MegaPower Semiconductor

# 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.

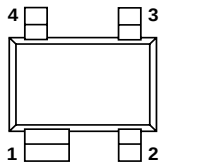
## DESCRIPTION

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.

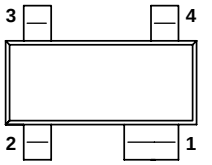
## PINNING

| 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 |




Top view MSB014

Fig.1 SOT143B.




Top view MSB035

Fig.2 SOT143R.

## QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $V_{CBO}$ | 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 °C; note 1 | – | – | 300 | mW |
| $h_{FE}$ | DC current gain | $I_C$ = 20 mA; $V_{CE}$ = 6 V; $T_j$ = 25 °C | 60 | 120 | 250 | |
| $C_{re}$ | feedback capacitance | $I_C$ = 0; $V_{CB}$ = 6 V; f = 1 MHz | – | 0.3 | – | pF |
| $f_T$ | transition frequency | $I_C$ = 20 mA; $V_{CE}$ = 6 V; f = 1 GHz; $T_{amb}$ = 25 °C | – | 9 | – | GHz |
| $G_{UM}$ | maximum unilateral power gain | $I_C$ = 20 mA; $V_{CE}$ = 6 V; f = 900 MHz; $T_{amb}$ = 25 °C | – | 19 | – | dB |
| | | $I_C$ = 20 mA; $V_{CE}$ = 6 V; f = 2 GHz; $T_{amb}$ = 25 °C | – | 13 | – | dB |
| $\lvert S_{21}\rvert^2$ | insertion power gain | $I_C$ = 20 mA; $V_{CE}$ = 6 V; f = 900 MHz; $T_{amb}$ = 25 °C | 17 | 18 | – | dB |
| F | noise figure | $\Gamma_s = \Gamma_{opt}$ ; $I_c$ = 5 mA; $V_{CE}$ = 6 V; f = 900 MHz; $T_{amb}$ = 25 °C | – | 1.1 | 1.6 | dB |
| | | $\Gamma_s = \Gamma_{opt}$ ; $I_C$ = 20 mA; $V_{CE}$ = 6 V; f = 900 MHz; $T_{amb}$ = 25 °C | – | 1.6 | 2.1 | dB |
| | | $\Gamma_s = \Gamma_{opt}$ ; $I_C$ = 5 mA; $V_{CE}$ = 8 V; f = 2 GHz; $T_{amb}$ = 25 °C | – | 1.9 | – | dB |

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

s

## CHARACTERISTICS

$T_j$ = 25 °C unless otherwise specified.

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

**Notes**

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

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

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

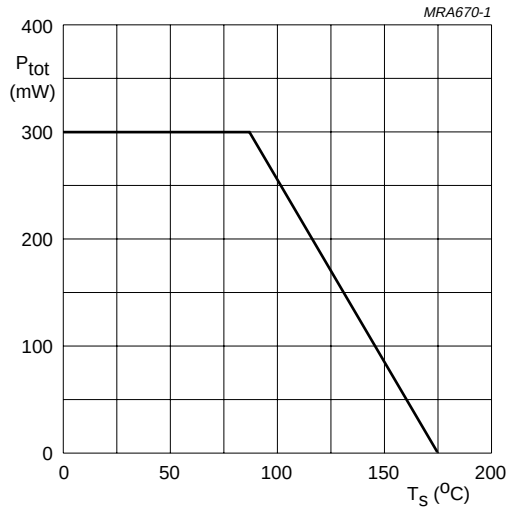
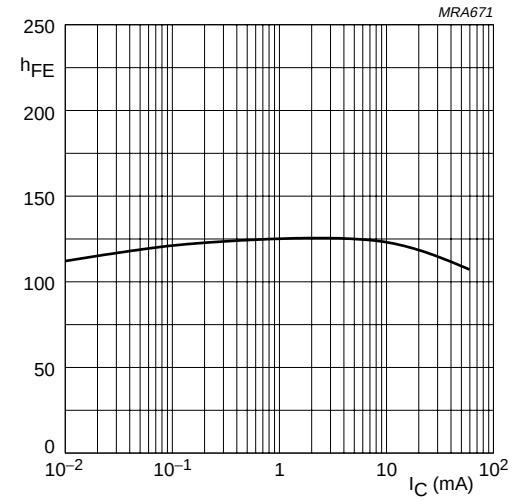
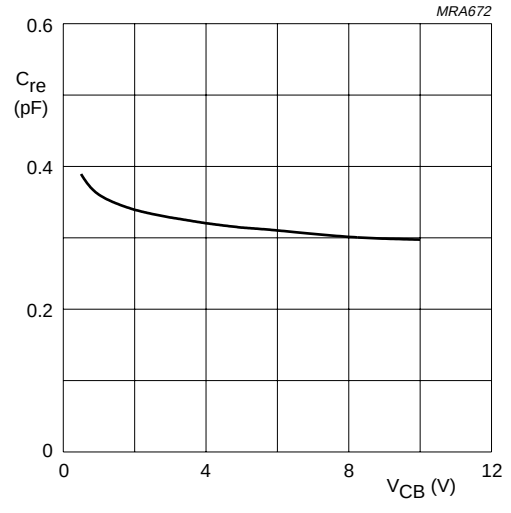



