

DATA SHEET

BFG540W
BFG540W/X; BFG540W/XR
NPN 9 GHz wideband transistor

Product specification
Supersedes data of 1997 Dec 04

2000 May 23



NPN 9 GHz wideband transistor

BFG540W BFG540W/X; BFG540W/XR

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), MATV/CATV amplifiers and repeater amplifiers in fibre-optic systems.

DESCRIPTION

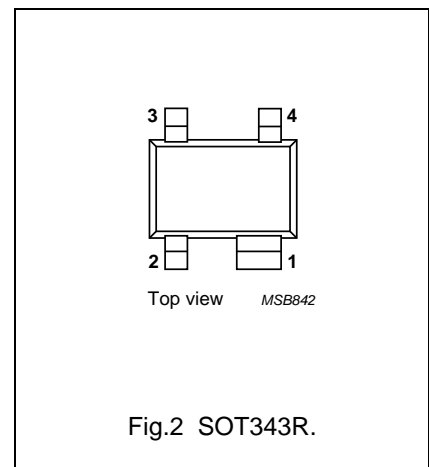
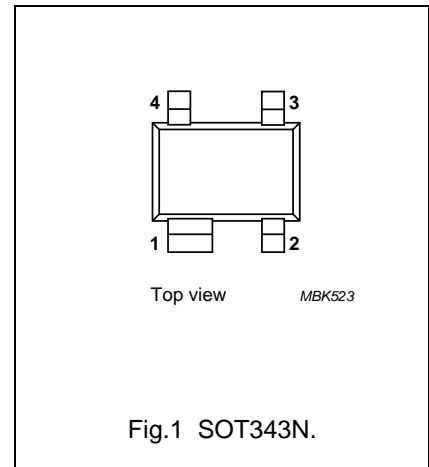
NPN silicon planar epitaxial transistors in 4-pin dual-emitter SOT343N and SOT343R plastic packages.

MARKING

| TYPE NUMBER | CODE |
|-------------|------|
| BFG540W | N9 |
| BFG540W/X | N7 |
| BFG540W/XR | N8 |

PINNING

| PIN | DESCRIPTION |
|-------------------------------|-------------|
| BFG540W (see Fig.1) | |
| 1 | collector |
| 2 | base |
| 3 | emitter |
| 4 | emitter |
| BFG540W/X (see Fig.1) | |
| 1 | collector |
| 2 | emitter |
| 3 | base |
| 4 | emitter |
| BFG540W/XR (see Fig.2) | |
| 1 | collector |
| 2 | emitter |
| 3 | base |
| 4 | emitter |



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) | | – | – | 120 | mA |
| P_{tot} | total power dissipation | $T_s \leq 85\text{ °C}$ | – | – | 500 | mW |
| h_{FE} | DC current gain | $I_C = 40\text{ mA}; V_{CE} = 8\text{ V}$ | 100 | 120 | 250 | |
| 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 | $I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$ | – | 16 | – | dB |
| | | $I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; f = 2\text{ GHz}; T_{amb} = 25\text{ °C}$ | – | 10 | – | dB |
| $ S_{21} ^2$ | insertion power gain | $I_C = 40\text{ mA}; V_{CE} = 8\text{ V}; f = 900\text{ MHz}; T_{amb} = 25\text{ °C}$ | 14 | 15 | – | dB |
| F | noise figure | $\Gamma_s = \Gamma_{opt}; I_C = 10\text{ mA}; V_{CE} = 8\text{ V}; f = 2\text{ GHz}$ | – | 2.1 | – | dB |

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LIMITING VALUES

In accordance with the Absolute Maximum Rating 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 | collector current (DC) | | – | 120 | mA |
| P _{tot} | total power dissipation | T _s ≤ 85 °C; see Fig.3; note 1 | – | 500 | mW |
| T _{stg} | storage temperature | | –65 | +150 | °C |
| T _j | junction temperature | | – | 175 | °C |

Note

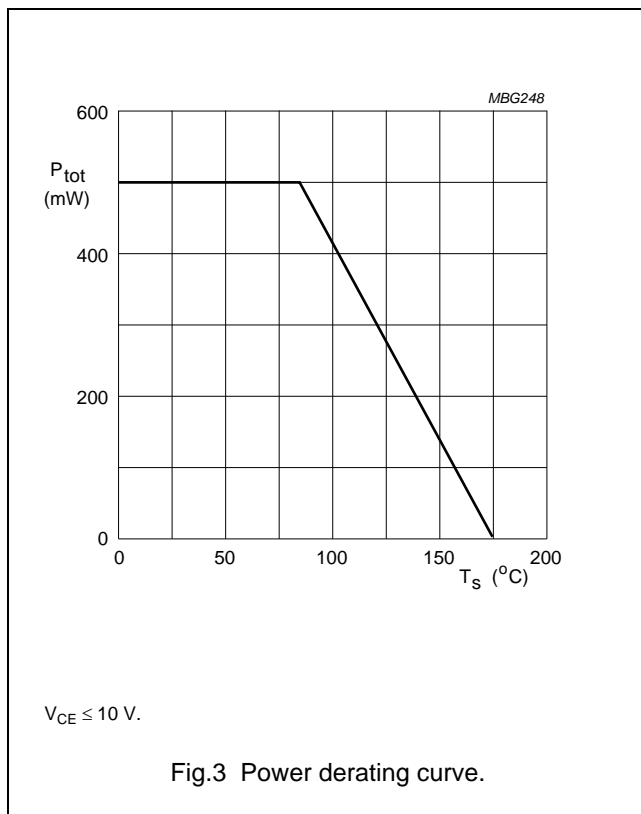
1. T_s is the temperature at the soldering point of the collector pin.

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 °C unless otherwise specified.

