

BFG93A; BFG93A/X

NPN 6 GHz wideband transistors

Rev. 05 — 26 November 2007

Product data sheet

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NXP Semiconductors

NPN 6 GHz wideband transistors

BFG93A; BFG93A/X

FEATURES

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

APPLICATIONS

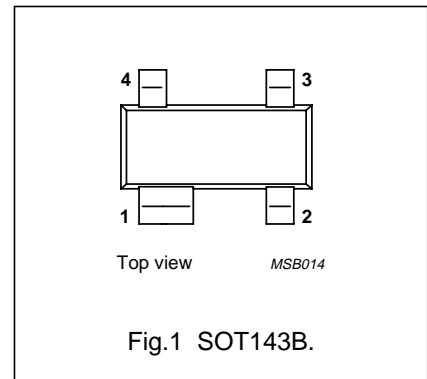
Wideband applications in the UHF and microwave range.

DESCRIPTION

NPN transistor in a 4-pin, dual-emitter SOT143B plastic package.

PINNING

| PIN | DESCRIPTION |
|-----------------|-------------|
| BFG93A | |
| 1 | collector |
| 2 | base |
| 3 | emitter |
| 4 | emitter |
| BFG93A/X | |
| 1 | collector |
| 2 | emitter |
| 3 | base |
| 4 | emitter |



MARKING

| TYPE NUMBER | CODE |
|-------------|------|
| BFG93A | R8% |
| BFG93A/X | %MX |

QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|-----------|-------------------------------|---|------|------|------|------|
| V_{CB0} | collector-base voltage | open emitter | – | – | 15 | V |
| V_{CEO} | collector-emitter voltage | open base | – | – | 12 | V |
| I_C | collector current (DC) | | – | – | 35 | mA |
| P_{tot} | total power dissipation | $T_s \leq 85\text{ °C}$ | – | – | 300 | mW |
| C_{re} | feedback capacitance | $I_C = i_c = 0; V_{CB} = 5\text{ V}; f = 1\text{ MHz}$ | – | 0.6 | – | pF |
| f_T | transition frequency | $I_C = 30\text{ mA}; V_{CE} = 5\text{ V}; f = 500\text{ MHz}$ | 4.5 | 6 | – | GHz |
| G_{UM} | maximum unilateral power gain | $I_C = 30\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ °C}; f = 1\text{ GHz}$ | – | 16 | – | dB |
| | | $I_C = 30\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ °C}; f = 2\text{ GHz}$ | – | 10 | – | dB |
| F | noise figure | $\Gamma_s = \Gamma_{opt}; I_C = 5\text{ mA}; V_{CE} = 8\text{ V}; T_{amb} = 25\text{ °C}; f = 1\text{ GHz}$ | – | 1.7 | – | dB |

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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 | – | 15 | V |
| V _{CEO} | collector-emitter voltage | open base | – | 12 | V |
| V _{EBO} | emitter-base voltage | open collector | – | 2 | V |
| I _C | collector current (DC) | | – | 35 | mA |
| P _{tot} | total power dissipation | T _s ≤ 85 °C; note 1 | – | 300 | mW |
| T _{stg} | storage temperature range | | –65 | +150 | °C |
| T _j | junction operating temperature | | – | 175 | °C |

