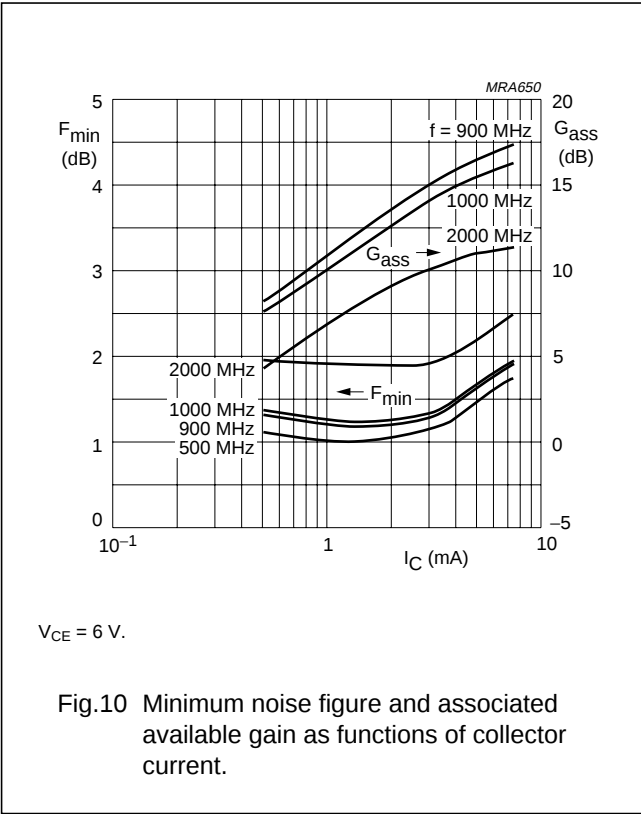
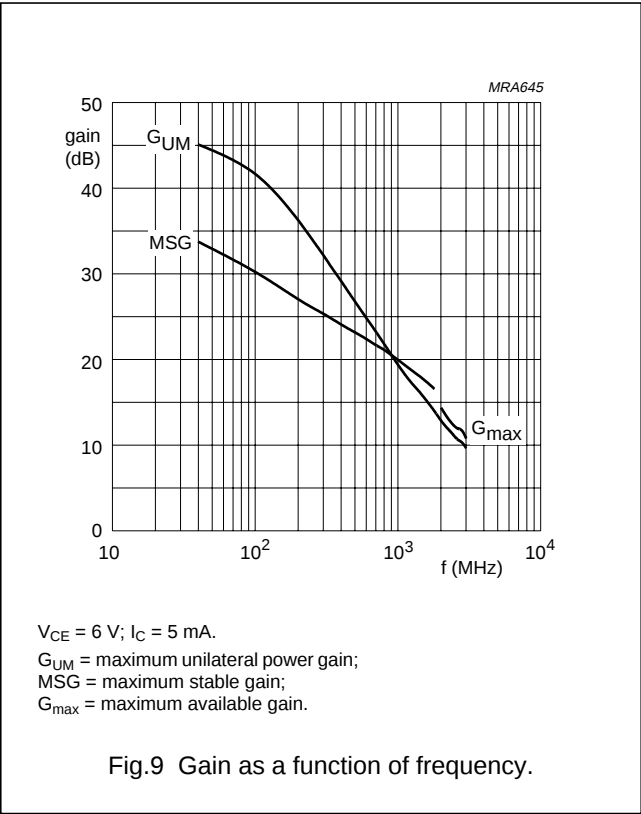