Fig.3 Power derating curve.



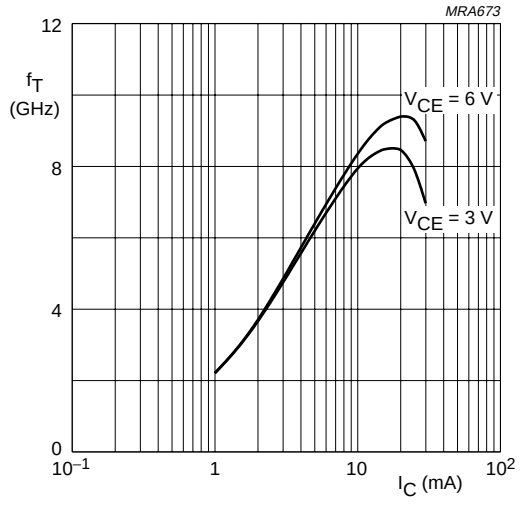

$V_{CE}$ = 6 V; $T_j$ = 25 °C.

Fig.4 DC current gain as a function of collector current.




$I_C$ = 0; f = 1 MHz.

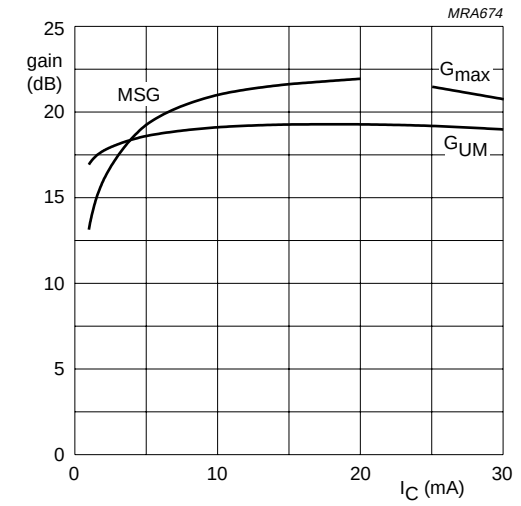
Fig.5 Feedback capacitance as a function of collector-base voltage.




f = 1 GHz; $T_{amb}$ = 25 °C.

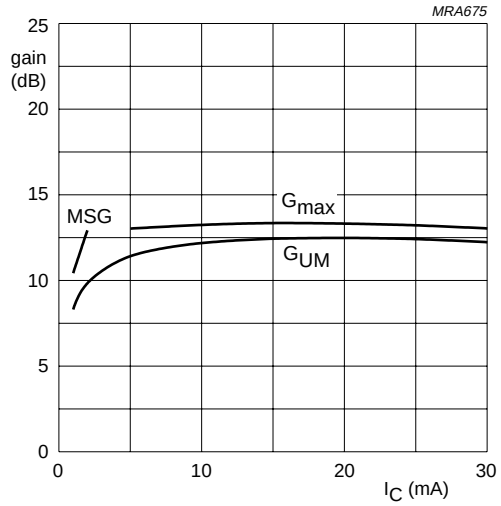
Fig.6 Transition frequency as a function of collector current.