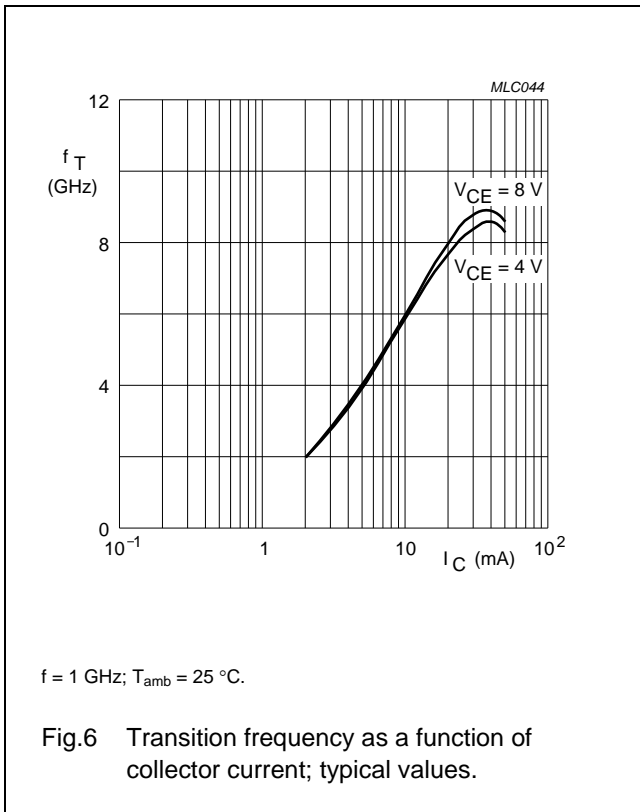
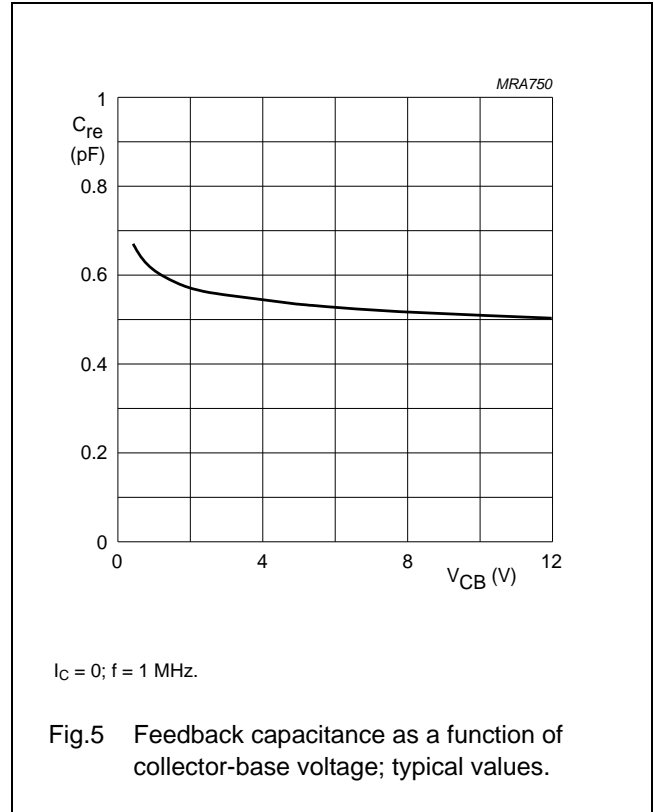
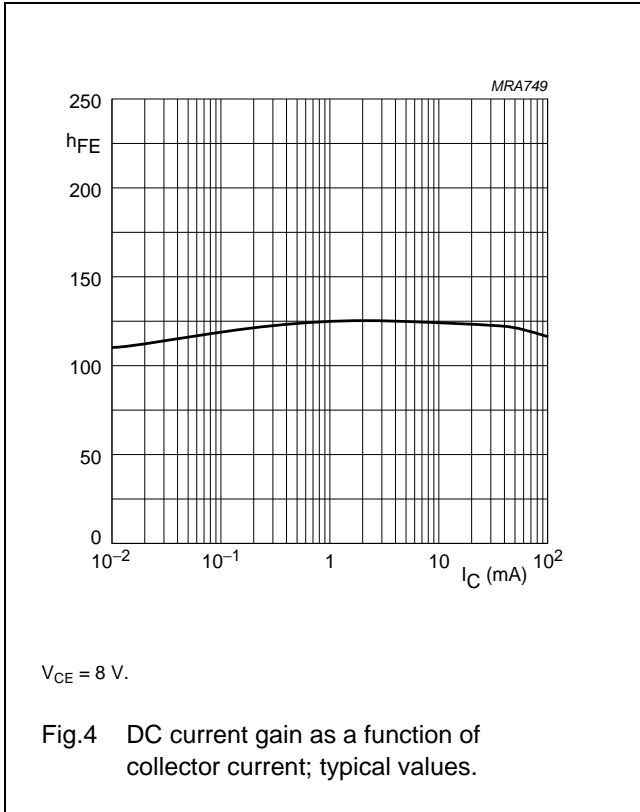
| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--------------------------------|---|--|------|------|------|------|
| V _{(BR)CBO} | collector-base breakdown voltage | open emitter; I _C = 10 μA; I _E = 0 | 20 | – | – | V |
| V _{(BR)CES} | collector-emitter breakdown voltage | R _{BE} = 0; I _C = 40 μA | 15 | – | – | V |
| V _{(BR)EBO} | emitter-base breakdown voltage | open collector; I _E = 100 μA; I _C = 0 | 2.5 | – | – | V |
| I _{CBO} | collector cut-off current | open emitter; V _{CB} = 8 V; I _E = 0 | – | – | 50 | nA |
| h _{FE} | DC current gain | I _C = 40 mA; V _{CE} = 8 V | 100 | 120 | 250 | |
| f _T | transition frequency | I _C = 40 mA; V _{CE} = 8 V; f = 1 GHz; T _{amb} = 25 °C | – | 9 | – | GHz |
| C _c | collector capacitance | I _E = i _e = 0; V _{CB} = 8 V; f = 1 MHz | – | 0.9 | – | pF |
| C _e | emitter capacitance | I _C = i _c = 0; V _{EB} = 0.5 V; f = 1 MHz | – | 2 | – | pF |
| C _{re} | feedback capacitance | I _C = 0; V _{CB} = 8 V; f = 1 MHz | – | 0.5 | – | pF |
| G _{UM} | maximum unilateral power gain; note 1 | I _C = 40 mA; V _{CE} = 8 V; f = 900 MHz; T _{amb} = 25 °C | – | 16 | – | dB |
| | | I _C = 40 mA; V _{CE} = 8 V; f = 2 GHz; T _{amb} = 25 °C | – | 10 | – | dB |
| s ₂₁ ² | insertion power gain | I _C = 40 mA; V _{CE} = 8 V; f = 900 MHz; T _{amb} = 25 °C | 14 | 15 | – | dB |
| F | noise figure | Γ _s = Γ _{opt} ; I _C = 10 mA; V _{CE} = 8 V; f = 900 MHz | – | 1.3 | 1.8 | dB |
| | | Γ _s = Γ _{opt} ; I _C = 40 mA; V _{CE} = 8 V; f = 900 MHz | – | 1.9 | 2.4 | dB |
| | | Γ _s = Γ _{opt} ; I _C = 10 mA; V _{CE} = 8 V; f = 2 GHz | – | 2.1 | – | dB |
| P _{L1} | output power at 1 dB gain compression | I _C = 40 mA; V _{CE} = 8 V; f = 900 MHz; R _L = 50 Ω; T _{amb} = 25 °C | – | 21 | – | dBm |
| I _{TO} | 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 s₁₂ is zero. $G_{UM} = 10 \log \frac{|s_{21}|^2}{(1 - |s_{11}|^2)(1 - |s_{22}|^2)}$ dB.
- I_C = 40 mA; V_{CE} = 8 V; R_L = 50 Ω; T_{amb} = 25 °C;
 - f_p = 900 MHz; f_q = 902 MHz; measured at f_(2p-q) = 898 MHz and f_(2q-p) = 904 MHz.
- d_{im} = –60 dB (DIN45004B); V_p = V_o; V_q = V_o – 6 dB; V_r = V_o – 6 dB; R_L = 75 Ω; V_{CE} = 8 V; I_C = 40 mA;
 - f_p = 795.25 MHz; f_q = 803.25 MHz; f_r = 805.25 MHz; measured at f_(p+q-r) = 793.25 MHz.
- I_C = 40 mA; V_{CE} = 8 V; V_o = 275 mV; R_L = 75 Ω; T_{amb} = 25 °C;
 - f_p = 250 MHz; f_q = 560 MHz; measured at f_(p+q) = 810 MHz.

