

BFG520W; BFG520W/X

NPN 9 GHz wideband transistors

Rev. 04 — 21 November 2007

Product data sheet

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NXP Semiconductors

NPN 9 GHz wideband transistors

BFG520W; BFG520W/X

FEATURES

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

APPLICATIONS

RF front end wideband applications in the GHz range, such as analog and digital cellular telephones, cordless telephones (CT2, CT3, PCN, DECT, etc.), radar detectors, pagers, satellite television tuners (SATV) and repeater amplifiers in fibre-optic systems.

DESCRIPTION

NPN silicon planar epitaxial transistor in a 4-pin dual-emitter SOT343N plastic package.

MARKING

| TYPE NUMBER | CODE |
|-------------|------|
| BFG520W | N3 |
| BFG520W/X | N4 |

PINNING

| PIN | DESCRIPTION | |
|-----|-------------|-----------|
| | BFG520W | BFG520W/X |
| 1 | collector | collector |
| 2 | base | emitter |
| 3 | emitter | base |
| 4 | emitter | emitter |

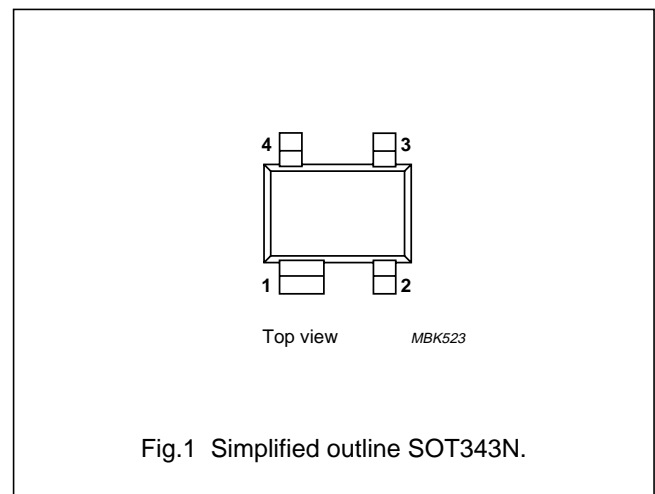


Fig.1 Simplified outline SOT343N.

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) | | – | – | 70 | mA |
| P_{tot} | total power dissipation | $T_s \leq 85\text{ °C}$ | – | – | 500 | mW |
| h_{FE} | DC current gain | $I_C = 20\text{ mA}; V_{CE} = 6\text{ V}$ | 60 | 120 | 250 | |
| C_{re} | feedback capacitance | $I_C = 0; V_{CB} = 6\text{ V}; f = 1\text{ MHz}$ | – | 0.35 | – | pF |
| f_T | transition frequency | $I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; f = 1\text{ GHz}; T_{amb} = 25\text{ °C}$ | – | 9 | – | GHz |
| G_{UM} | maximum unilateral power gain | $I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$ | – | 17 | – | dB |
| $ S_{21} ^2$ | insertion power gain | $I_C = 20\text{ mA}; V_{CE} = 6\text{ V}; f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$ | 16 | 17 | – | dB |
| F | noise figure | $\Gamma_s = \Gamma_{opt}; I_C = 5\text{ mA}; V_{CE} = 6\text{ V}; f = 900\text{ MHz}$ | – | 1.1 | 1.6 | 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 | – | 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) | | – | 70 | mA |
| P _{tot} | total power dissipation | T _s ≤ 85 °C; see Fig.2; note 1 | – | 500 | mW |
| T _{stg} | storage temperature | | –65 | +150 | °C |
| T _j | junction temperature | | – | 175 | °C |

Note

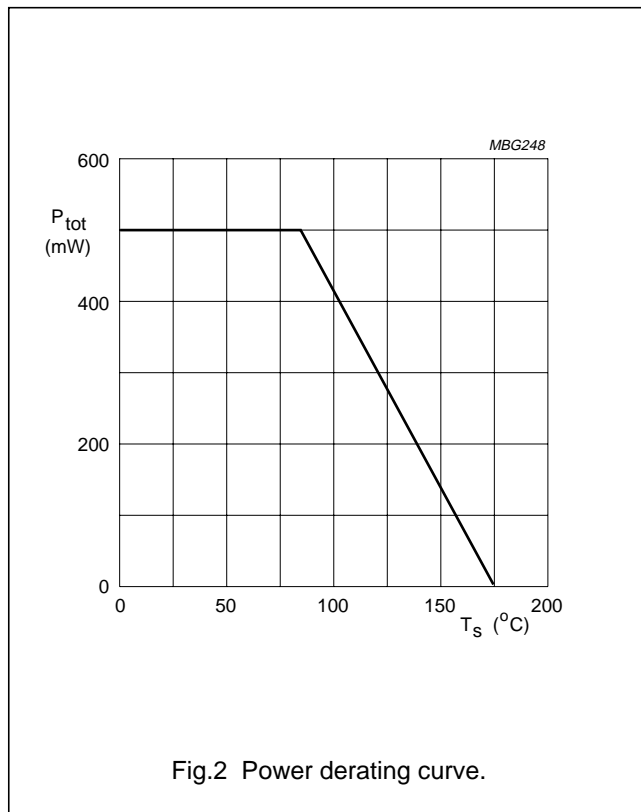
1. T_s is the temperature at the soldering point of the collector pin.

THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---------------------|---|--------------------------------|-------|------|
| R _{th j-s} | thermal resistance from junction to soldering point | T _s ≤ 85 °C; note 1 | 180 | K/W |

Note

1. 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.