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



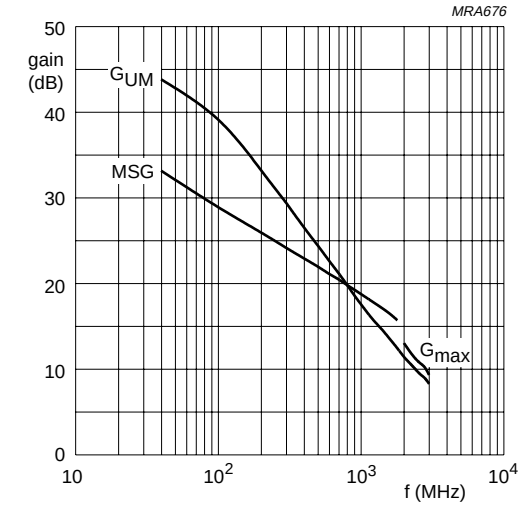

$V_{CE}$ = 6 V; f = 900 MHz; $T_{amb}$ = 25 °C.

Fig.7 Gain as a function of collector current.



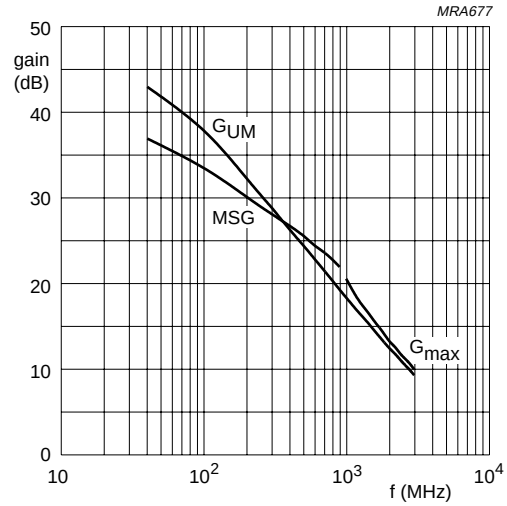

$V_{CE}$ = 6 V; f = 2 GHz; $T_{amb}$ = 25 °C.

Fig.8 Gain as a function of collector current.




$I_C$ = 5 mA; $V_{CE}$ = 6 V; $T_{amb}$ = 25 °C.

Fig.9 Gain as a function of frequency.




$I_C$ = 20 mA; $V_{CE}$ = 6 V; $T_{amb}$ = 25 °C.

Fig.10 Gain as a function of frequency.

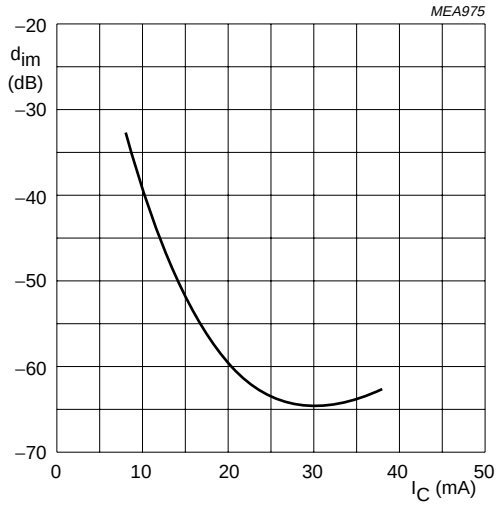



Fig.11 Intermodulation distortion as a function of collector current.