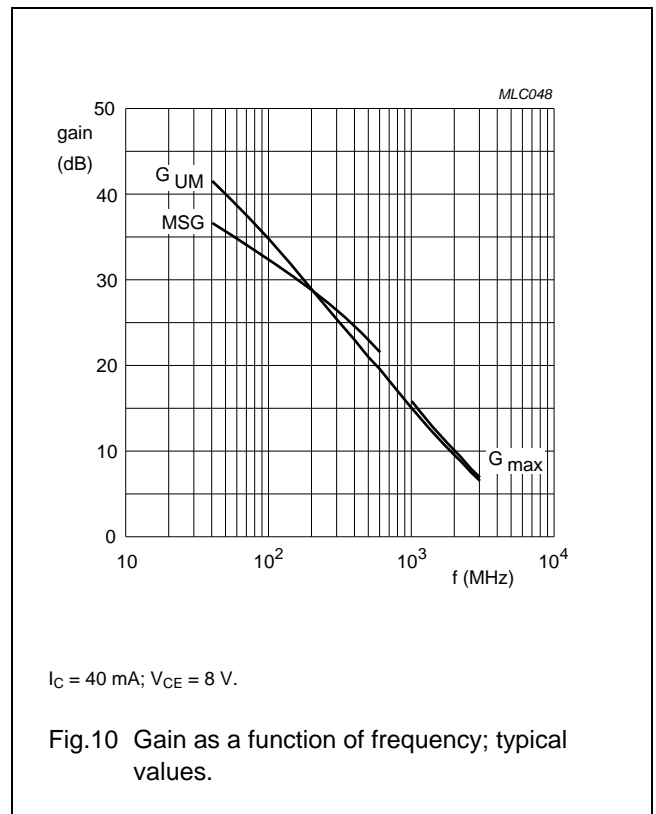
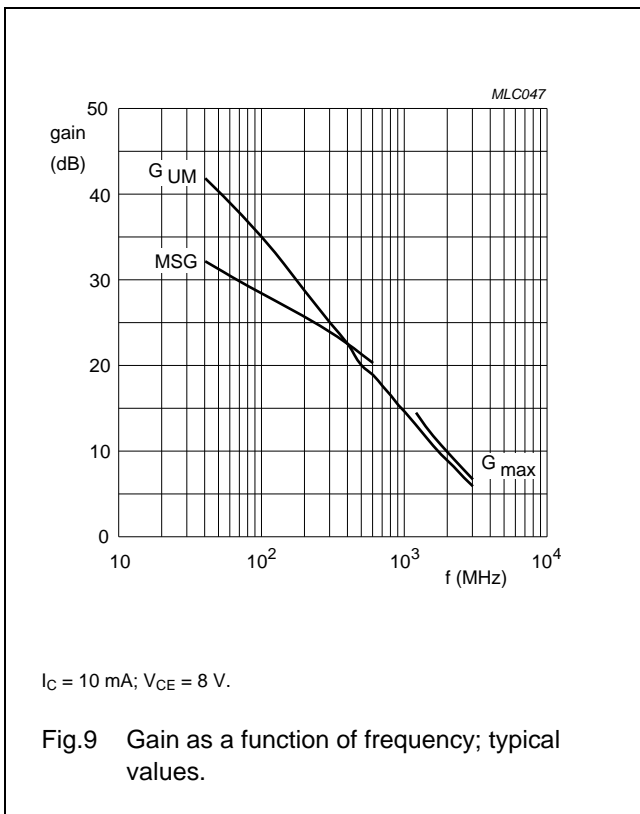
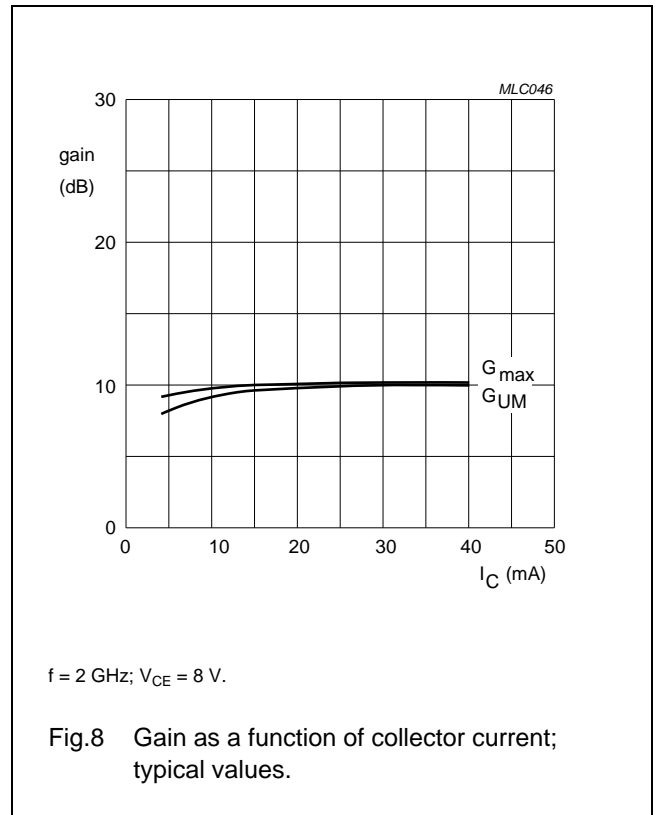
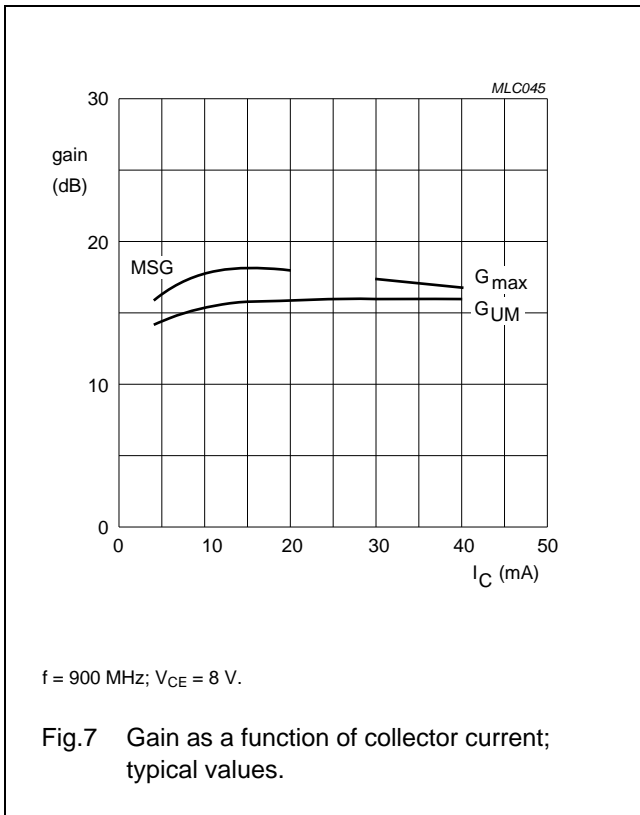
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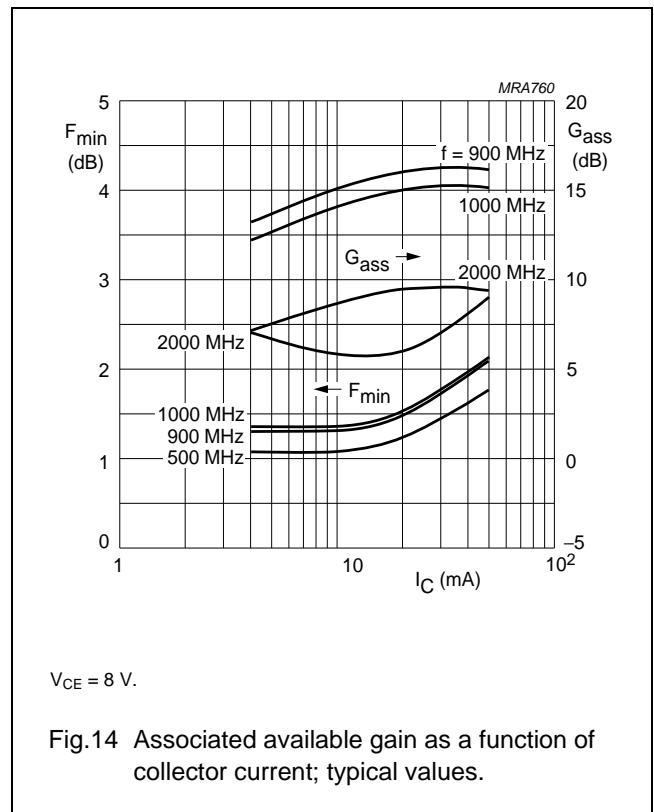