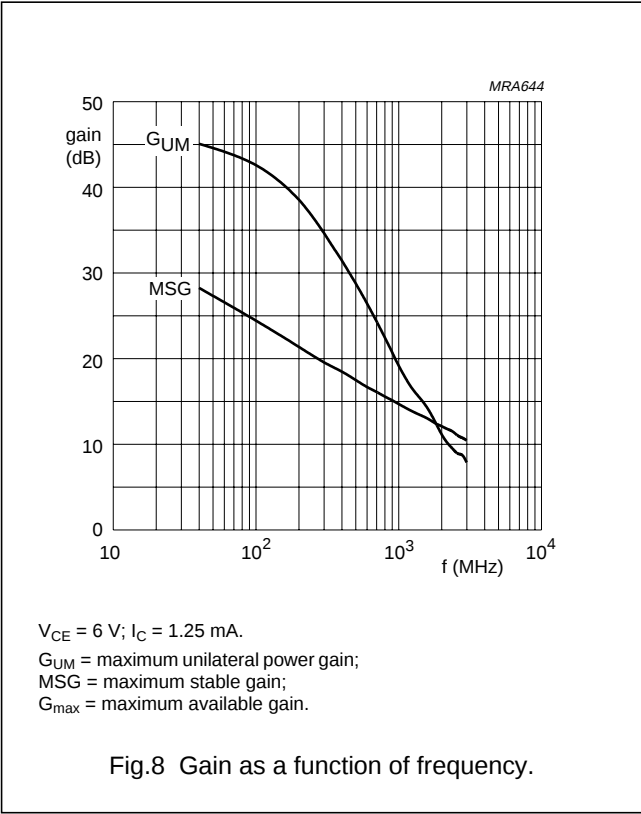
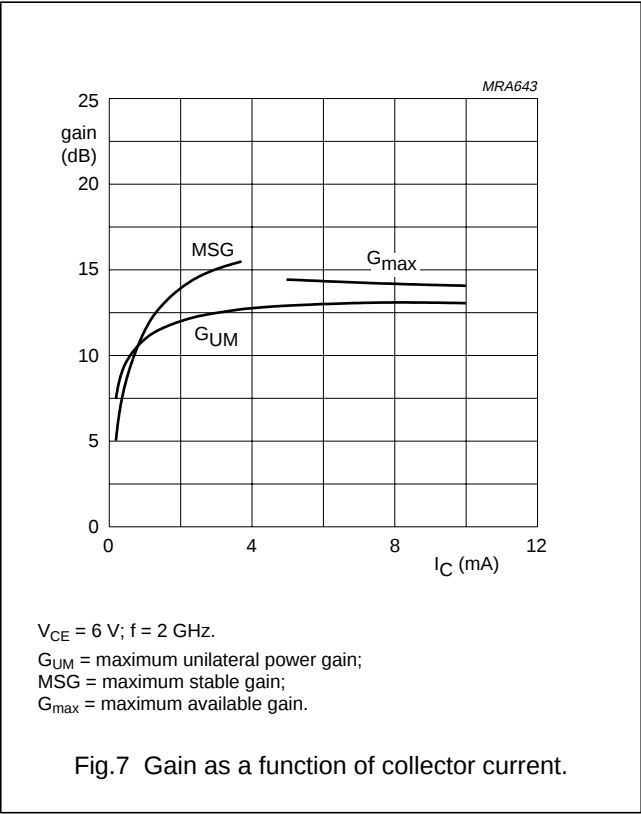