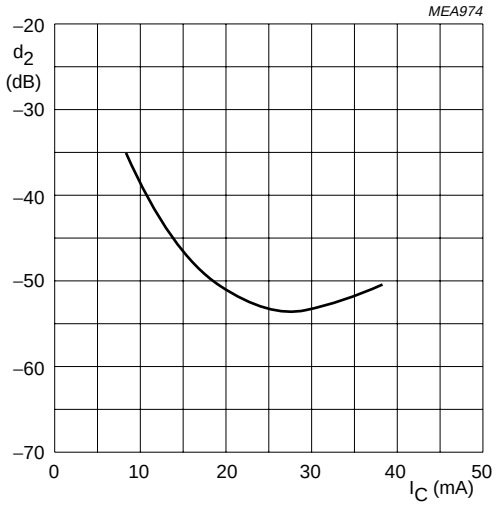
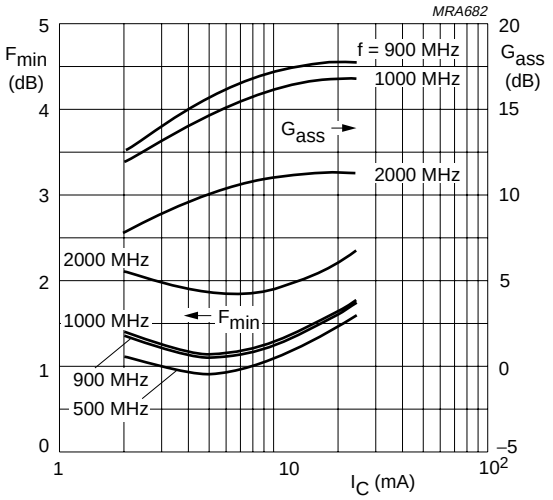
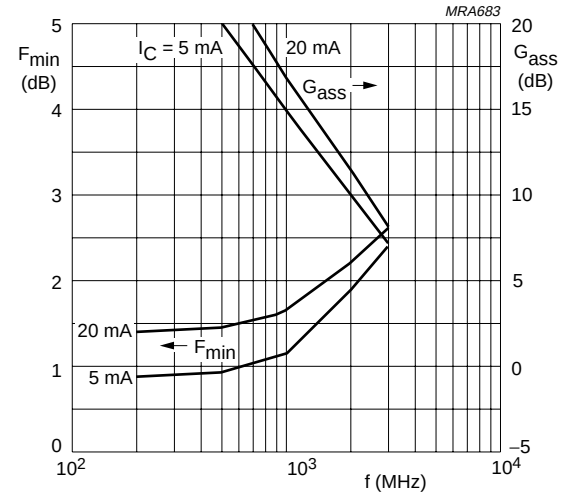



Fig.12 Second order intermodulation distortion as a function of collector current.



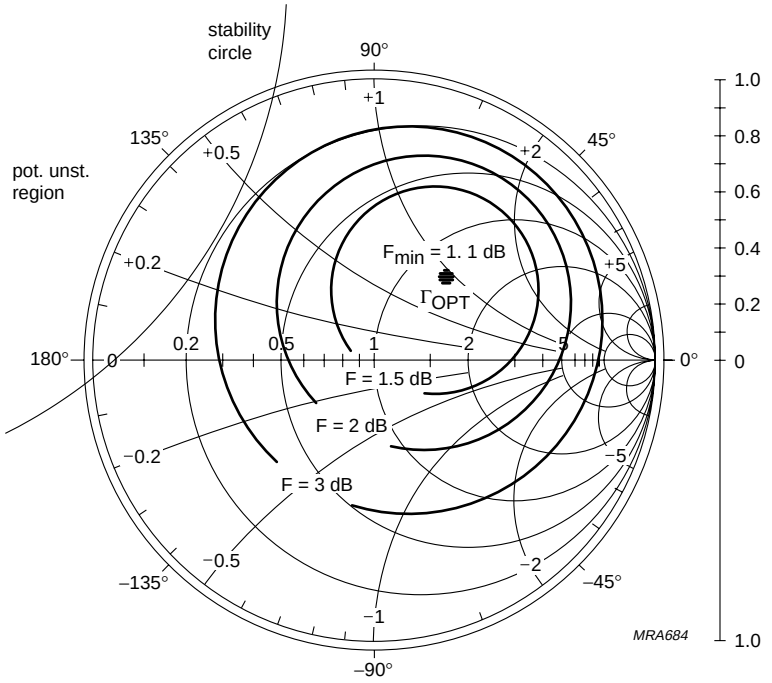

$V_{CE}$ = 6 V; $T_{amb}$ = 25 °C.