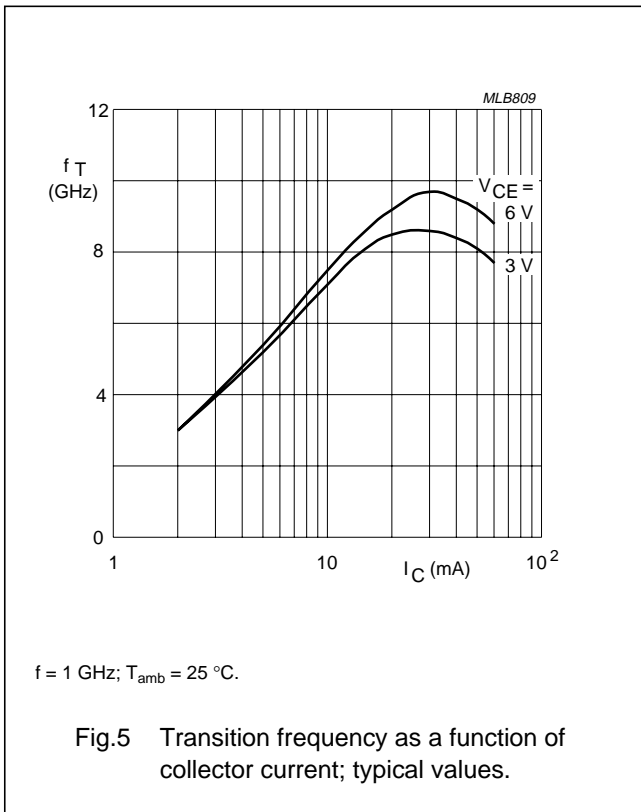
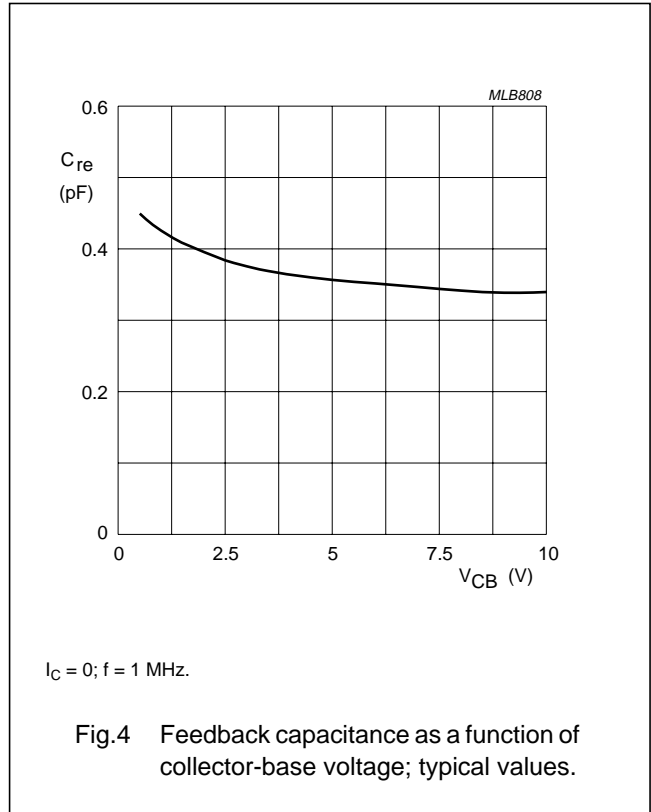
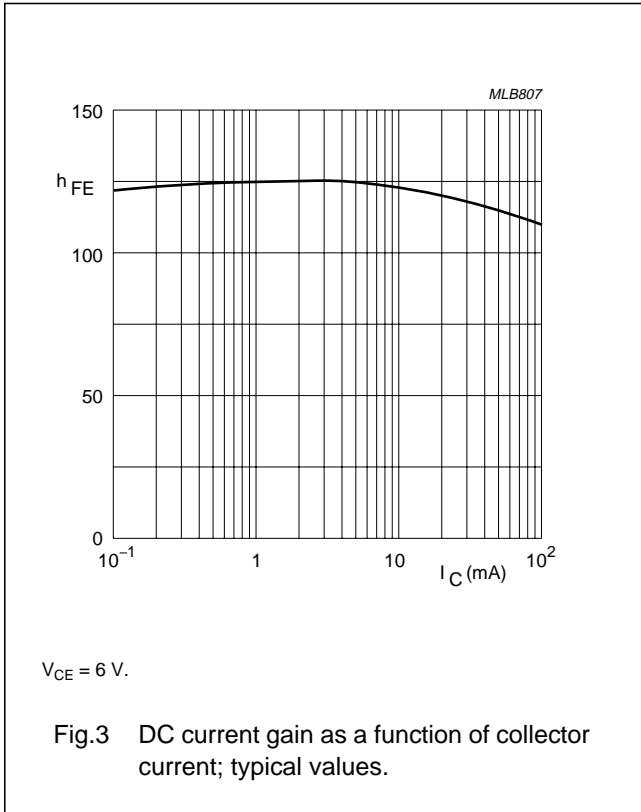
| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---------------|--|---|------|------|------|------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage | $I_C = 10\ \mu\text{A}; I_E = 0$ | 20 | – | – | V |
| $V_{(BR)CES}$ | collector-emitter breakdown voltage | $I_C = 10\ \mu\text{A}; R_{BE} = 0$ | 15 | – | – | V |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage | $I_E = 10\ \mu\text{A}; I_C = 0$ | 2.5 | – | – | V |
| I_{CBO} | collector leakage current | $V_{CB} = 6\ \text{V}; I_E = 0$ | – | – | 50 | nA |
| h_{FE} | DC current gain | $I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V};$ see Fig.3 | 60 | 120 | 250 | |
| C_{re} | feedback capacitance | $I_C = 0; V_{CB} = 6\ \text{V}; f = 1\ \text{MHz};$ see Fig.4 | – | 0.35 | – | pF |
| f_T | transition frequency | $I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; f = 1\ \text{GHz};$ $T_{amb} = 25\text{ °C};$ see Fig.5 | – | 9 | – | GHz |
| G_{UM} | maximum unilateral power gain; note 1 | $I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; f = 900\ \text{MHz};$ $T_{amb} = 25\text{ °C}$ | – | 17 | – | dB |
| | | $I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; f = 2\ \text{GHz};$ $T_{amb} = 25\text{ °C}$ | – | 11 | – | dB |
| $ S_{21} ^2$ | insertion power gain | $I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; f = 900\ \text{MHz};$ $T_{amb} = 25\text{ °C}$ | 16 | 17 | – | dB |
| F | noise figure | $\Gamma_s = \Gamma_{opt}; I_C = 5\ \text{mA}; V_{CE} = 6\ \text{V};$ $f = 900\ \text{MHz}$ | – | 1.1 | 1.6 | dB |
| | | $\Gamma_s = \Gamma_{opt}; I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V};$ $f = 900\ \text{MHz}$ | – | 1.6 | 2.1 | dB |
| | | $\Gamma_s = \Gamma_{opt}; I_C = 5\ \text{mA}; V_{CE} = 6\ \text{V};$ $f = 2\ \text{GHz}$ | – | 1.85 | – | dB |
| PL_1 | output power at 1 dB gain compression | $I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; f = 900\ \text{MHz};$ $R_L = 50\ \Omega; T_{amb} = 25\text{ °C}$ | – | 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 | note 4 | – | –50 | – | dB |

Notes

- G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero. $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$ dB.
- $I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; R_L = 50\ \Omega; T_{amb} = 25\text{ °C};$
 $f_p = 900\ \text{MHz}; f_q = 902\ \text{MHz};$ measured at $2f_p - f_q = 898\ \text{MHz}$ and $2f_q - f_p = 904\ \text{MHz}.$
- $d_{im} = -60\ \text{dB}$ (DIN45004B); $I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; V_p = V_o; V_q = V_o - 6\ \text{dB}; V_r = V_o - 6\ \text{dB}; R_L = 75\ \Omega;$
 $f_p = 795.25\ \text{MHz}; f_q = 803.25\ \text{MHz}; f_r = 805.25\ \text{MHz};$ measured at $f_p + f_q - f_r = 793.25\ \text{MHz}.$
- $I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}; V_o = 75\ \text{mV}; R_L = 75\ \Omega; T_{amb} = 25\text{ °C};$
 $f_p = 250\ \text{MHz}; f_q = 560\ \text{MHz};$ measured at $f_p + f_q = 810\ \text{MHz}.$