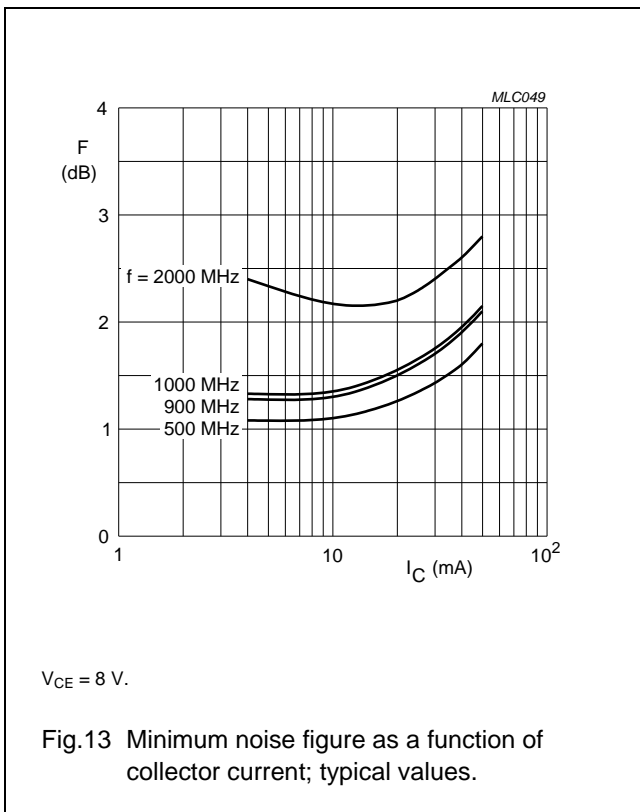
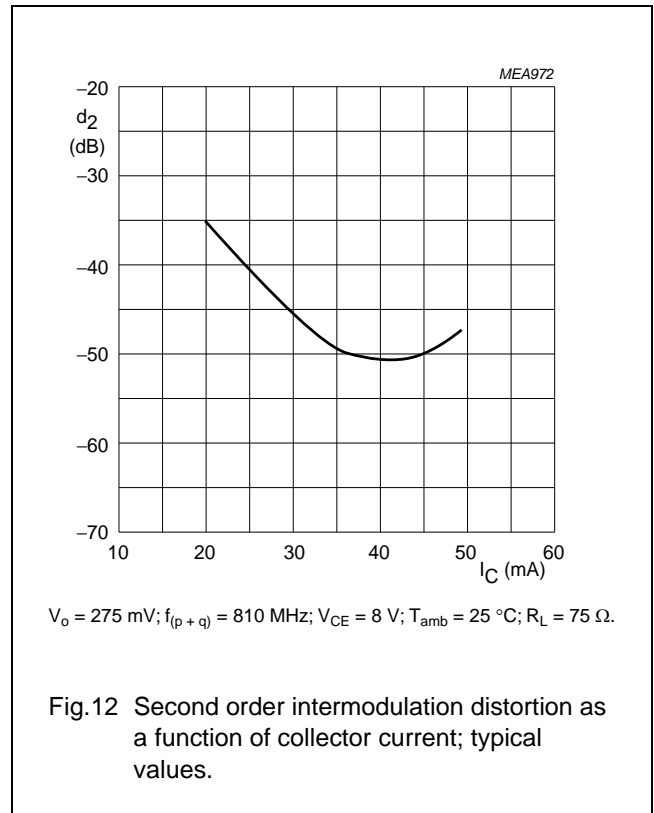
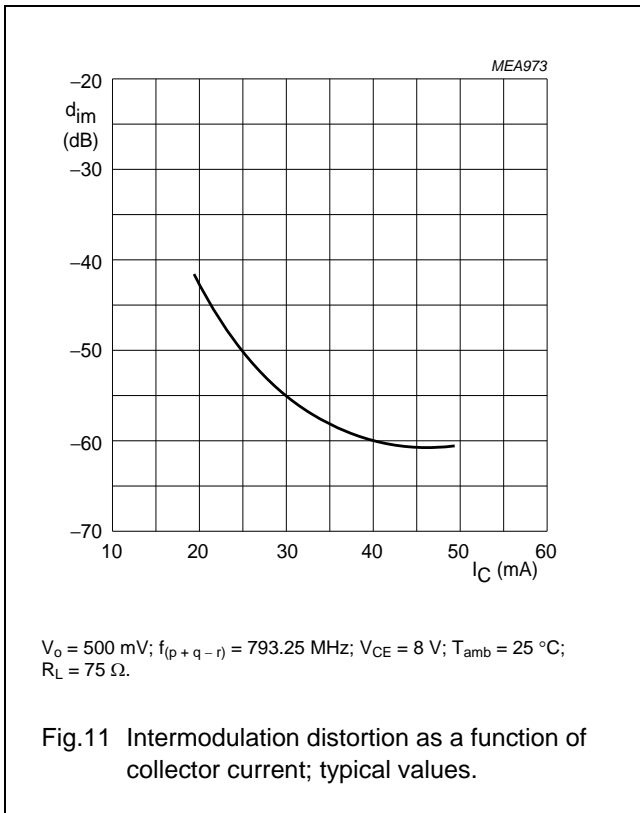
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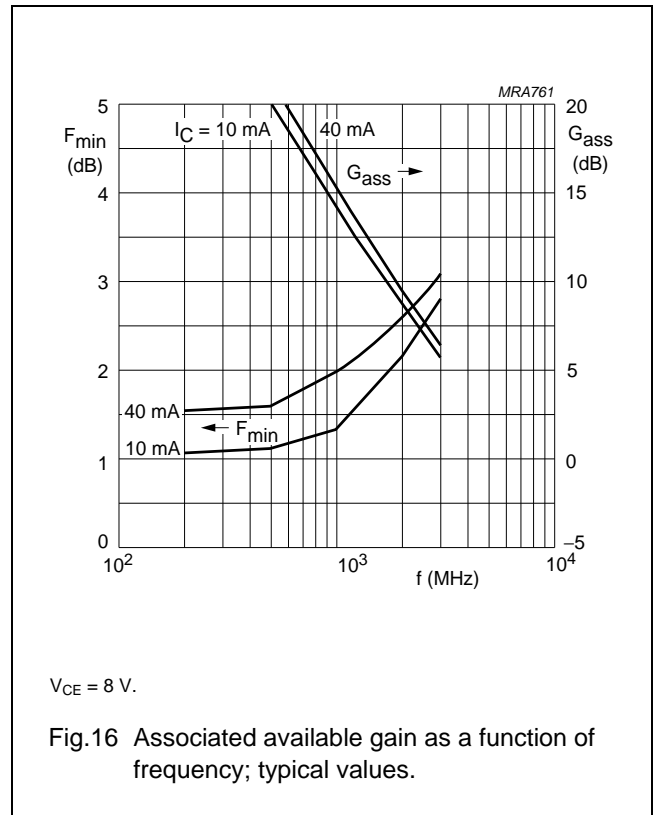