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



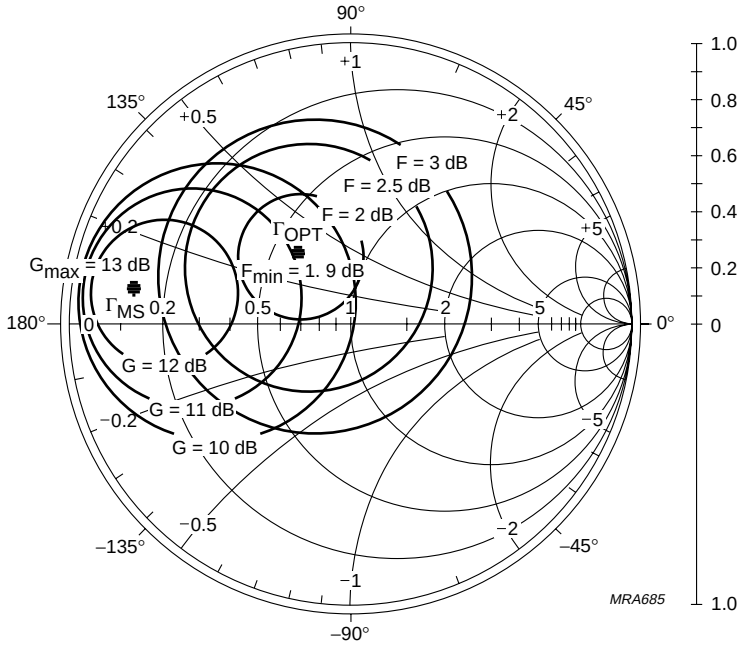

$V_{CE}$ = 6 V; $T_{amb}$ = 25 °C.

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



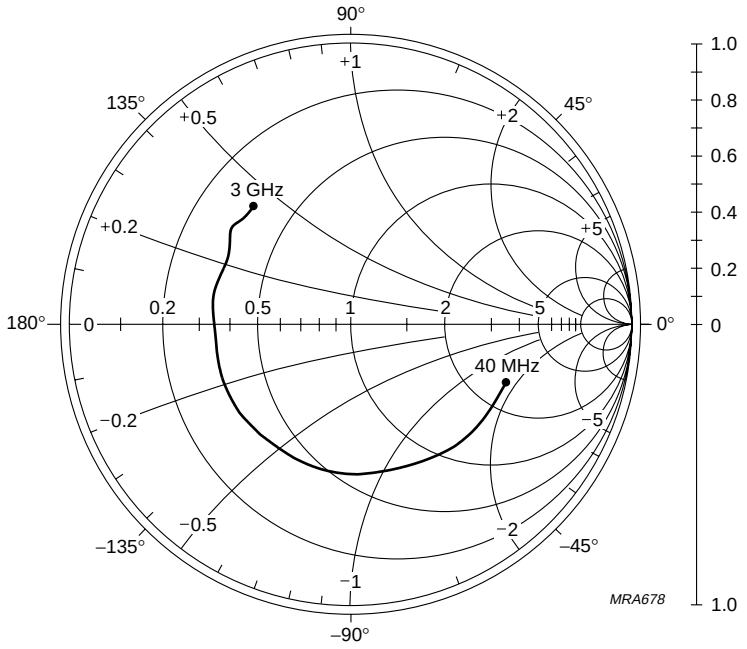

$I_C$ = 5 mA; $V_{CE}$ = 6 V;
f = 900 MHz; $Z_o$ = 50 Ω.

Fig.15 Noise circle figure.