$V_{CE} = 6\text{ V}$ ;  $f = 900\text{ MHz}$ .  
 $G_{UM}$  = maximum unilateral power gain;  
 $MSG$  = maximum stable gain;  
 $G_{max}$  = maximum available gain.

Fig.6 Gain as a function of collector current.

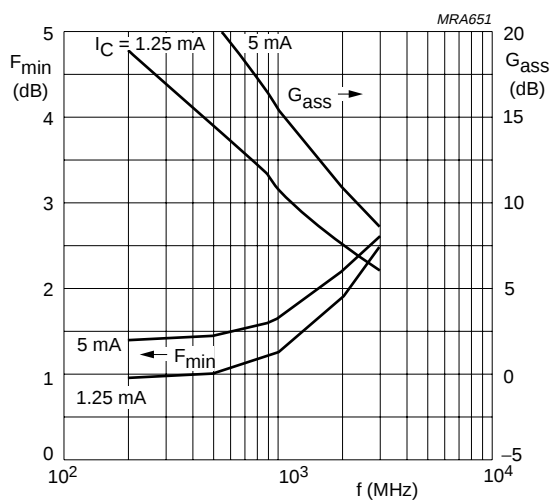
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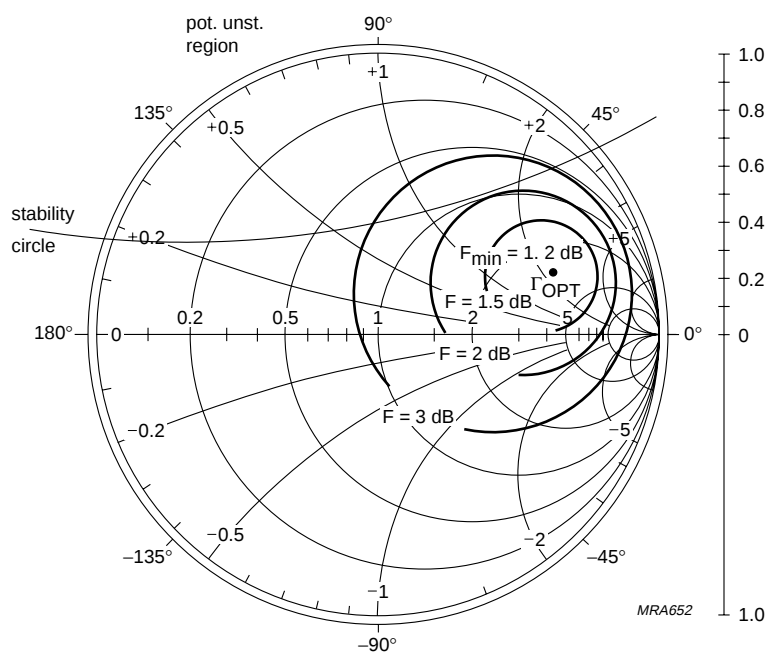
## NPN 9 GHz wideband transistors

## BFG505; BFG505/X



$V_{CE} = 6$  V.

Fig.11 Minimum noise figure and associated available gain as functions of frequency.



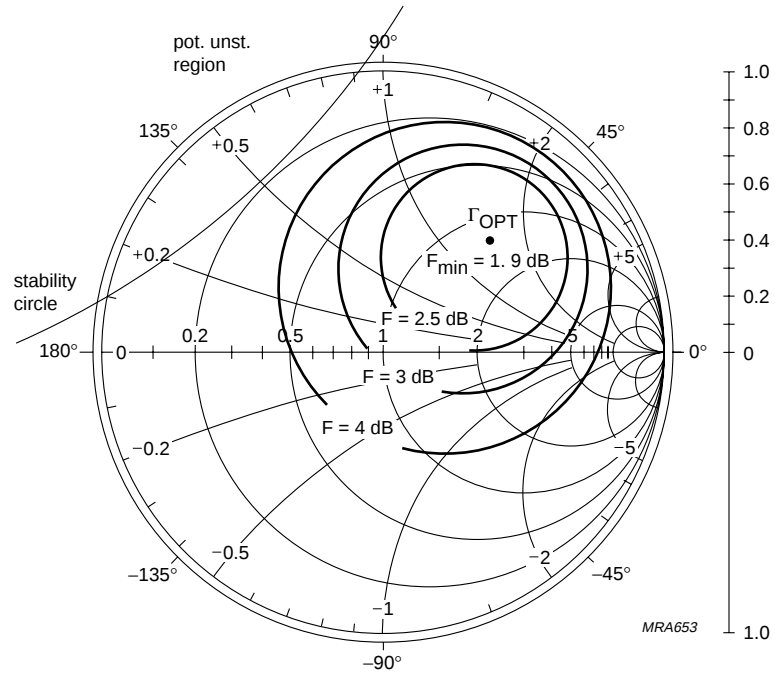
$Z_0 = 50 \Omega$ .