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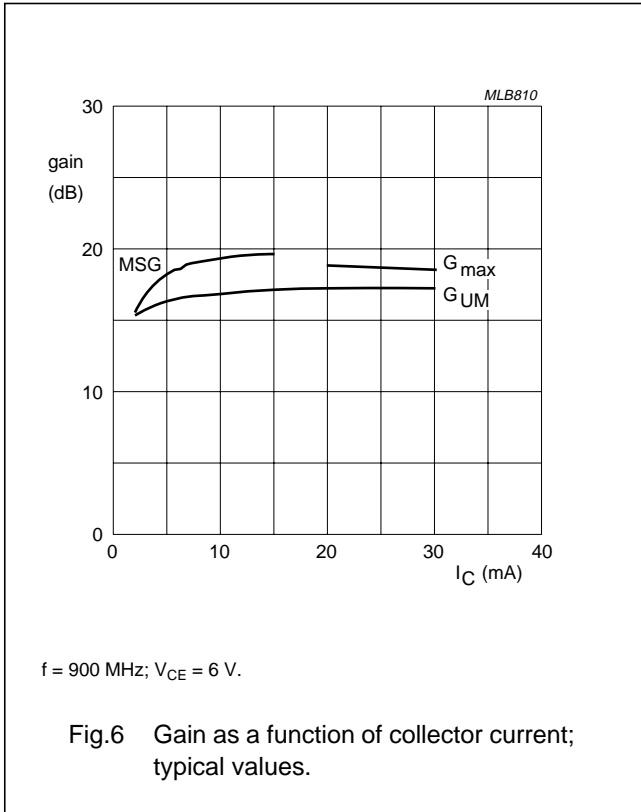


Fig.6 Gain as a function of collector current; typical values.

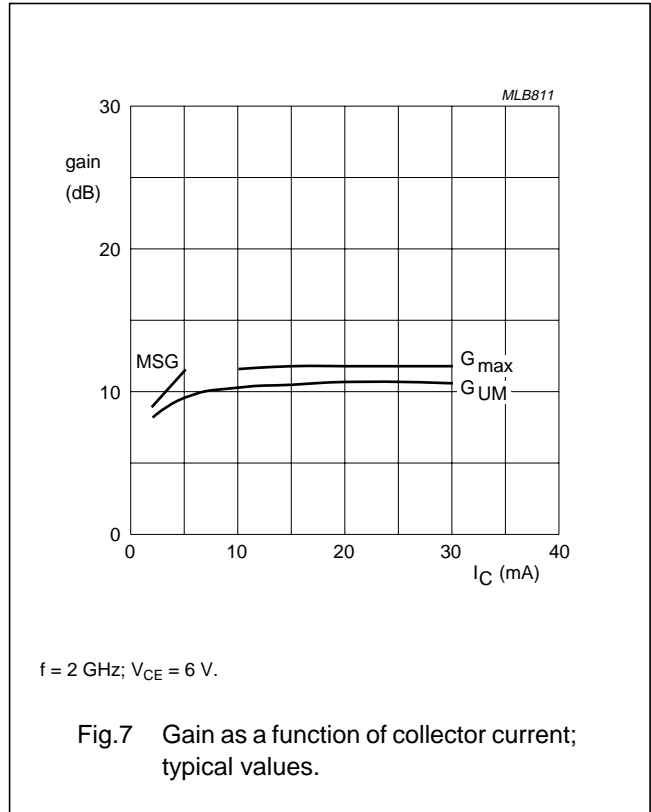


Fig.7 Gain as a function of collector current; typical values.

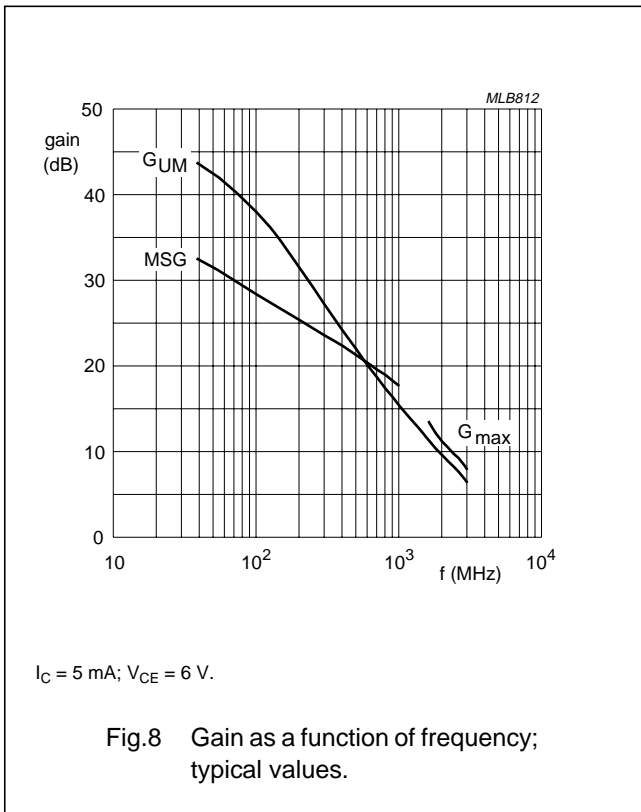


Fig.8 Gain as a function of frequency; typical values.