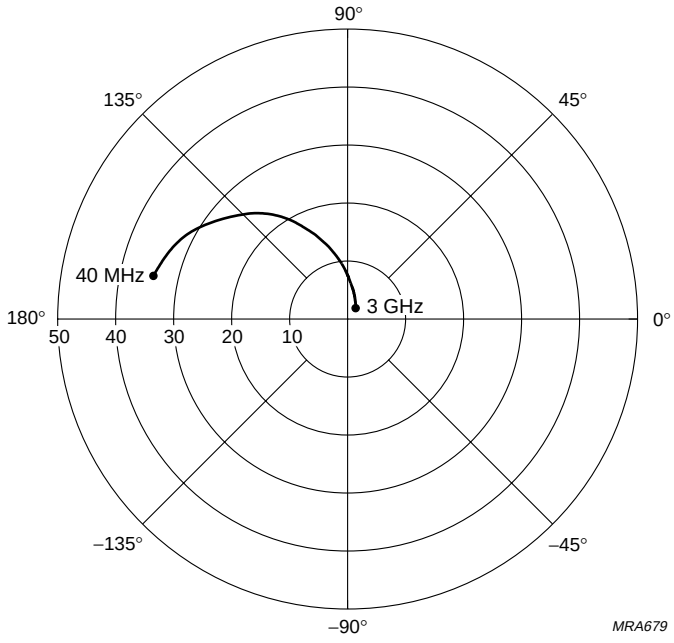

$I_C$ = 5 mA; $V_{CE}$ = 6 V;
f = 2 GHz; $Z_o$ = 50 Ω.

Fig.16 Noise circle figure.



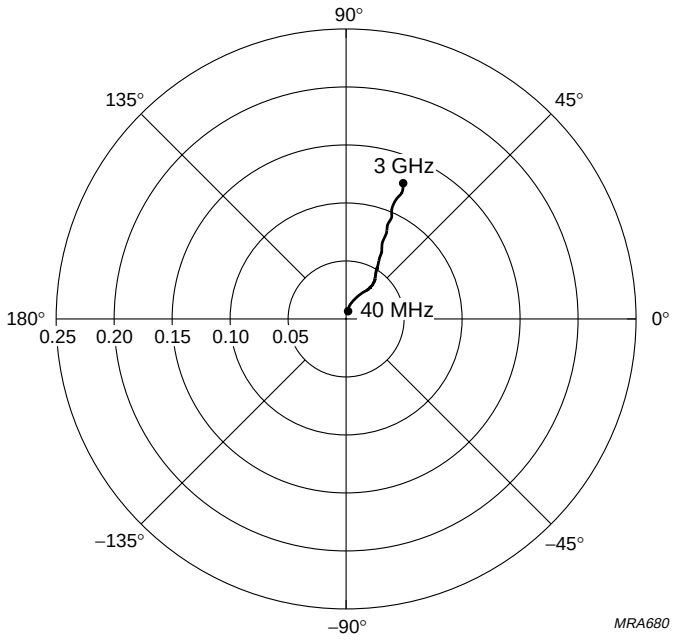

$I_C$ = 20 mA; $V_{CE}$ = 6 V.
$Z_o$ = 50 Ω.

Fig.17 Common emitter input reflection coefficient ($S_{11}$).



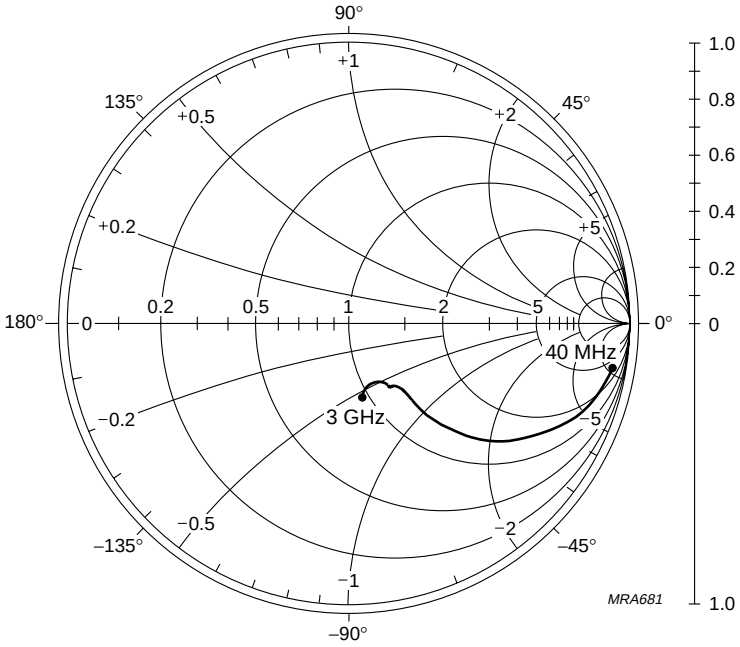

$I_C$ = 20 mA; $V_{CE}$ = 6 V.