Note

1. 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

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

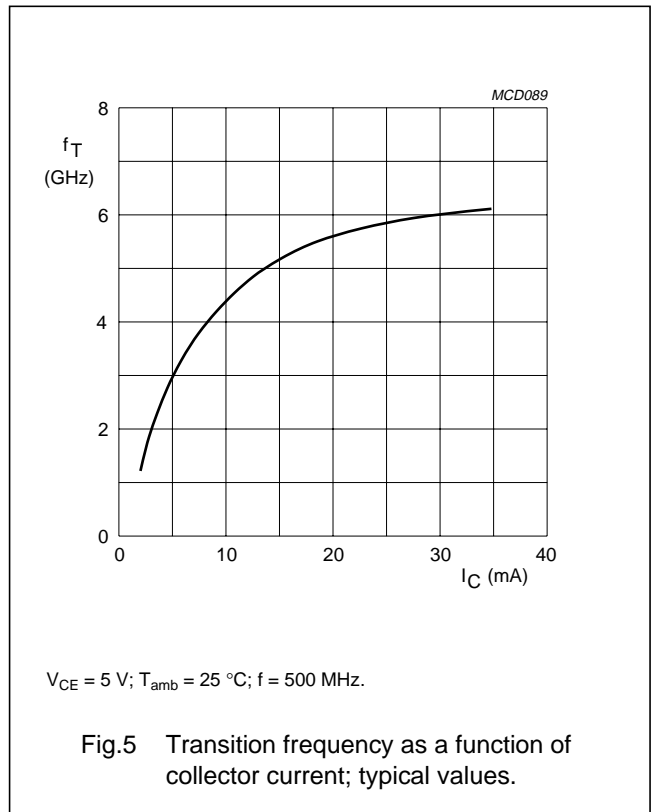
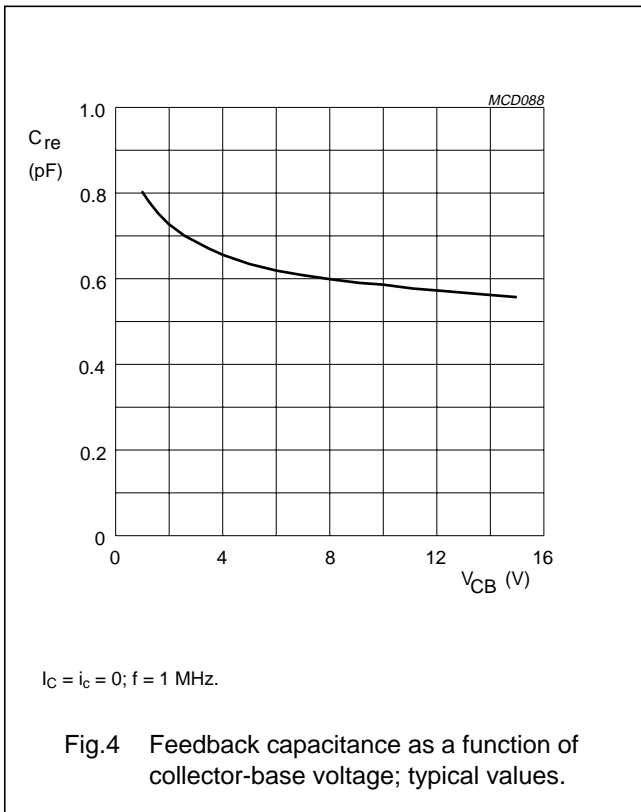
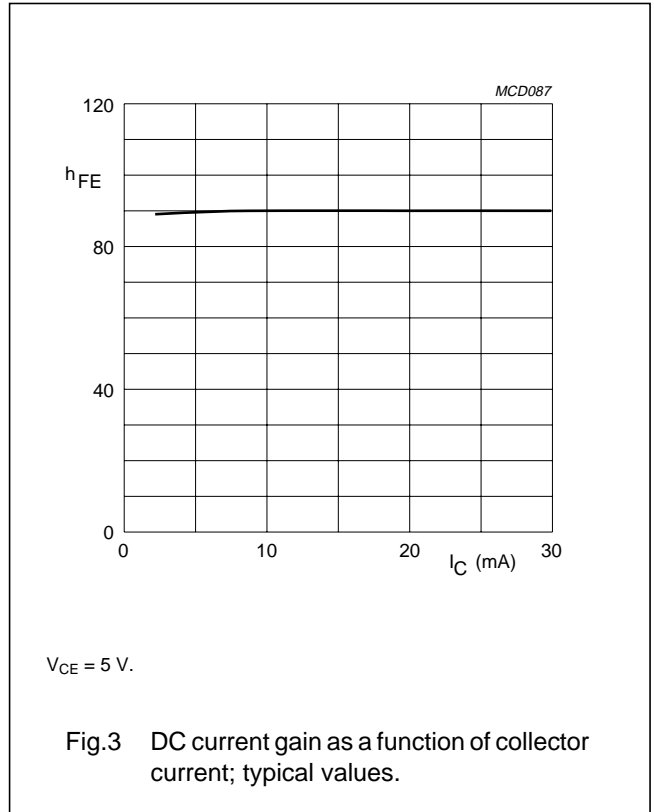
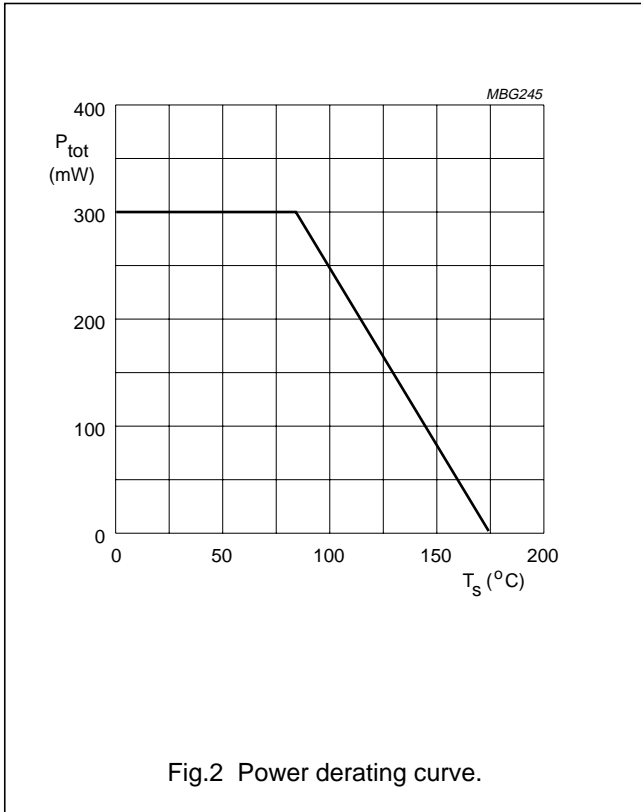
| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|------------------|---------------------------------------|---|------|------|------|------|
| I _{CBO} | collector leakage current | I _E = 0; V _{CB} = 5 V | – | – | 50 | nA |
| h _{FE} | DC current gain | I _C = 30 mA; V _{CE} = 5 V | 40 | 90 | – | |
| C _c | collector capacitance | I _E = i _e = 0; V _{CB} = 5 V; f = 1 MHz | – | 0.9 | – | pF |
| C _e | emitter capacitance | I _C = i _c = 0; V _{EB} = 5 V; f = 1 MHz | – | 1.9 | – | pF |
| C _{re} | feedback capacitance | I _C = i _c = 0; V _{CB} = 5 V; f = 1 MHz | – | 0.6 | – | pF |
| f _T | transition frequency | I _C = 30 mA; V _{CE} = 5 V; f = 500 MHz | 4.5 | 6 | – | GHz |
| G _{UM} | maximum unilateral power gain; note 1 | I _C = 30 mA; V _{CE} = 8 V; T _{amb} = 25 °C; f = 1 GHz | – | 16 | – | dB |
| | | I _C = 30 mA; V _{CE} = 8 V; T _{amb} = 25 °C; f = 2 GHz | – | 10 | – | dB |
| F | noise figure | Γ _s = Γ _{opt} ; I _C = 5 mA; V _{CE} = 8 V; T _{amb} = 25 °C; f = 1 GHz | – | 1.7 | – | dB |
| | | Γ _s = Γ _{opt} ; I _C = 5 mA; V _{CE} = 8 V; T _{amb} = 25 °C; f = 2 GHz | – | 2.3 | – | dB |