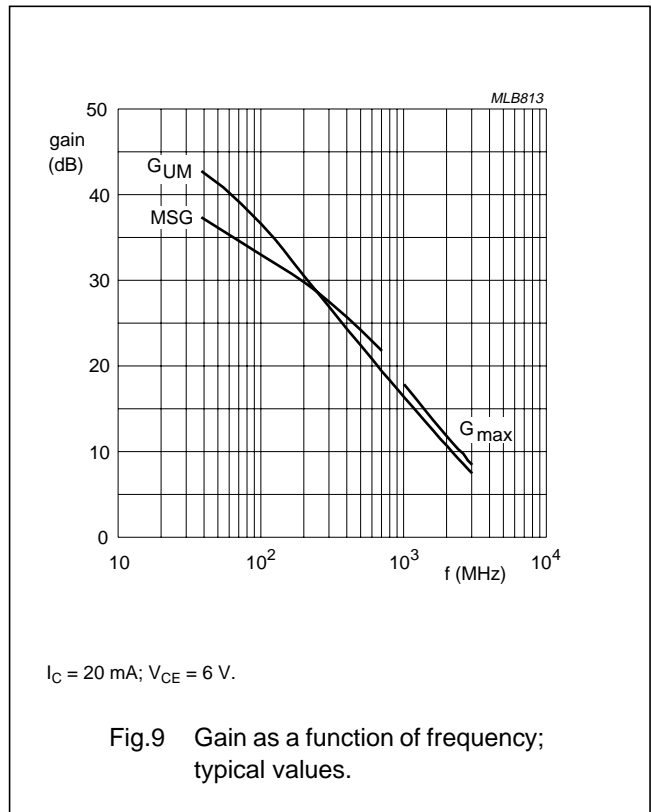
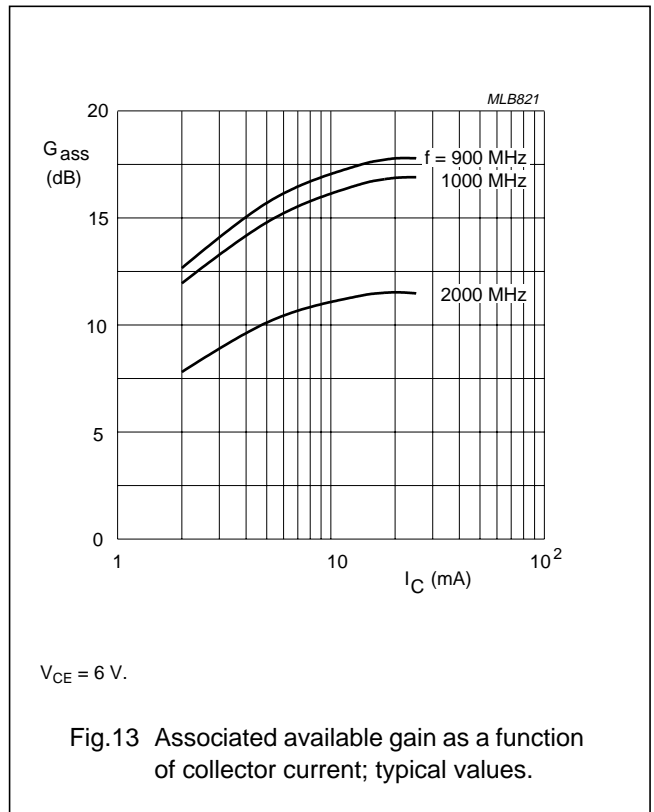
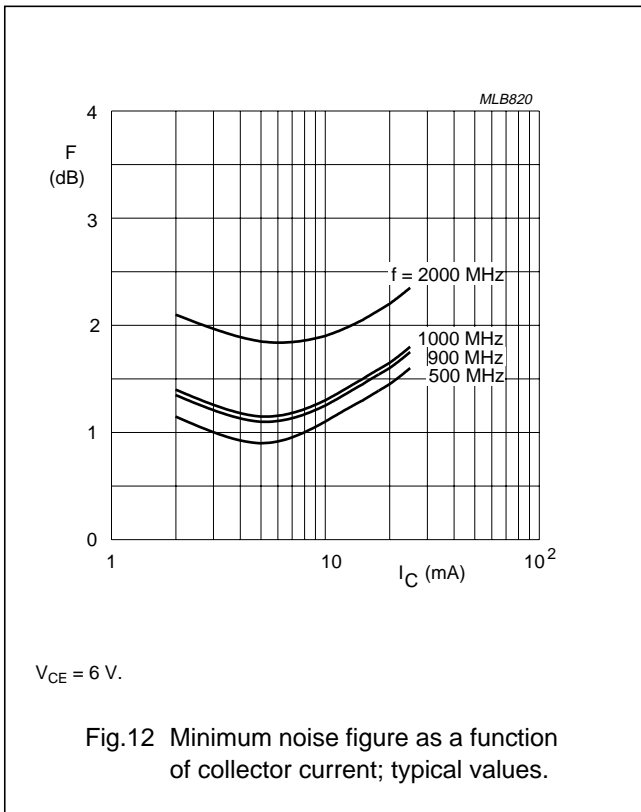
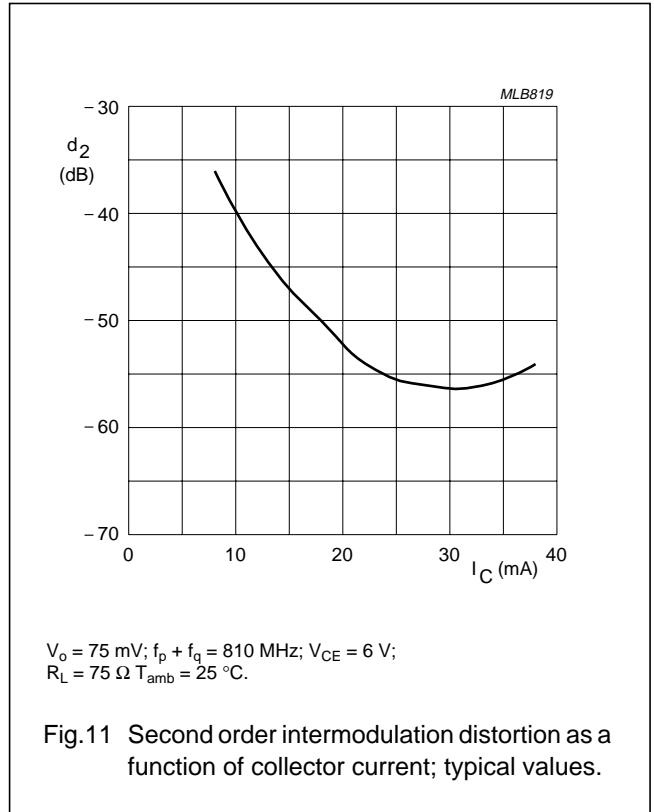
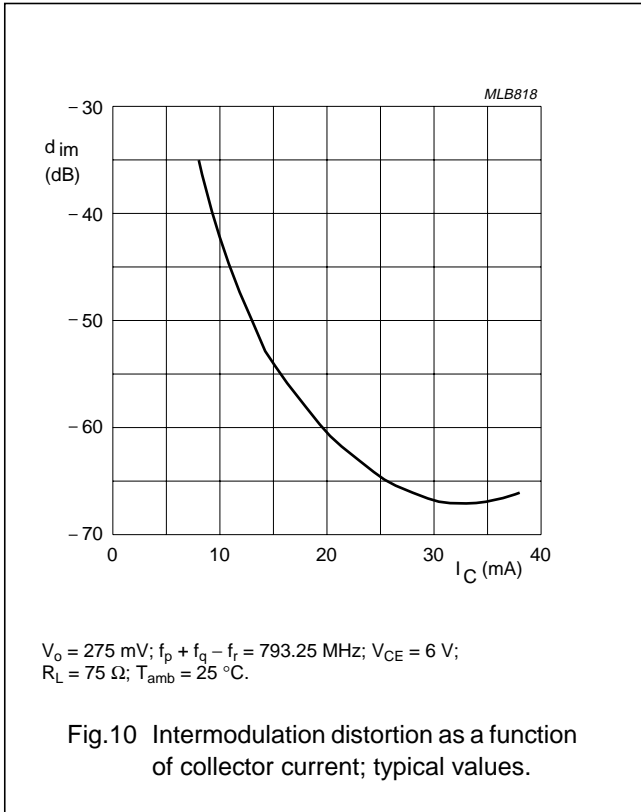


Fig.9 Gain as a function of frequency; typical values.