Fig.18 Common emitter forward transmission coefficient ($S_{21}$).




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

Fig.19 Common emitter reverse transmission coefficient ($S_{12}$).

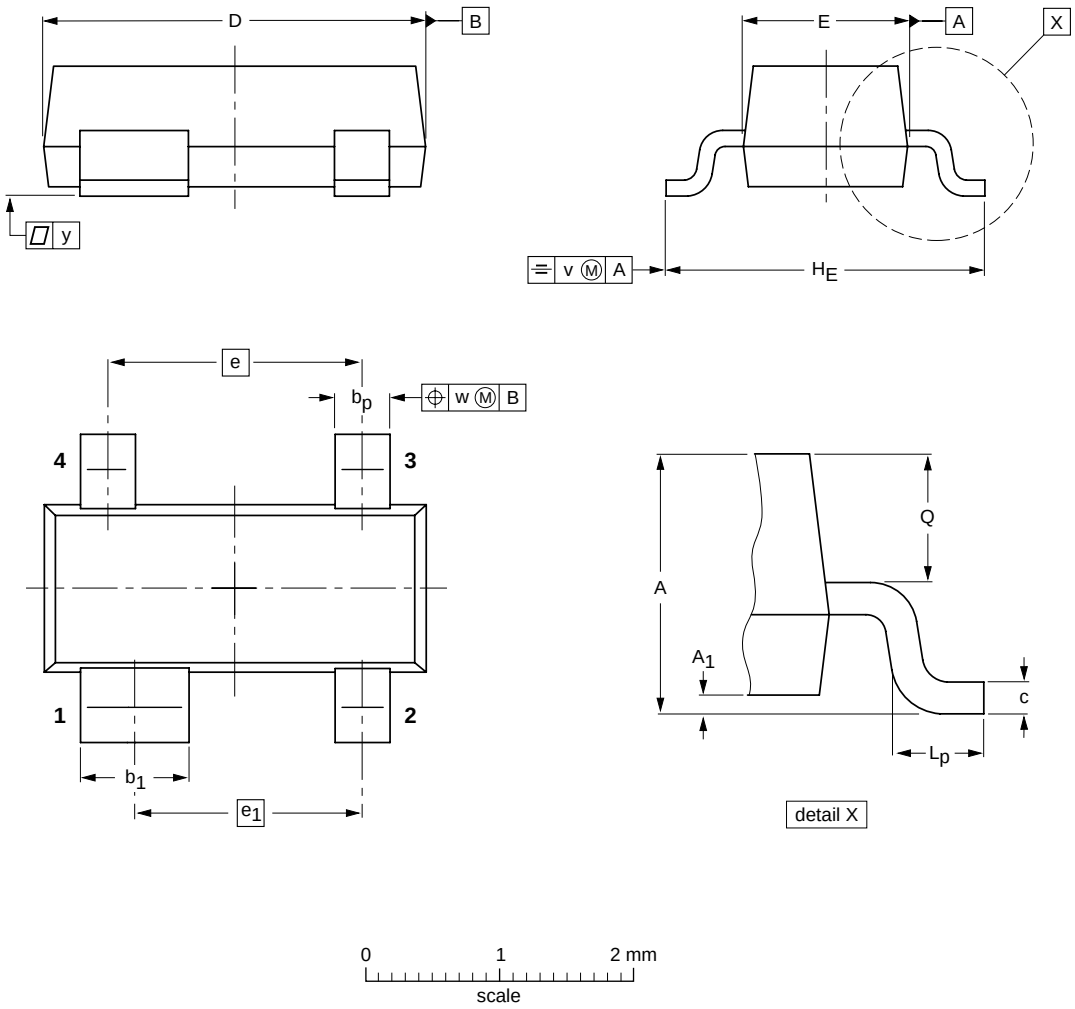



$I_C$ = 20 mA; $V_{CE}$ = 6 V.
$Z_o$ = 50 Ω.