$V_{CE} = 6$  V;  $I_C = 1.25$  mA;  $f = 900$  MHz.

Fig.12 Noise circle figure.

## NPN 9 GHz wideband transistors

## BFG505; BFG505/X



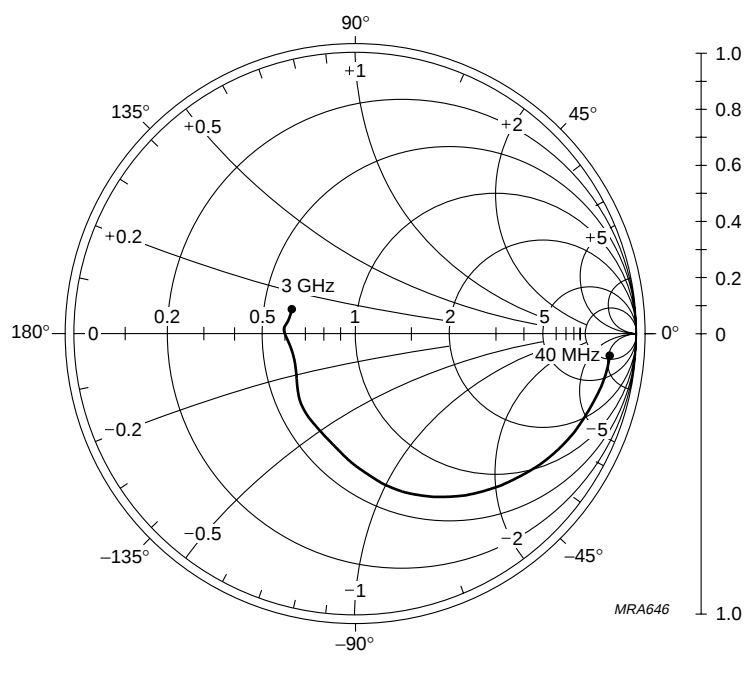
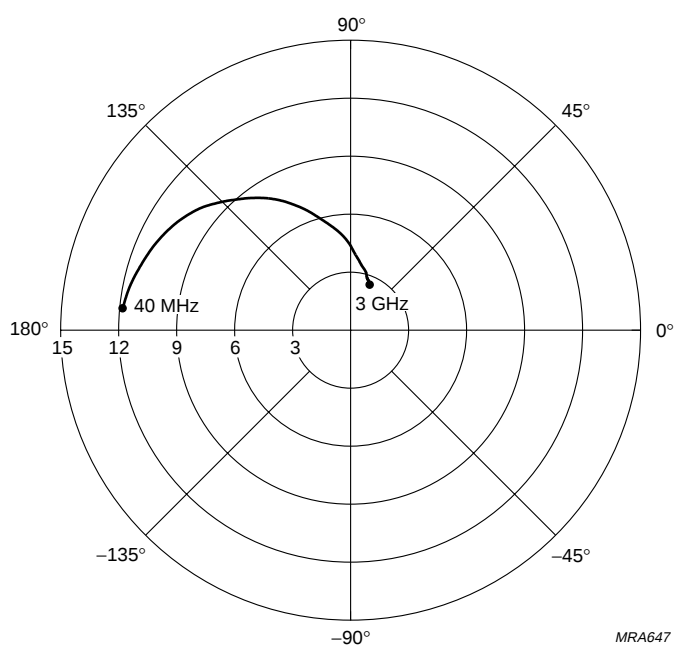
$Z_0 = 50 \Omega$ .

$V_{CE} = 6 \text{ V}$ ;  $I_c = 1.25 \text{ mA}$ ;  $f = 2000 \text{ MHz}$ .

Fig.13 Noise circle figure.