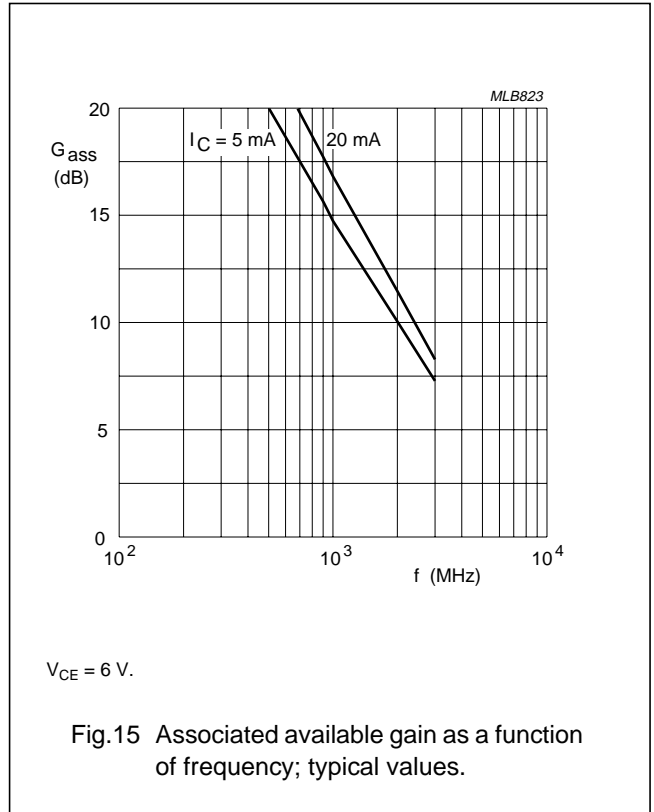
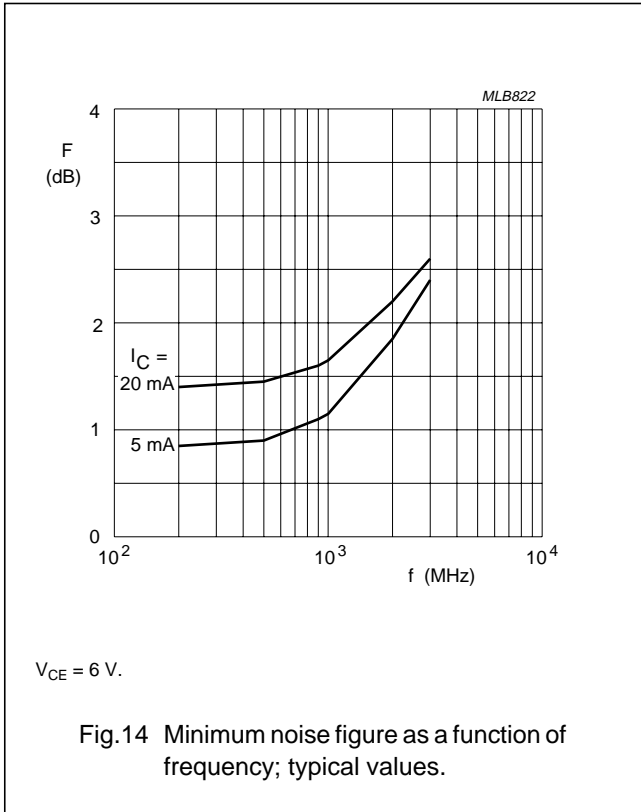
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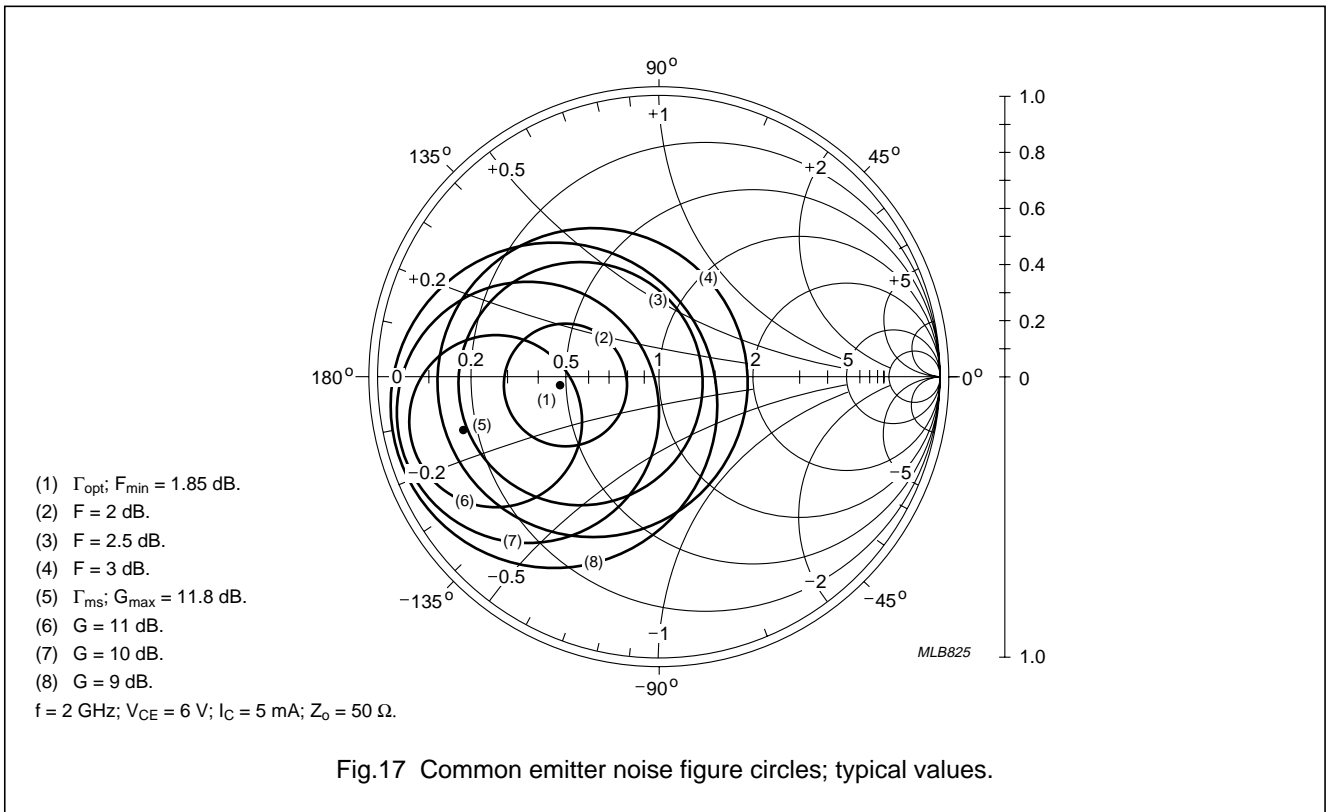
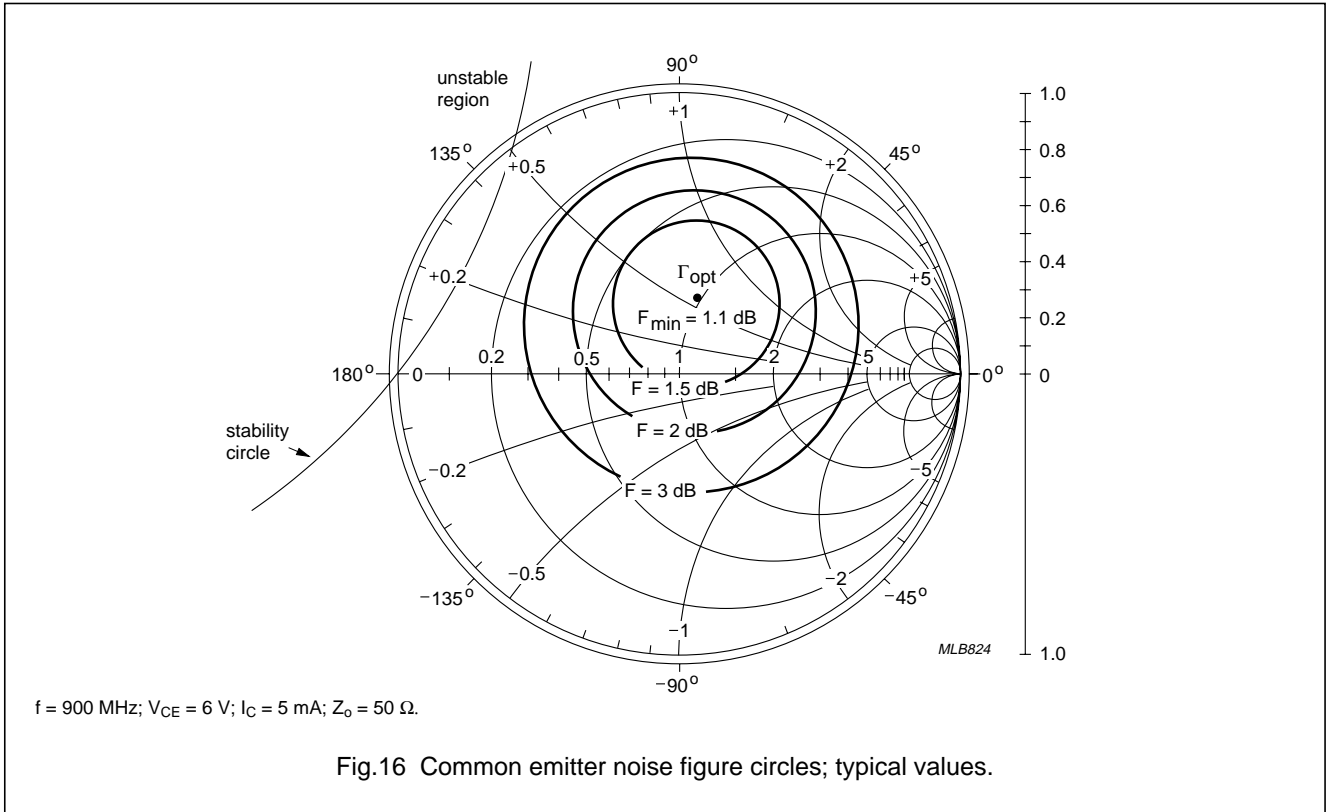
NPN 9 GHz wideband transistors