Note

1. G_{UM} is the maximum unilateral power gain, assuming S₁₂ is zero and $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.

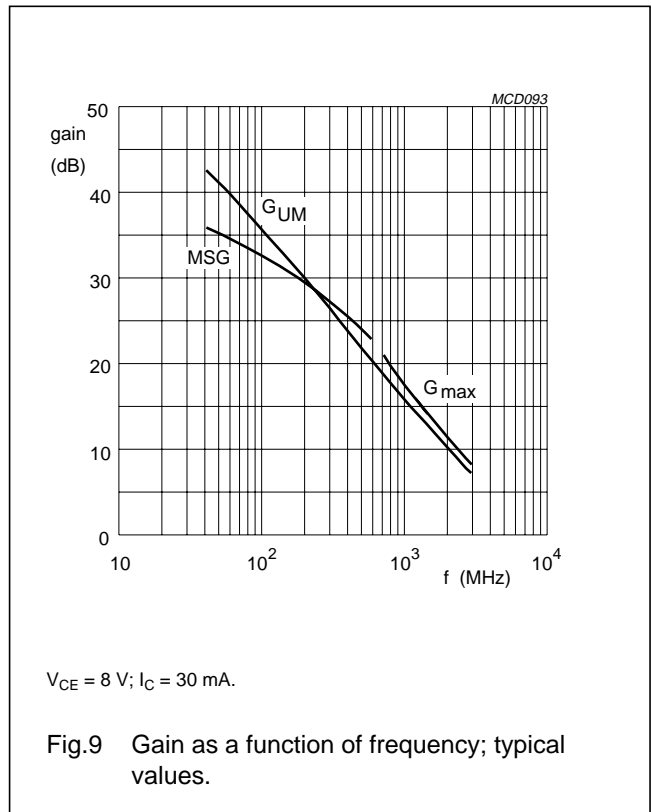
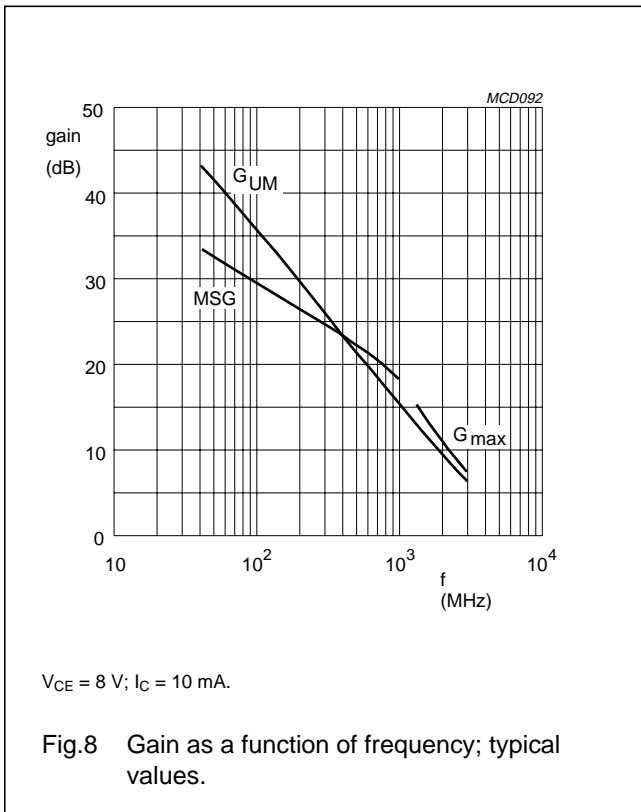
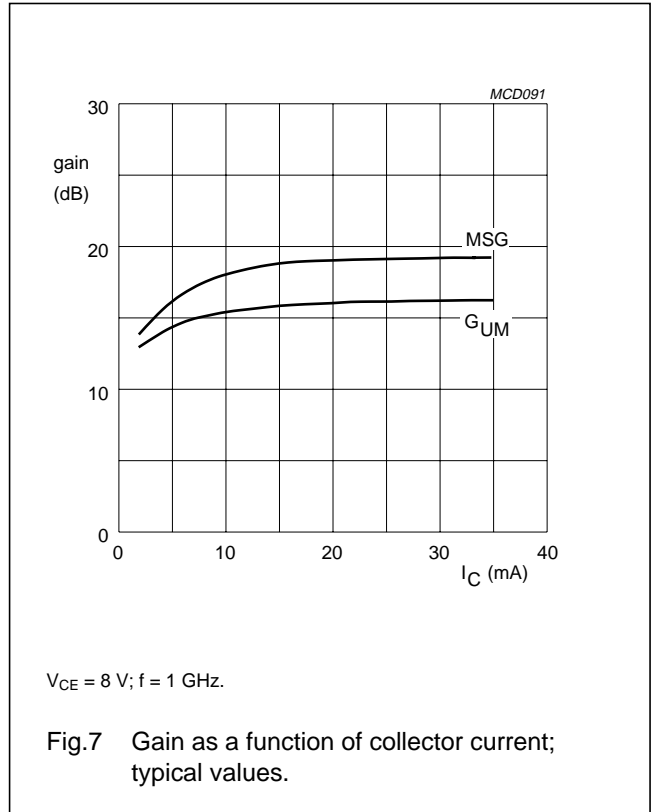