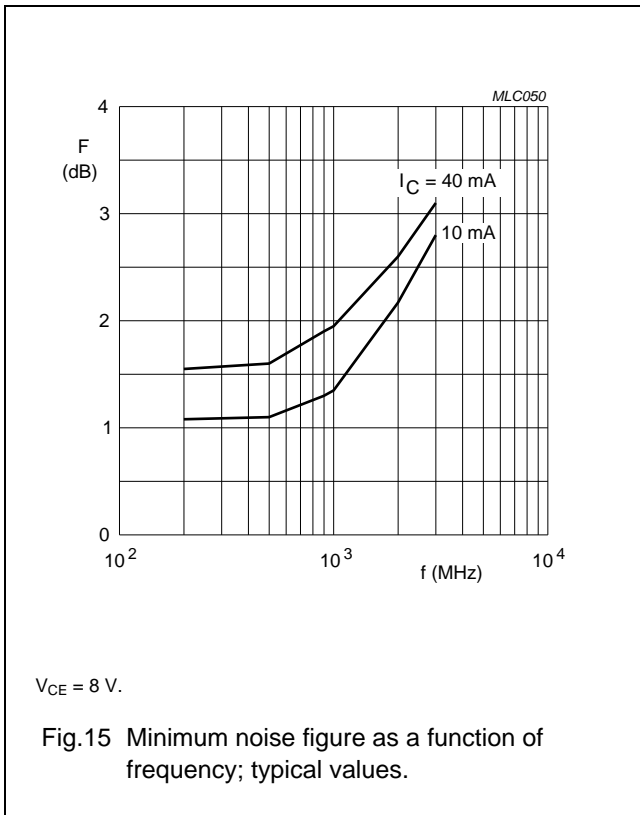
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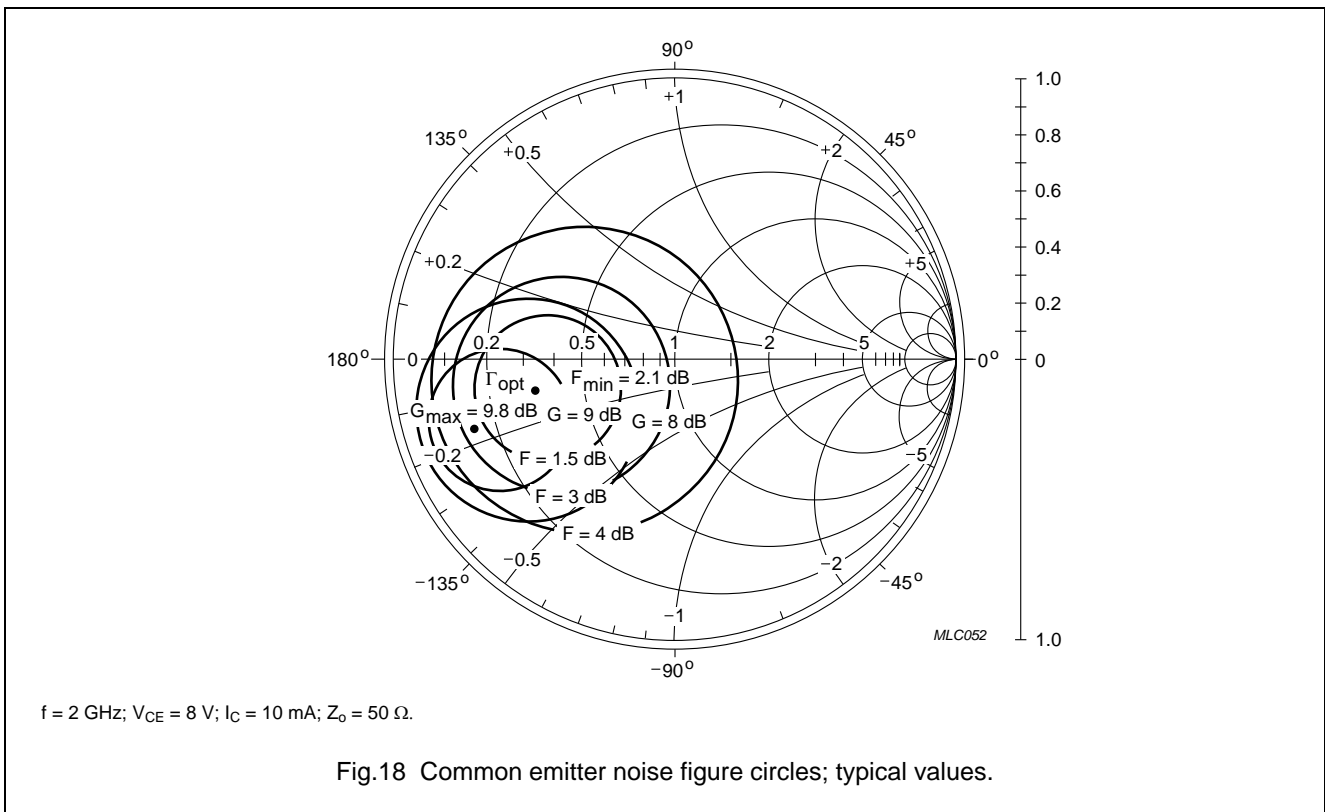
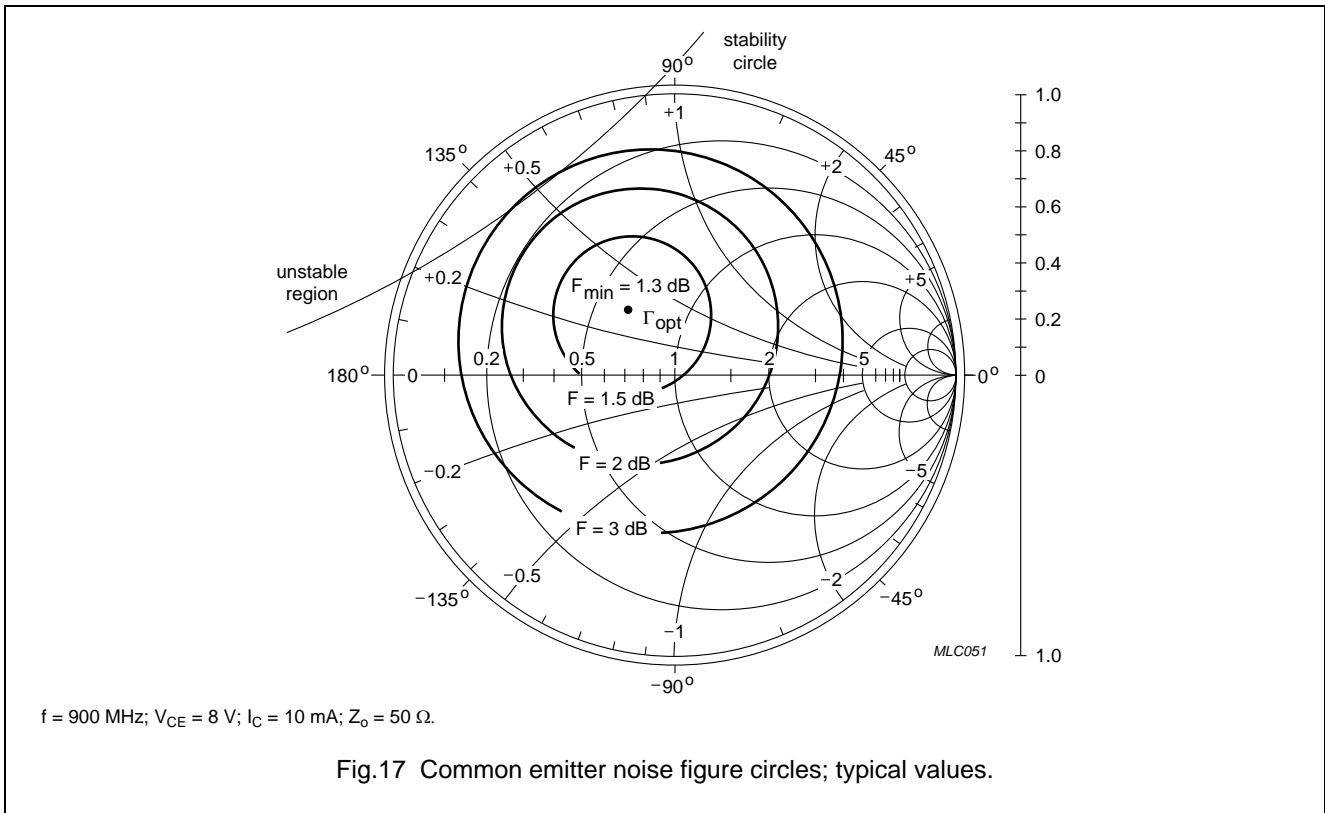
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BFG540W/X; BFG540W/XR