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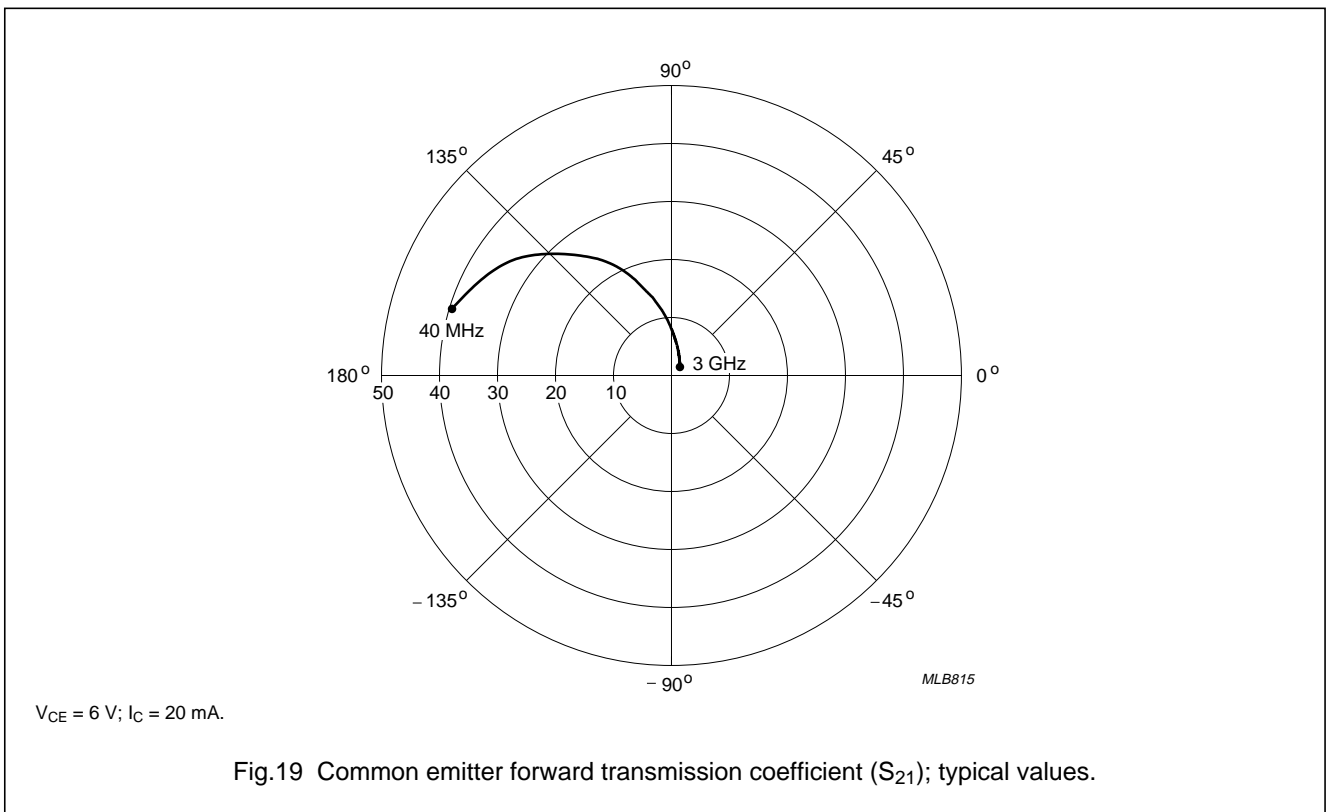
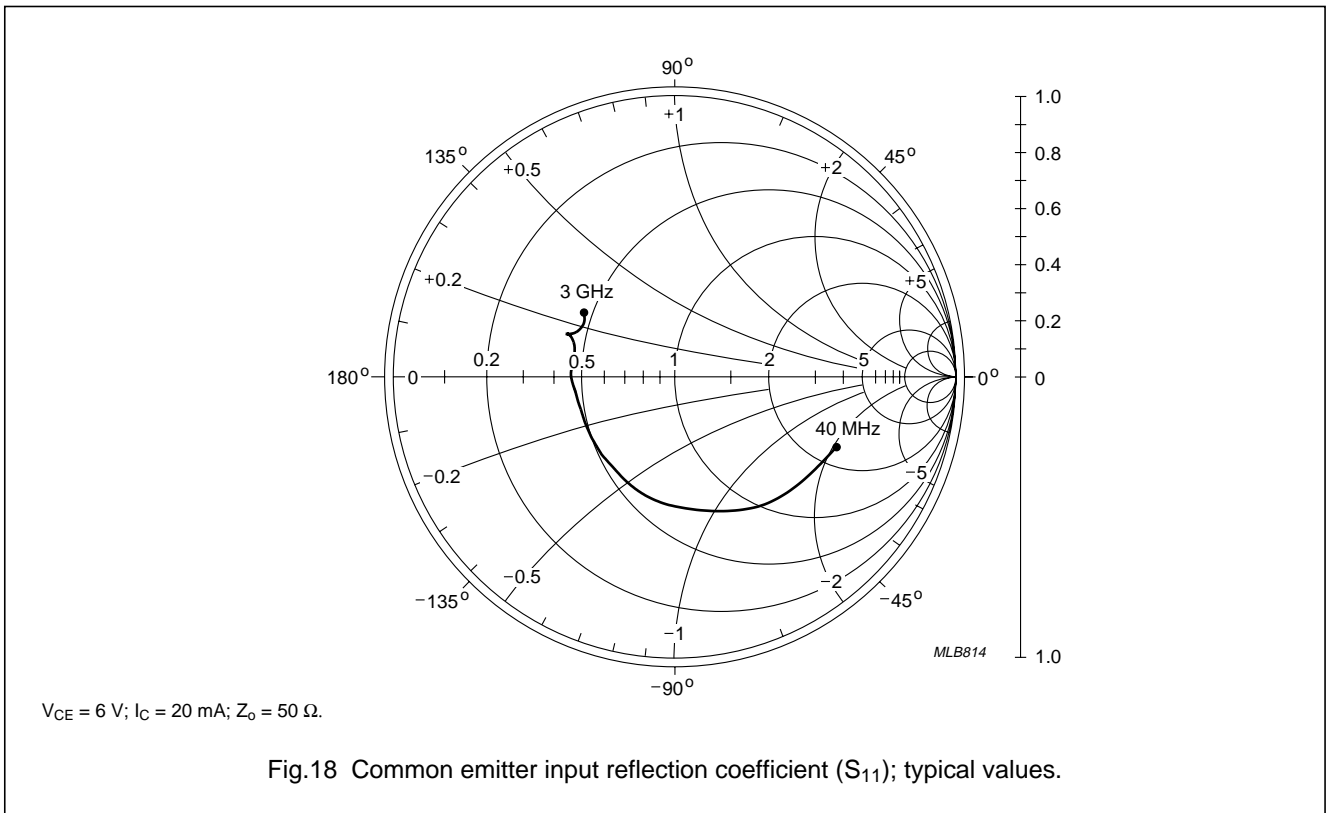
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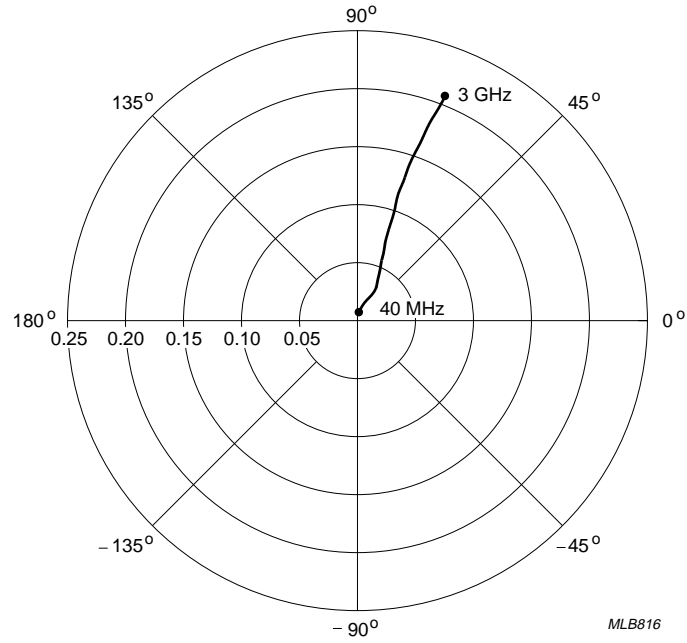
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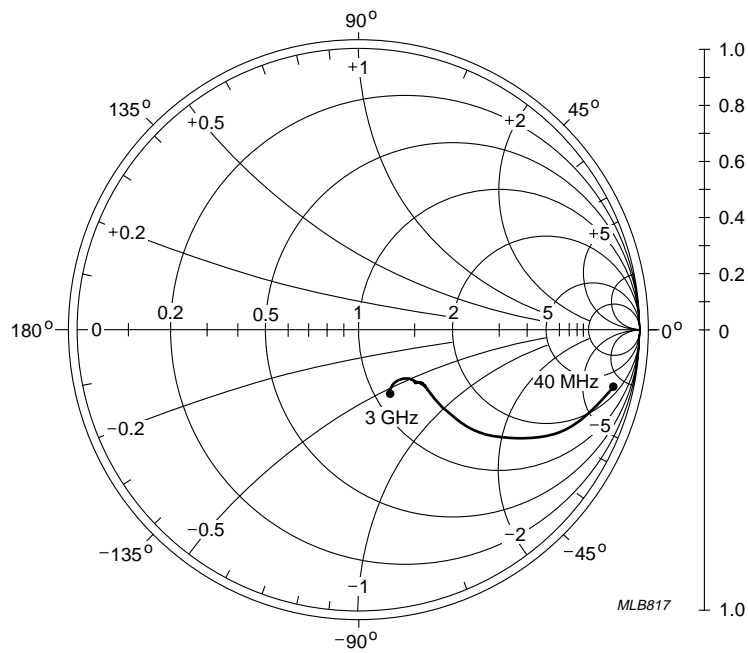
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$V_{CE} = 6\text{ V}; I_C = 20\text{ mA}$.