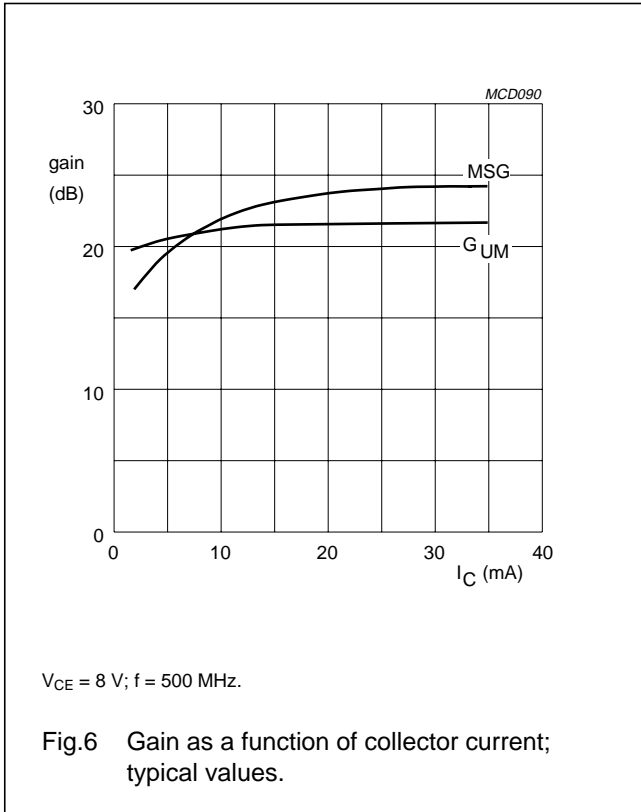
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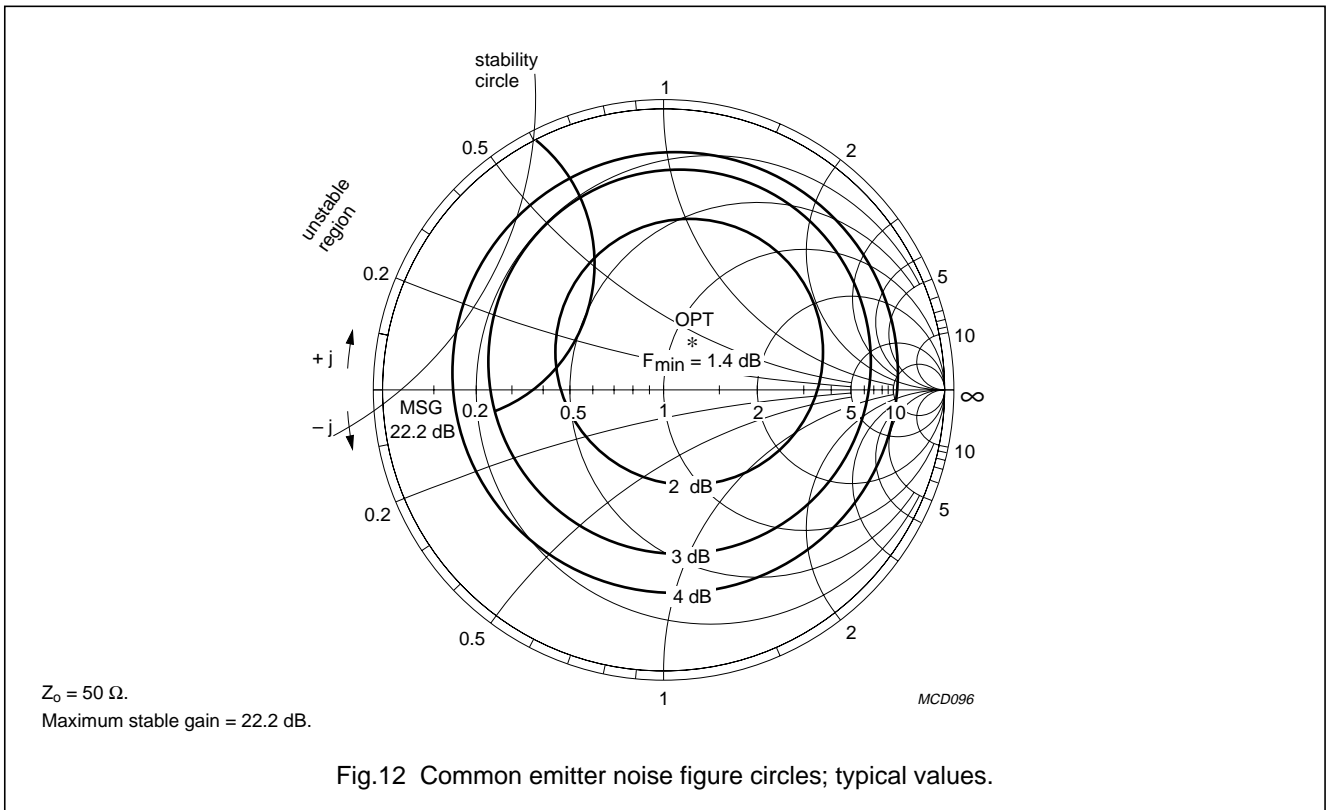
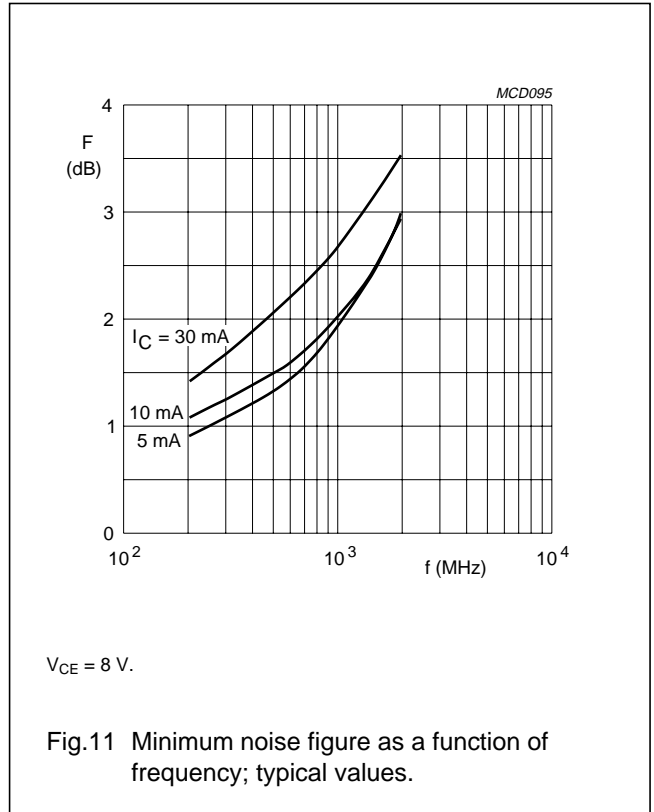
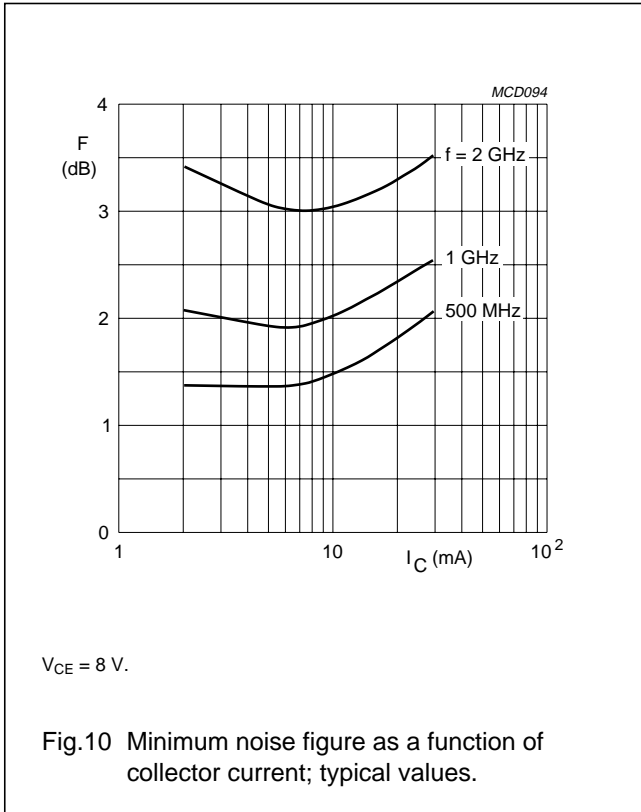
NPN 6 GHz wideband transistors