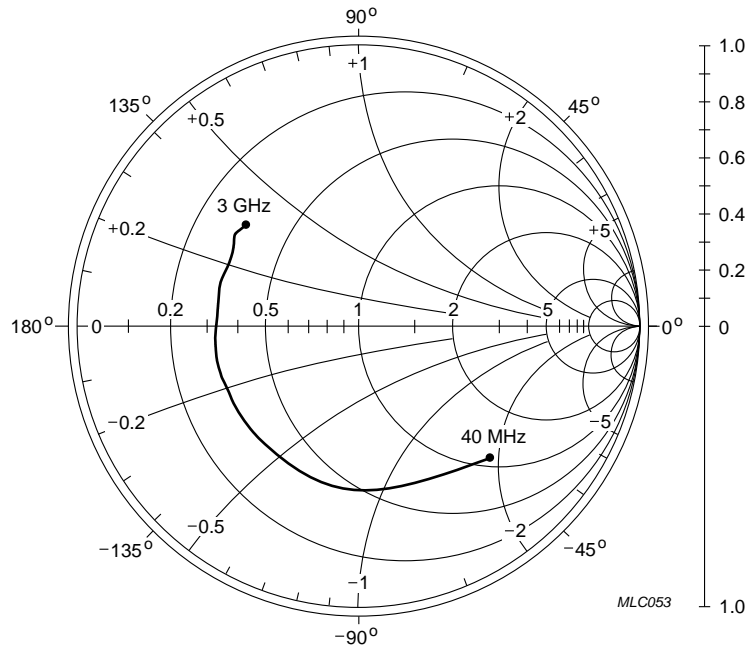
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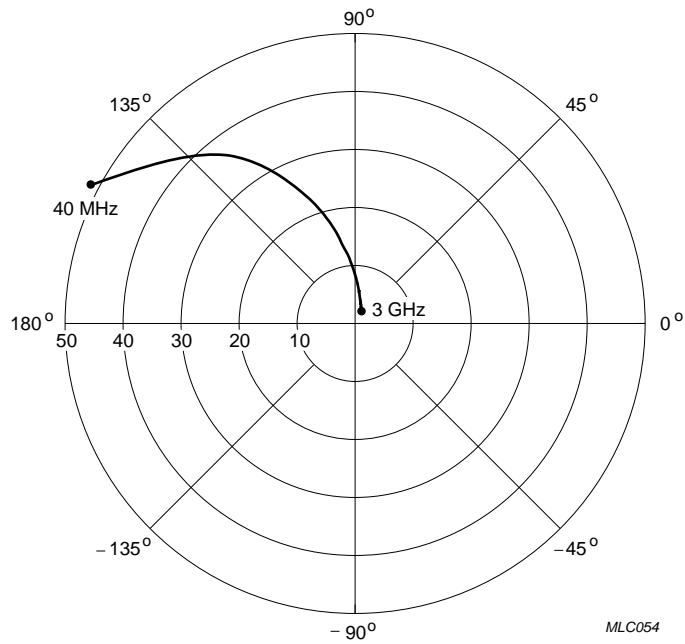
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BFG540W/X; BFG540W/XR