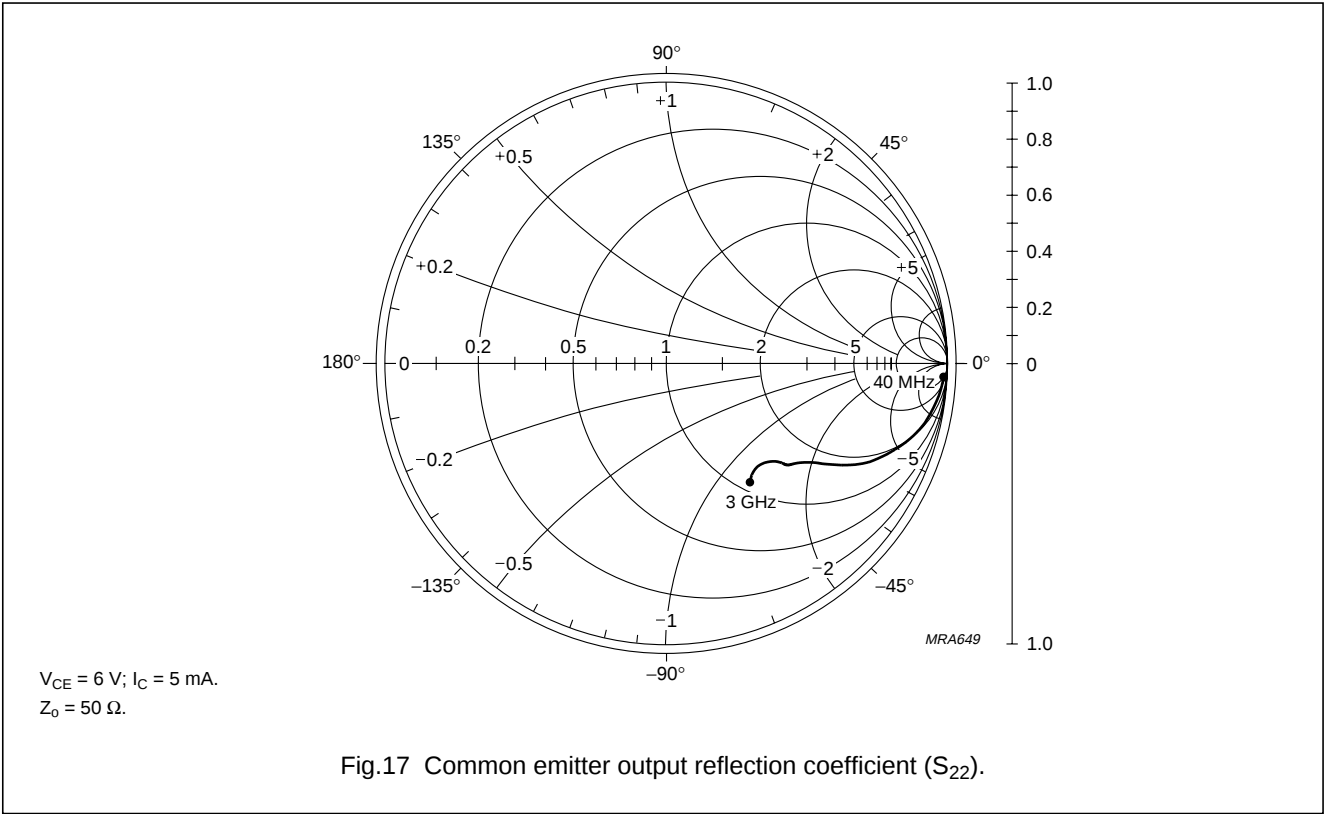