BFG93A; BFG93A/X



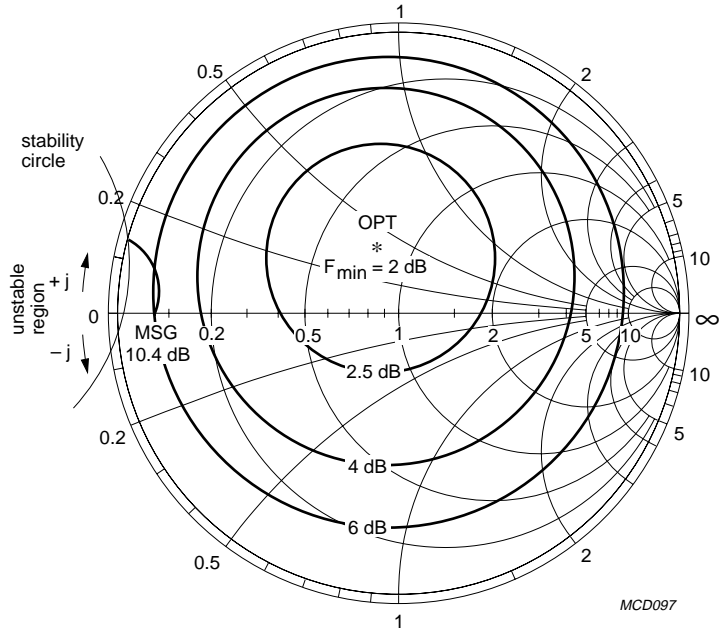
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BFG93A; BFG93A/X