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

Fig.19 Common emitter input reflection coefficient (s_{11}); typical values.

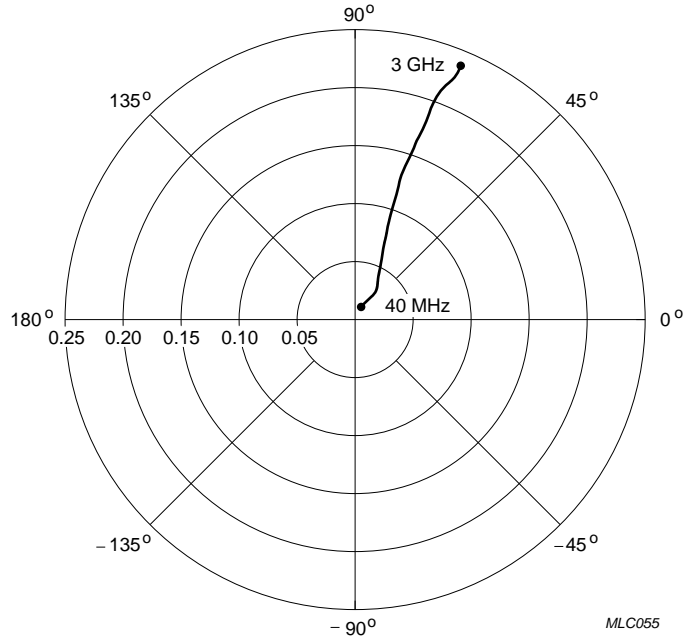


$V_{CE} = 8\text{ V}$; $I_C = 40\text{ mA}$.

Fig.20 Common emitter forward transmission coefficient (s_{21}); typical values.

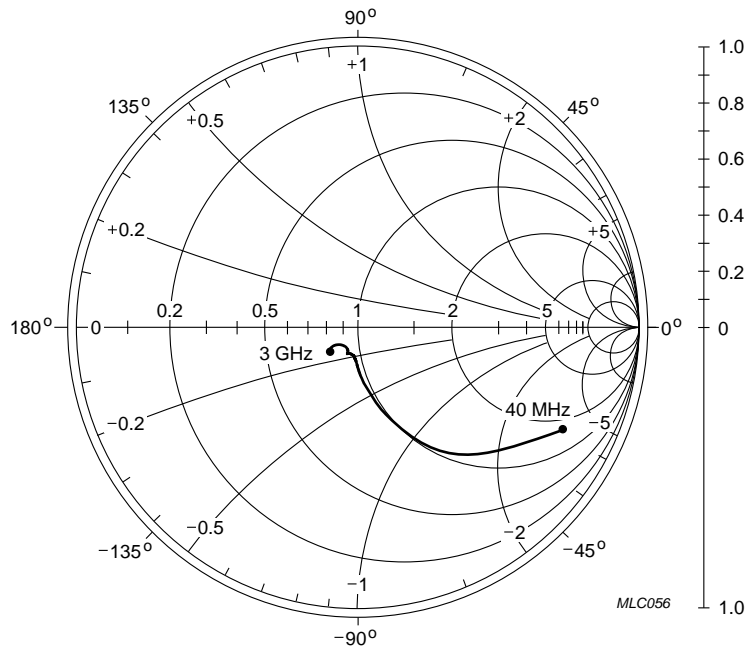
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$V_{CE} = 8\text{ V}; I_C = 40\text{ mA}$.

Fig.21 Common emitter reverse transmission coefficient (s_{12}); typical values.



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

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

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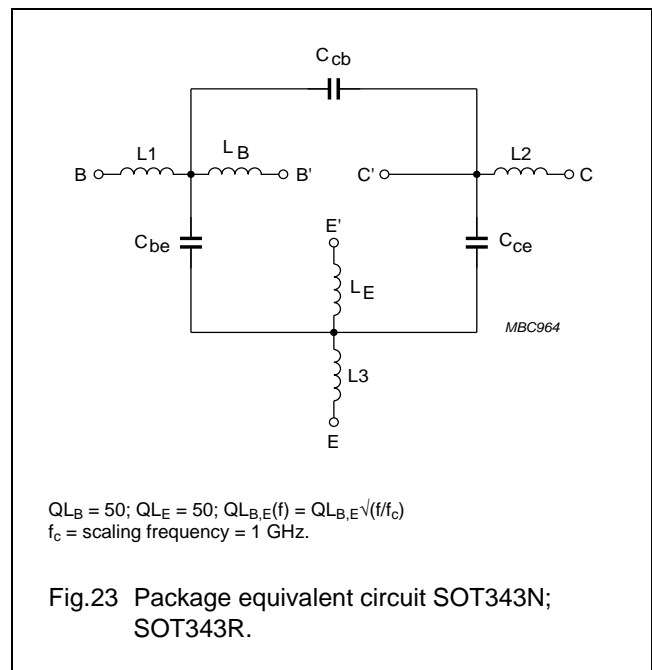
SPICE parameters for the BFG540W crystal

| SEQUENCE No. | PARAMETER | VALUE | UNIT |
|--------------|-----------|-------|------|
| 1 | IS | 1.045 | fA |
| 2 | BF | 184.3 | – |
| 3 | NF | 0.981 | – |
| 4 | VAF | 41.69 | V |
| 5 | IKF | 10.00 | A |
| 6 | ISE | 232.4 | fA |
| 7 | NE | 2.028 | – |
| 8 | BR | 43.99 | – |
| 9 | NR | 0.992 | – |
| 10 | VAR | 2.097 | V |
| 11 | IKR | 166.2 | mA |
| 12 | ISC | 129.8 | aA |
| 13 | NC | 1.064 | – |
| 14 | RB | 5.000 | Ω |
| 15 | IRB | 1.000 | μA |
| 16 | RBM | 5.000 | Ω |
| 17 | RE | 353.5 | mΩ |
| 18 | RC | 1.340 | Ω |
| 19 (1) | XTB | 0.000 | – |
| 20 (1) | EG | 1.110 | eV |
| 21 (1) | XTI | 3.000 | – |
| 22 | CJE | 1.978 | pF |
| 23 | VJE | 600.0 | mV |
| 24 | MJE | 0.332 | – |
| 25 | TF | 7.457 | ps |
| 26 | XTF | 11.40 | – |
| 27 | VTF | 3.158 | V |
| 28 | ITF | 156.9 | mA |
| 29 | PTF | 0.000 | deg |
| 30 | CJC | 793.7 | fF |
| 31 | VJC | 185.5 | mV |
| 32 | MJC | 0.084 | – |
| 33 | XCJC | 0.150 | – |
| 34 | TR | 1.598 | ns |
| 35 (1) | CJS | 0.000 | F |

| SEQUENCE No. | PARAMETER | VALUE | UNIT |
|--------------|-----------|-------|------|
| 36 (1) | VJS | 750.0 | mV |
| 37 (1) | MJS | 0.000 | – |
| 38 | FC | 0.814 | – |

Note

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



List of components (see Fig.23).