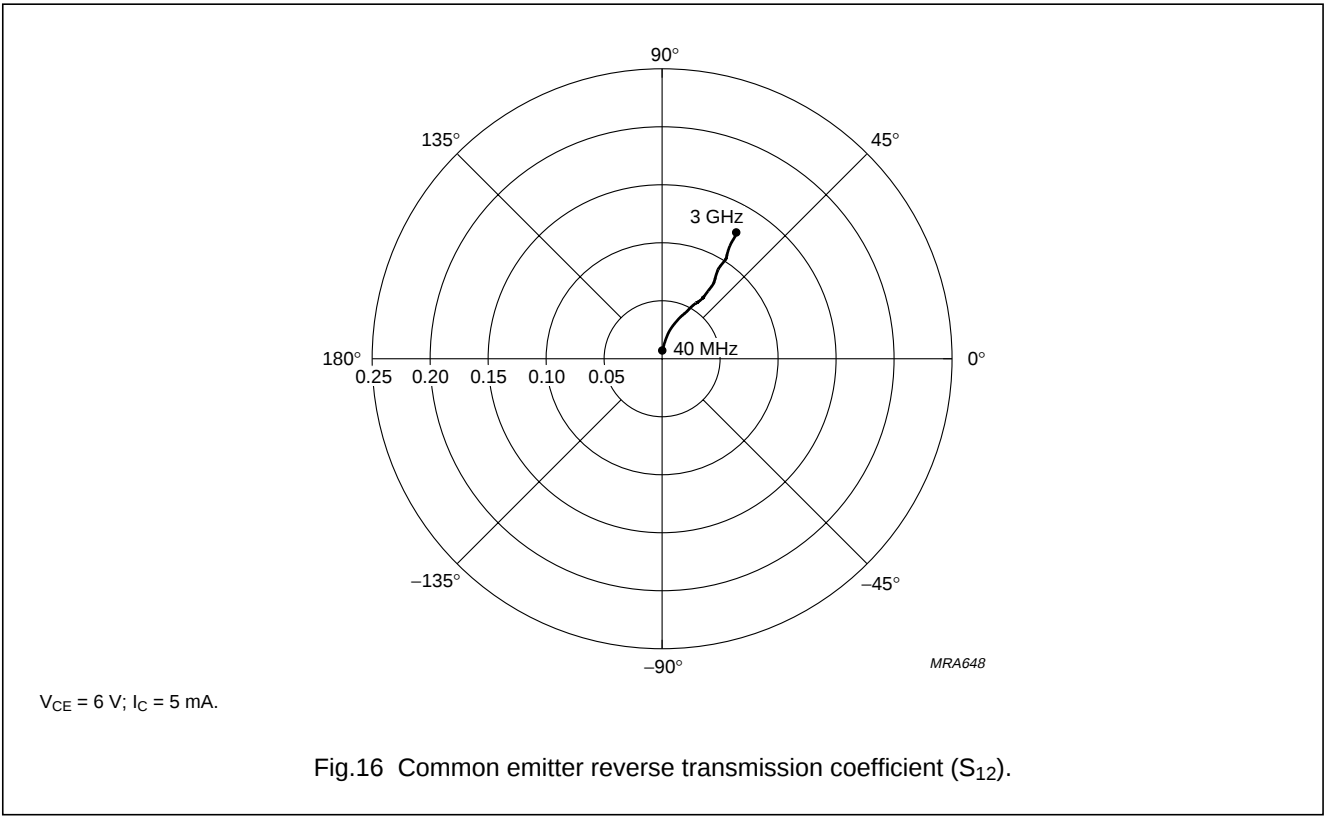
## NPN 9 GHz wideband transistors