Fig.20 Common emitter output reflection coefficient ($S_{22}$).

## PACKAGE OUTLINES

**Plastic surface mounted package; 4 leads** **SOT143B**

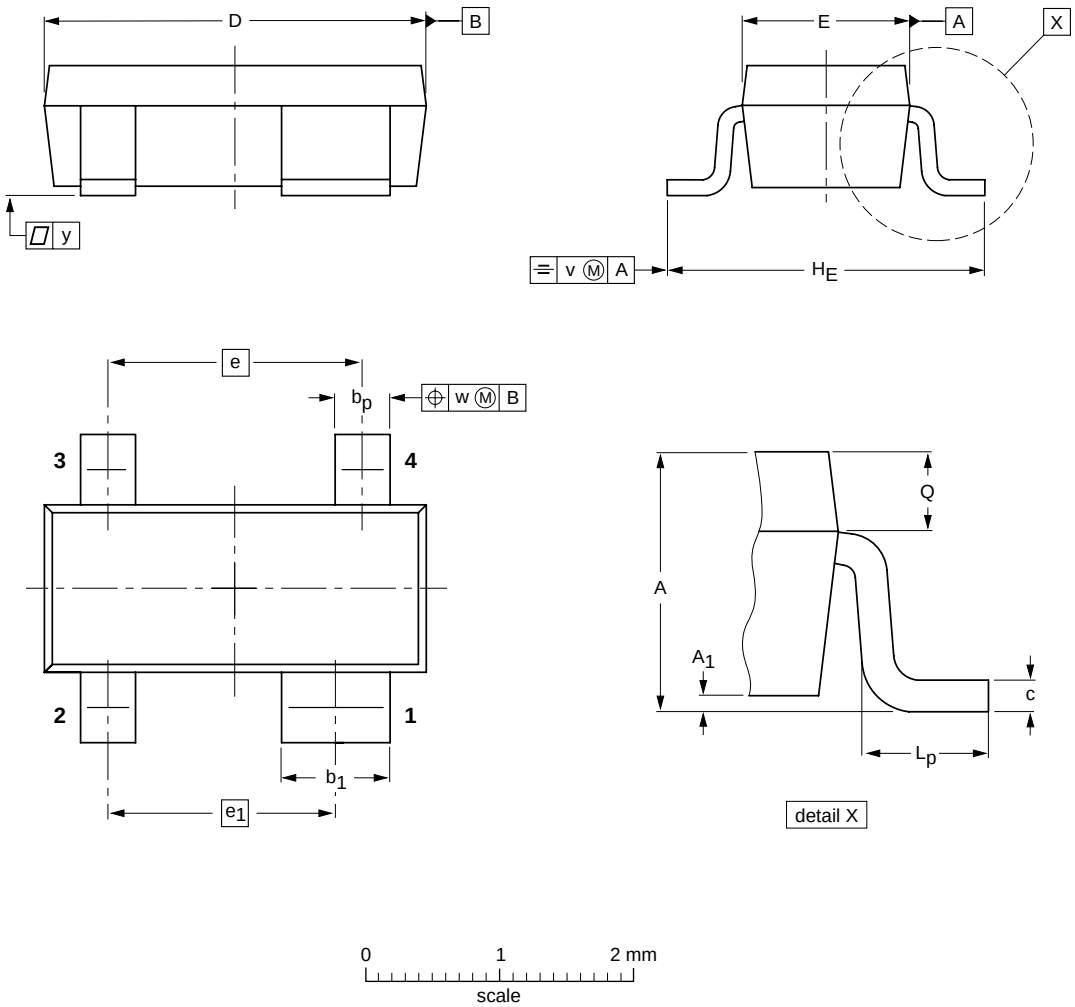



**DIMENSIONS (mm are the original dimensions)**

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

**Plastic surface mounted package; reverse pinning; 4 leads** **SOT143R**




**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<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 |