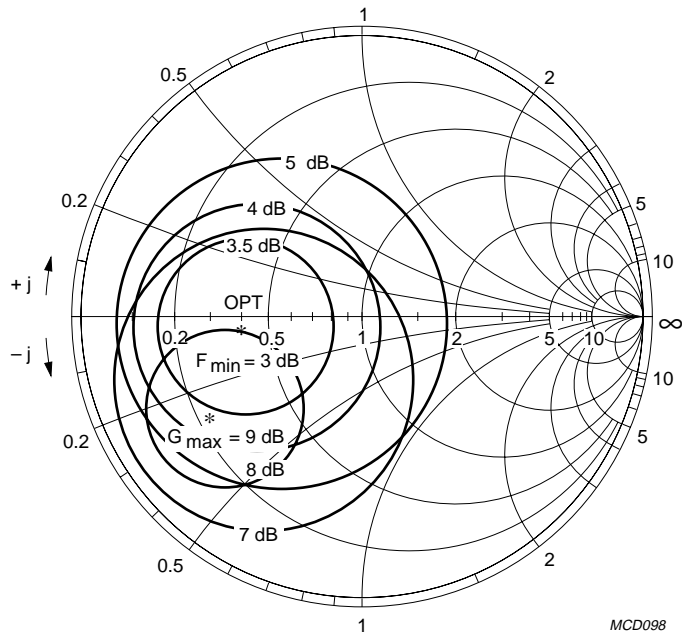
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$Z_0 = 50 \Omega$.
Maximum stable gain = 10.4 dB.

Fig.13 Common emitter noise figure circles; typical values.

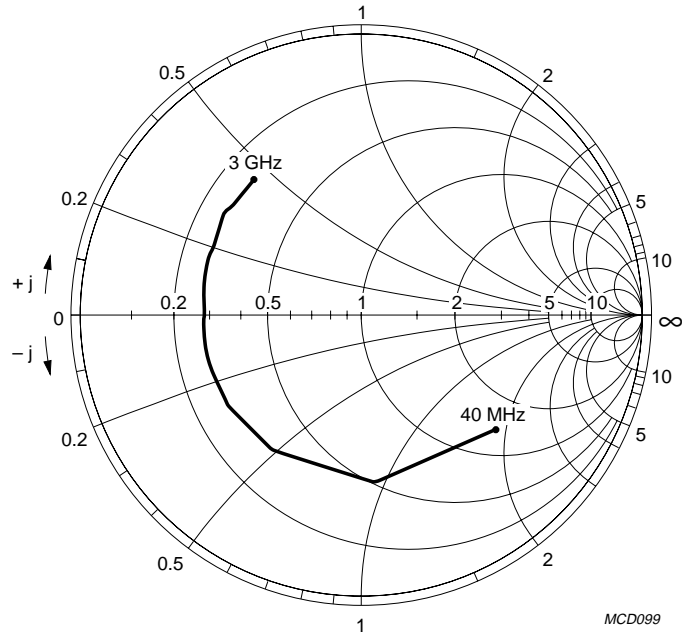


$Z_0 = 50 \Omega$.

Fig.14 Common emitter noise figure circles; typical values.

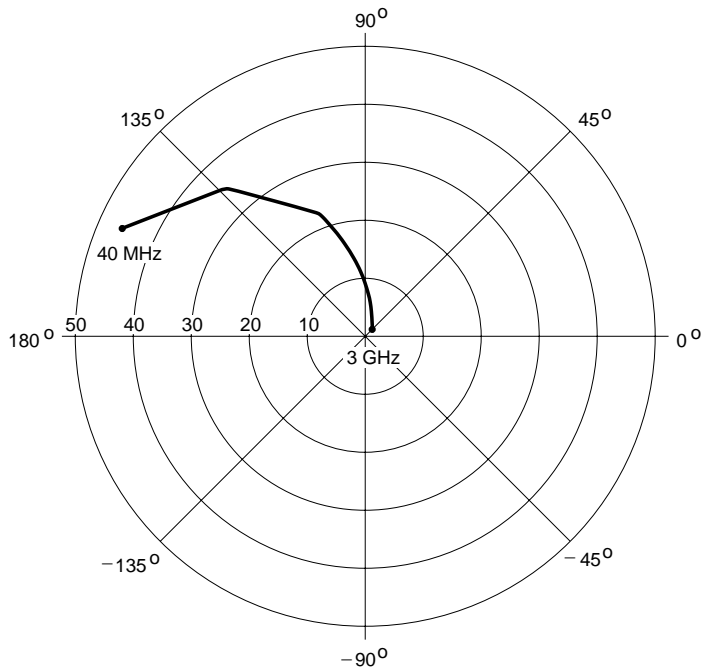
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$V_{CE} = 8\text{ V}; I_C = 30\text{ mA}; Z_o = 50\ \Omega.$

Fig.15 Common emitter input reflection coefficient (S_{11}).



$V_{CE} = 8\text{ V}; I_C = 30\text{ mA}; R_{max} = 50\ \Omega.$

Fig.16 Common emitter forward transmission coefficient (S_{21}).