| 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 |

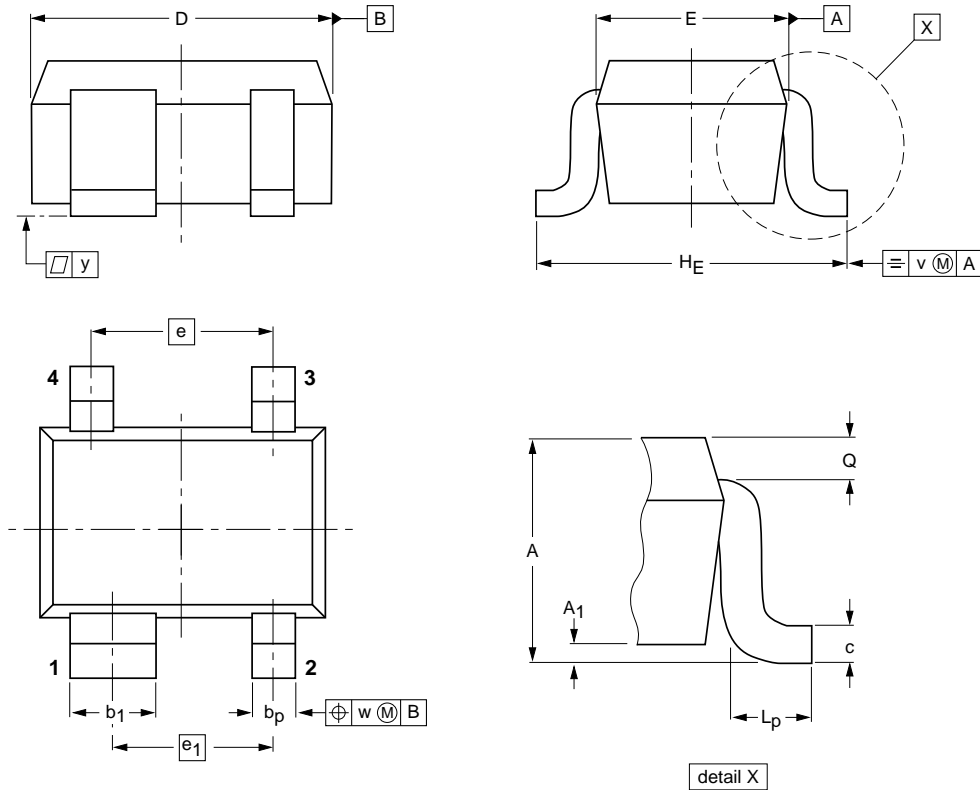
NPN 9 GHz wideband transistor

BFG540W
BFG540W/X; BFG540W/XR

PACKAGE OUTLINES

Plastic surface-mounted package; 4 leads

SOT343N



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 0.8 | 0.1 | 0.4 0.3 | 0.7 0.5 | 0.25 0.10 | 2.2 1.8 | 1.35 1.15 | 1.3 | 1.15 | 2.2 2.0 | 0.45 0.15 | 0.23 0.13 | 0.2 | 0.2 | 0.1 |

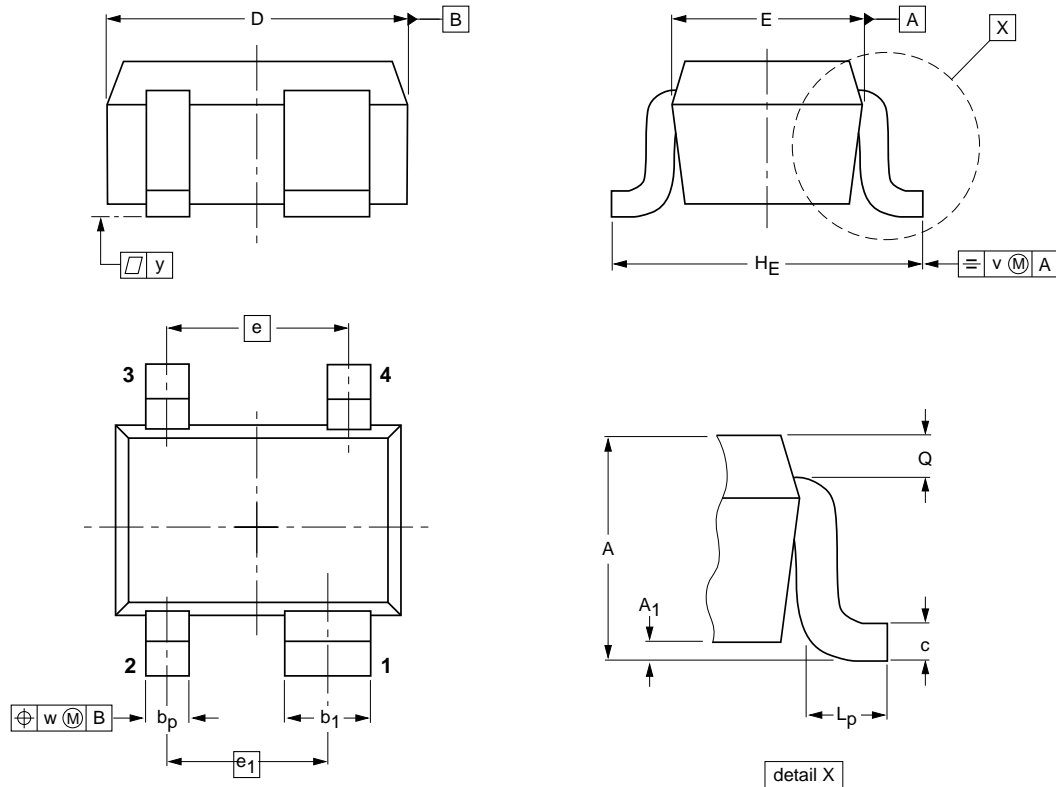
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|--------------------|------------|-------|------|--|------------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT343N | | | | | | 97-05-21 06-03-16 |

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BFG540W
BFG540W/X; BFG540W/XR

Plastic surface-mounted package; reverse pinning; 4 leads

SOT343R



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 0.8 | 0.1 | 0.4 0.3 | 0.7 0.5 | 0.25 0.10 | 2.2 1.8 | 1.35 1.15 | 1.3 | 1.15 | 2.2 2.0 | 0.45 0.15 | 0.23 0.13 | 0.2 | 0.2 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|--------------------|------------|-------|------|--|------------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT343R | | | | | | 97-05-21 06-03-16 |

NPN 9 GHz wideband transistor

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BFG540W/X; BFG540W/XR

DATA SHEET STATUS

| DOCUMENT STATUS ⁽¹⁾ | PRODUCT STATUS ⁽²⁾ | DEFINITION |
|--------------------------------|-------------------------------|---|
| Objective data sheet | Development | This document contains data from the objective specification for product development. |
| Preliminary data sheet | Qualification | This document contains data from the preliminary specification. |
| Product data sheet | Production | This document contains the product specification. |

Notes

1. Please consult the most recently issued document before initiating or completing a design.
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Customer notification

This data sheet was changed to reflect the new company name NXP Semiconductors, including new legal definitions and disclaimers. No changes were made to the technical content, except for package outline drawings which were updated to the latest version.

Contact information

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