Fig.20 Common emitter reverse transmission coefficient (S_{12}); typical values.



$V_{CE} = 6\text{ V}; I_C = 20\text{ mA}; Z_0 = 50\ \Omega$.

Fig.21 Common emitter output reflection coefficient (S_{22}); typical values.

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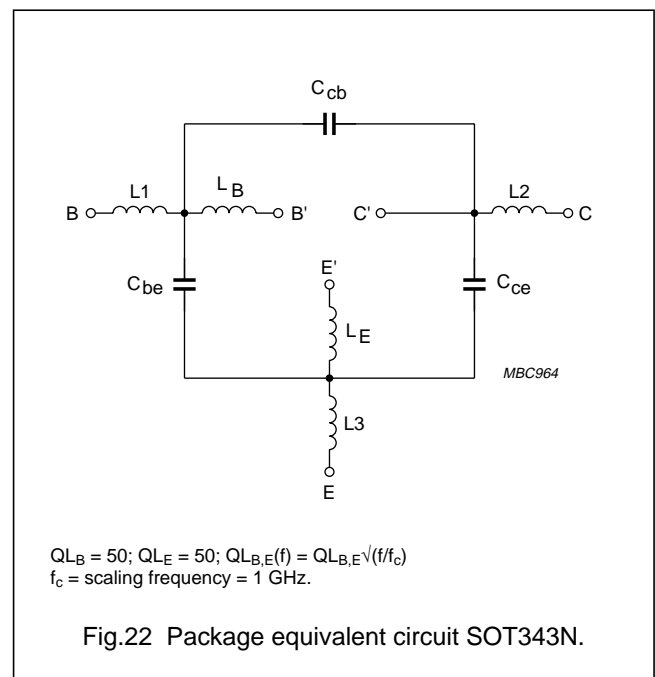
SPICE parameters for the BFG520W die