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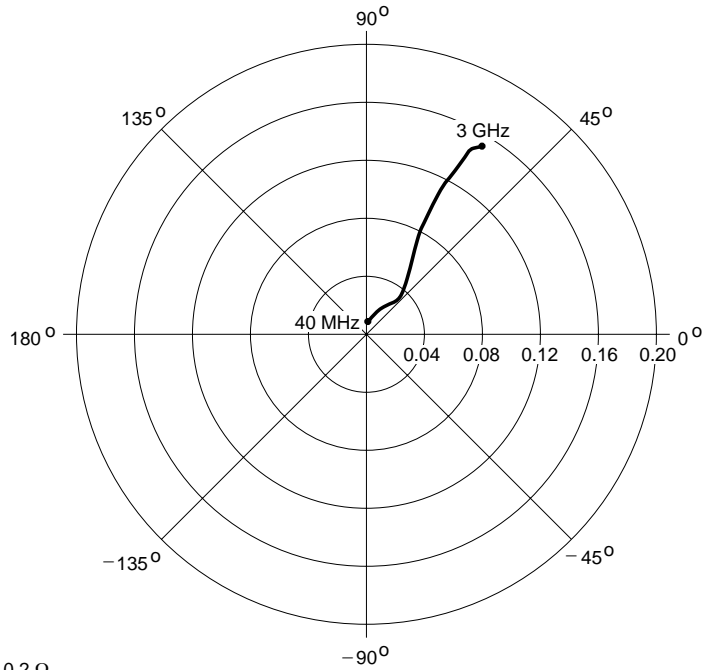


Fig.17 Common emitter reverse transmission coefficient (S_{12}).

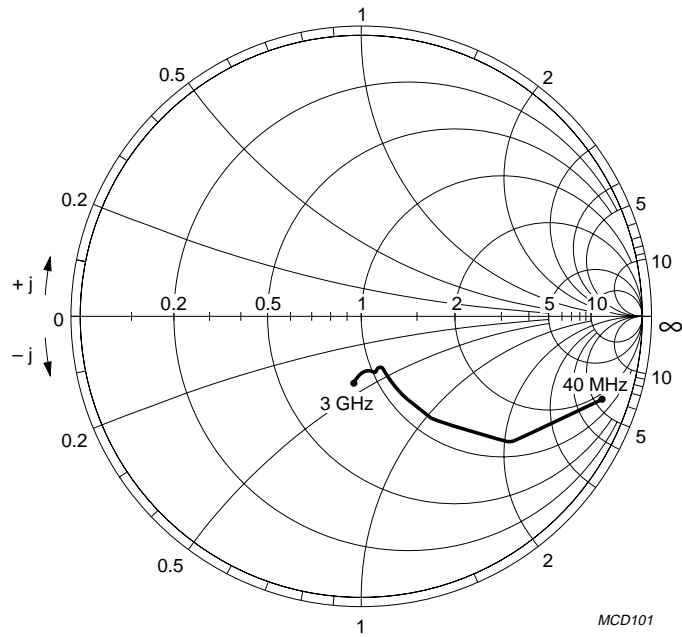


Fig.18 Common emitter output reflection coefficient (S_{22}).

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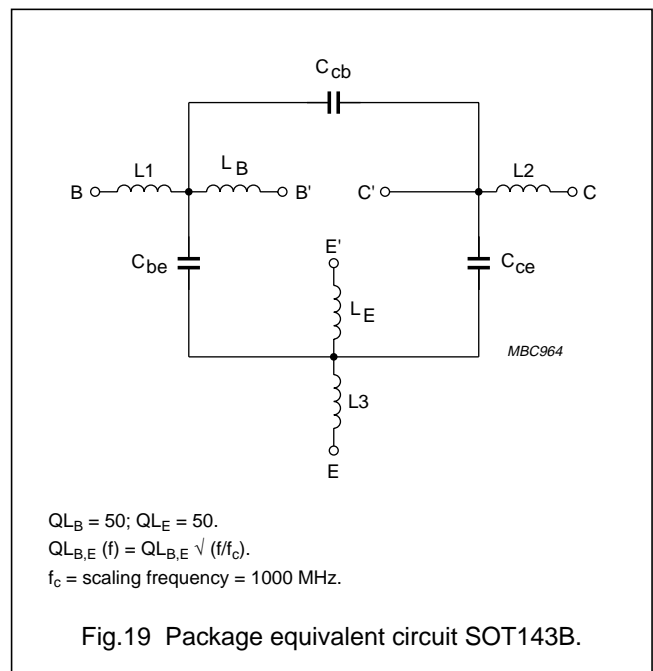
SPICE parameters for BFR91A(X) die

| SEQUENCE No. | PARAMETER | VALUE | UNIT |
|--------------|-----------|-------|------|
| 1 | IS | 1.328 | fA |
| 2 | BF | 102.0 | – |
| 3 | NF | 1.000 | – |
| 4 | VAF | 51.90 | V |
| 5 | IKF | 8.155 | A |
| 6 | ISE | 13.90 | fA |
| 7 | NE | 15.12 | – |
| 8 | BR | 17.69 | – |
| 9 | NR | 994.0 | m |
| 10 | VAR | 3.280 | V |
| 11 | IKR | 10.00 | A |
| 12 | ISC | 1.043 | aA |
| 13 | NC | 1.189 | – |
| 14 | RB | 10.00 | Ω |
| 15 | IRB | 1.000 | μA |
| 16 | RBM | 10.00 | Ω |
| 17 | RE | 763.6 | mΩ |
| 18 | RC | 9.000 | Ω |
| 19 (note 1) | XTB | 0.000 | – |
| 20 (note 1) | EG | 1.110 | EV |
| 21 (note 1) | XTI | 3.000 | – |
| 22 | CJE | 2.032 | pF |
| 23 | VJE | 600.0 | mV |
| 24 | MJE | 290.0 | m |
| 25 | TF | 6.557 | ps |
| 26 | XTF | 38.97 | – |
| 27 | VTF | 10.93 | V |
| 28 | ITF | 521.0 | mA |
| 29 | PTF | 0.000 | deg |
| 30 | CJC | 1.003 | pF |
| 31 | VJC | 340.8 | mV |
| 32 | MJC | 194.2 | m |
| 33 | XCJC | 120.0 | m |
| 34 | TR | 3.073 | ns |
| 35 (note 1) | CJS | 0.000 | F |

| SEQUENCE No. | PARAMETER | VALUE | UNIT |
|--------------|-----------|-------|------|
| 36 (note 1) | VJS | 750.0 | mV |
| 37 (note 1) | MJS | 0.000 | – |
| 38 | FC | 800.0 | m |