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Fig.14 Common emitter input reflection coefficient ( $S_{11}$ ).Fig.15 Common emitter forward transmission coefficient ( $S_{21}$ ).

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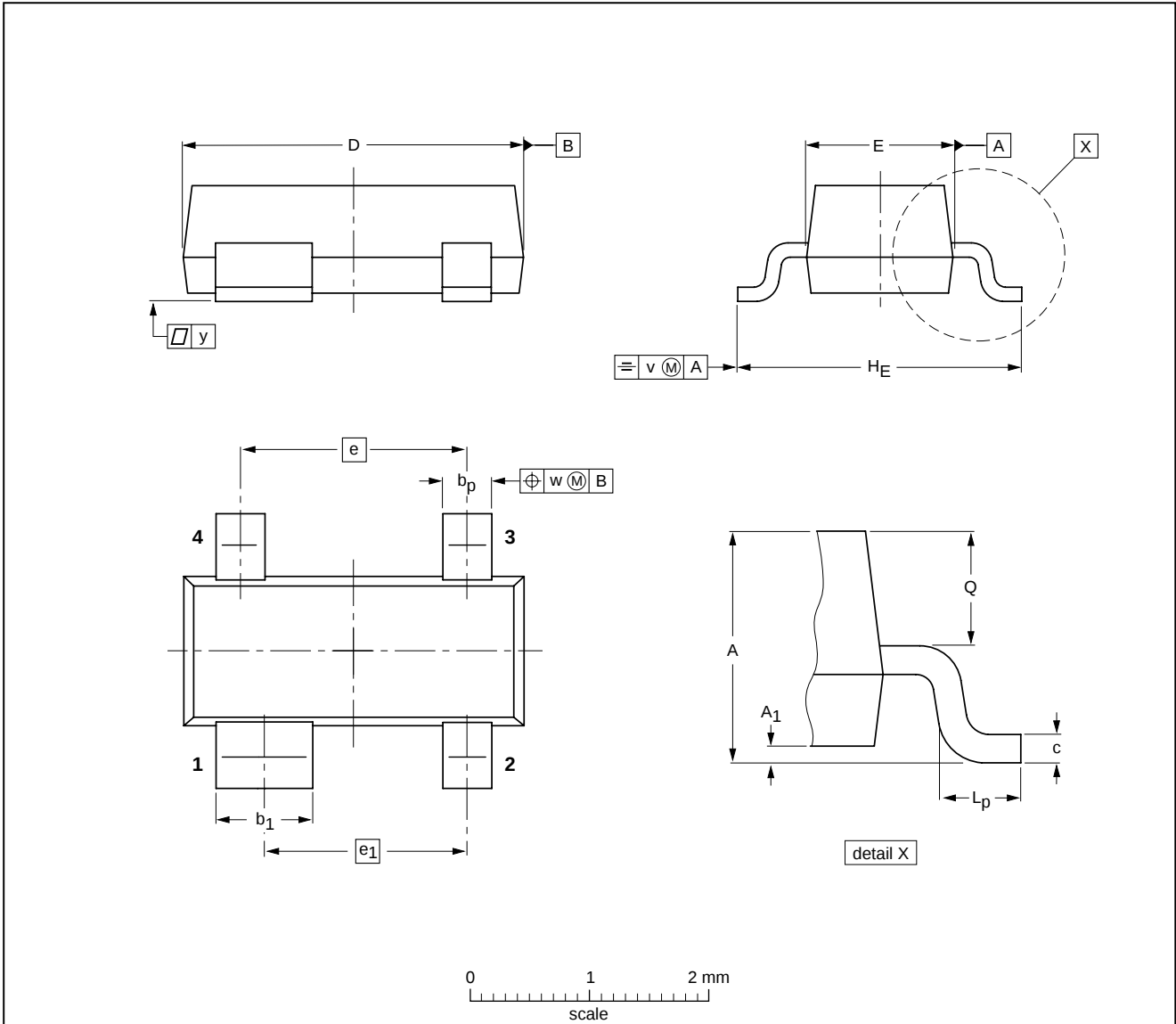
NPN 9 GHz wideband transistors

BFG505; BFG505/X

PACKAGE OUTLINE

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   |

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NPN 9 GHz wideband transistors

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BFG505; BFG505/X

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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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These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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NPN 9 GHz wideband transistors

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**NOTES**

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**NOTES**

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