| SEQUENCE No. | PARAMETER | VALUE | UNIT |
|--------------|-----------|-------|------|
| 1 | IS | 1.016 | fA |
| 2 | BF | 220.1 | – |
| 3 | NF | 1.000 | – |
| 4 | VAF | 48.06 | V |
| 5 | IKF | 510 | mA |
| 6 | ISE | 283 | fA |
| 7 | NE | 2.035 | – |
| 8 | BR | 100.7 | – |
| 9 | NR | 0.988 | – |
| 10 | VAR | 1.692 | V |
| 11 | IKR | 2.352 | mA |
| 12 | ISC | 24.48 | aA |
| 13 | NC | 1.022 | – |
| 14 | RB | 10.00 | Ω |
| 15 | IRB | 1.000 | μA |
| 16 | RBM | 10.00 | Ω |
| 17 | RE | 775.3 | mΩ |
| 18 | RC | 2.210 | Ω |
| 19 (1) | XTB | 0.000 | – |
| 20 (1) | EG | 1.110 | eV |
| 21 (1) | XTI | 3.000 | – |
| 22 | CJE | 1.245 | pF |
| 23 | VJE | 600.0 | mV |
| 24 | MJE | 0.258 | – |
| 25 | TF | 8.616 | ps |
| 26 | XTF | 6.788 | – |
| 27 | VTF | 1.414 | V |
| 28 | ITF | 110.3 | mA |
| 29 | PTF | 45.01 | deg |
| 30 | CJC | 447.6 | fF |
| 31 | VJC | 189.2 | mV |
| 32 | MJC | 0.070 | – |
| 33 | XCJC | 0.130 | – |
| 34 | TR | 543.7 | ps |
| 35 (1) | CJS | 0.000 | F |

| SEQUENCE No. | PARAMETER | VALUE | UNIT |
|--------------|-----------|-------|------|
| 36 (1) | VJS | 750.0 | mV |
| 37 (1) | MJS | 0.000 | – |
| 38 | FC | 0.780 | – |

Note

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



List of components (see Fig.22)

| DESIGNATION | VALUE | UNIT |
|-----------------|-------|------|
| C _{be} | 70 | fF |
| C _{cb} | 50 | fF |
| C _{ce} | 115 | fF |
| L1 | 0.34 | nH |
| L2 | 0.10 | nH |
| L3 | 0.25 | nH |
| L _B | 0.40 | nH |
| L _E | 0.40 | nH |

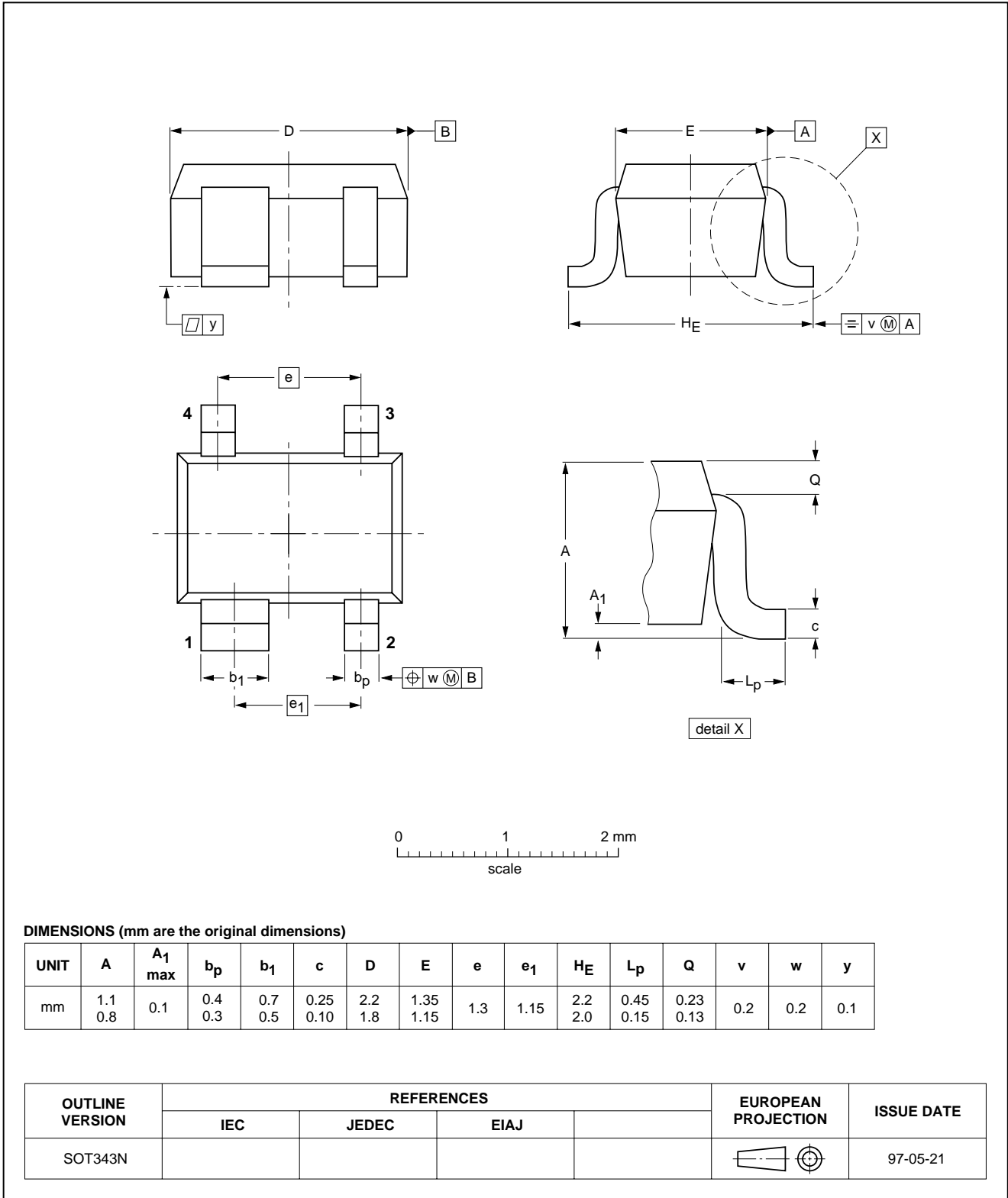
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PACKAGE OUTLINE

Plastic surface mounted package; 4 leads

SOT343N



Legal information

Data sheet status

| Document status ^{[1][2]} | Product status ^[3] | Definition |
|-----------------------------------|-------------------------------|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
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Revision history

Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|---|-----------------------|---------------|-------------|
| BFG520W_N_4 | 20071121 | Product data sheet | - | BFG520W_X_3 |
| Modifications: | <ul style="list-style-type: none"> Page 2; text in Pinning table changed | | | |
| BFG520W_X_3 | 19981002 | Product specification | - | BFG520W_2 |
| BFG520W_2 | 19950824 | Product specification | - | BFG520W_1 |
| BFG520W_1 | 19940829 | - | - | - |

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