Note

1. These parameters have not been extracted, the default values are shown.



List of components (see Fig.19)

| 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 |

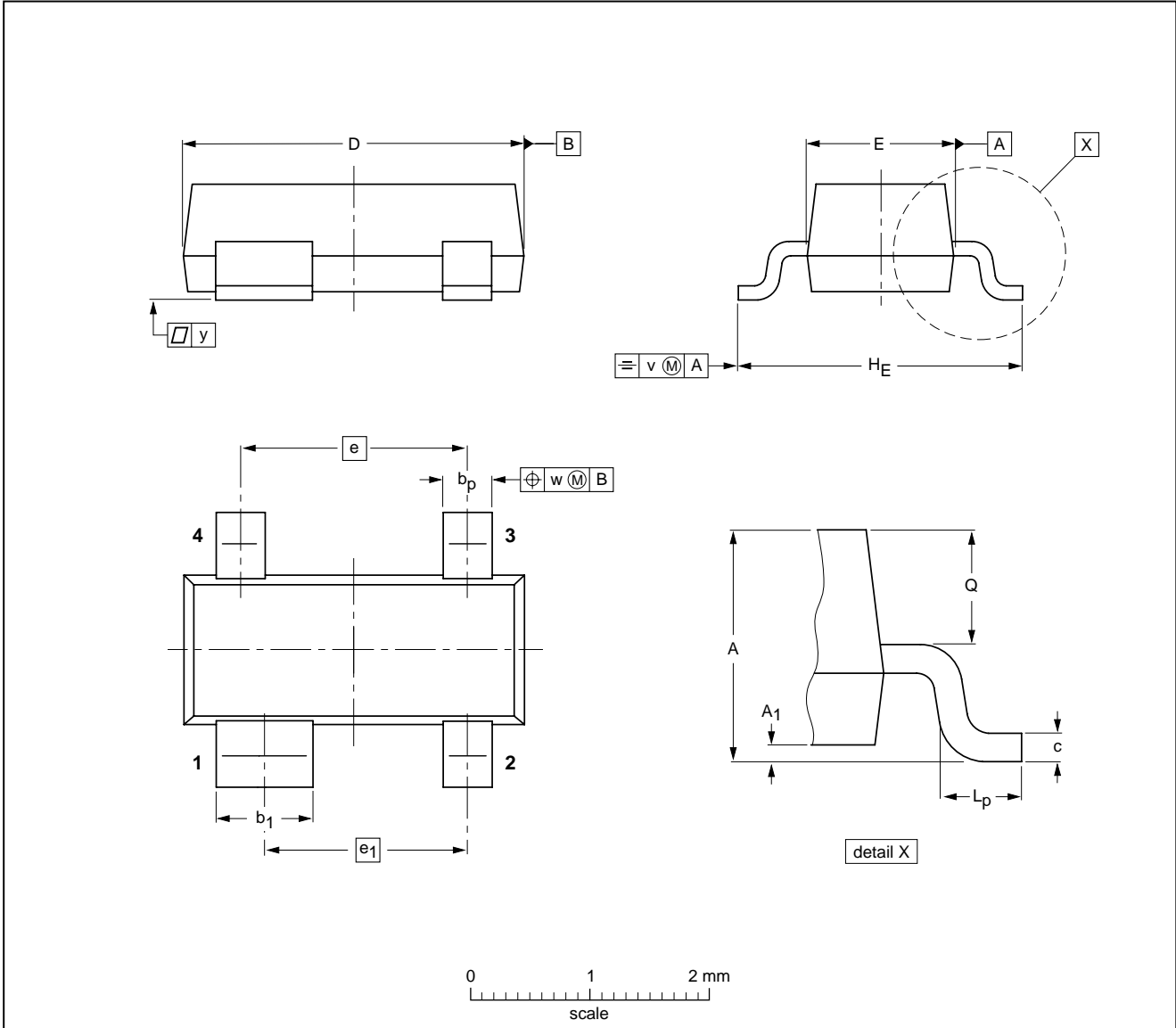
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PACKAGE OUTLINE

Plastic surface mounted package; 4 leads

SOT143B



DIMENSIONS (mm are the original dimensions)

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

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

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| Document status ^{[1][2]} | Product status ^[3] | Definition |
|-----------------------------------|-------------------------------|---|
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| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|--------------------------------|---|-----------------------|---------------|----------------|
| BFG93A_X_N_5 | 20071126 | Product data sheet | - | BFG93A_X_4 |
| Modifications: | • Marking table on page 2; changed code | | | |
| BFG93A_X_4 (9397 750 04351) | 19980923 | Product specification | - | BFG93SERIES_3 |
| BFG93SERIES_3 | 19950925 | Product specification | - | BFG93SERIES_2 |
| BFG93SERIES_2 | - | Product specification | - | BFG93_SERIES_1 |
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