# DATA SHEET

# BFS25A
## NPN 5 GHz wideband transistor

Product specification
File under Discrete Semiconductors, SC14

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Philips Semiconductors

PHILIPS

# NPN 5 GHz wideband transistor BFS25A

## FEATURES

- Low current consumption
- Low noise figure
- Gold metallization ensures excellent reliability
- SOT323 envelope.

## DESCRIPTION

NPN transistor in a plastic SOT323 envelope.

It is designed for use in RF amplifiers and oscillators in pagers and pocket phones with signal frequencies up to 2 GHz.

## PINNING

| PIN | DESCRIPTION |
|---|---|
| Code: N6 | |
| 1 | base |
| 2 | emitter |
| 3 | collector |

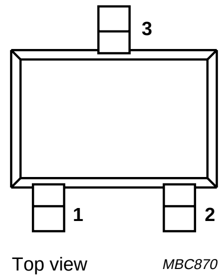



Fig.1 SOT323.

## QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $V_{CBO}$ | collector-base voltage | open emitter | – | – | 8 | V |
| $V_{CEO}$ | collector-emitter voltage | open base | – | – | 5 | V |
| $I_C$ | DC collector current | | – | – | 6.5 | mA |
| $P_{tot}$ | total power dissipation | up to $T_s$ = 170 °C; note 1 | – | – | 32 | mW |
| $h_{FE}$ | DC current gain | $I_C$ = 0.5 mA; $V_{CE}$ = 1 V; $T_j$ = 25 °C | 50 | 80 | 200 | |
| $f_T$ | transition frequency | $I_C$ = 1 mA; $V_{CE}$ = 1 V; f = 1 GHz; $T_{amb}$ = 25 °C | 3.5 | 5 | – | GHz |
| $G_{UM}$ | maximum unilateral power gain | $I_c$ = 0.5 mA; $V_{CE}$ = 1 V; f = 1 GHz; $T_{amb}$ = 25 °C | – | 13 | – | dB |
| F | noise figure | $I_c$ = 0.5 mA; $V_{CE}$ = 1 V; f = 1 GHz; $T_{amb}$ = 25 °C | – | 1.8 | – | 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 | – | 8 | V |
| $V_{CEO}$ | collector-emitter voltage | open base | – | 5 | V |
| $V_{EBO}$ | emitter-base voltage | open collector | – | 2 | V |
| $I_C$ | DC collector current | | – | 6.5 | mA |
| $P_{tot}$ | total power dissipation | up to $T_s$ = 170 °C; note 1 | – | 32 | 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 tab.

## THERMAL RESISTANCE

| SYMBOL | PARAMETER | CONDITIONS | THERMAL RESISTANCE |
|---|---|---|---|
| $R_{th\ j\text{-}s}$ | thermal resistance from junction to soldering point | up to $T_s$ = 170 °C; note 1 | 190 K/W |

**Note**

1. $T_s$ is the temperature at the soldering point of the collector tab.

## CHARACTERISTICS

$T_j$ = 25 °C, unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $I_{CBO}$ | collector cut-off current | $I_E$ = 0; $V_{CB}$ = 5 V | – | – | 50 | nA |
| $h_{FE}$ | DC current gain | $I_C$ = 0.5 mA; $V_{CE}$ = 1 V | 50 | 80 | 200 | |
| $C_{re}$ | feedback capacitance | $I_C$ = 0; $V_{CB}$ = 1 V; f = 1 MHz | – | 0.3 | 0.45 | pF |
| $f_T$ | transition frequency | $I_C$ = 1 mA; $V_{CE}$ = 1 V; f = 1 GHz; $T_{amb}$ = 25 °C | 3.5 | 5 | – | GHz |
| $G_{UM}$ | maximum unilateral power gain (note 1) | $I_C$ = 0.5 mA; $V_{CE}$ = 1 V; f = 1 GHz; $T_{amb}$ = 25 °C | – | 13 | – | dB |
| F | noise figure | $\Gamma_s = \Gamma_{opt}$; $I_C$ = 0.5 mA; $V_{CE}$ = 1 V; f = 1 GHz; $T_{amb}$ = 25 °C | – | 1.8 | – | dB |
| | | $\Gamma_s = \Gamma_{opt}$; $I_C$ = 1 mA; $V_{CE}$ = 1 V; f = 1 GHz; $T_{amb}$ = 25 °C | – | 2 | – | dB |

**Note**

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

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

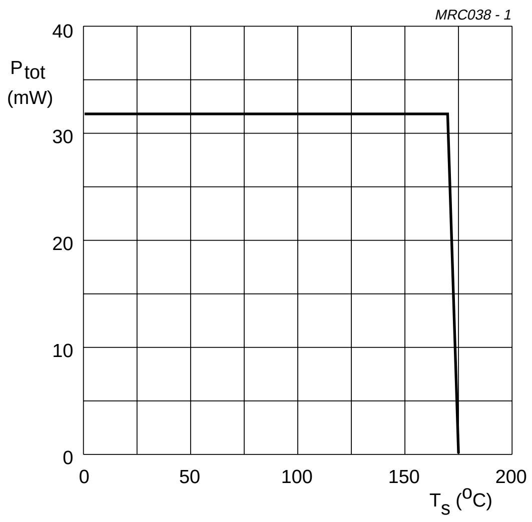
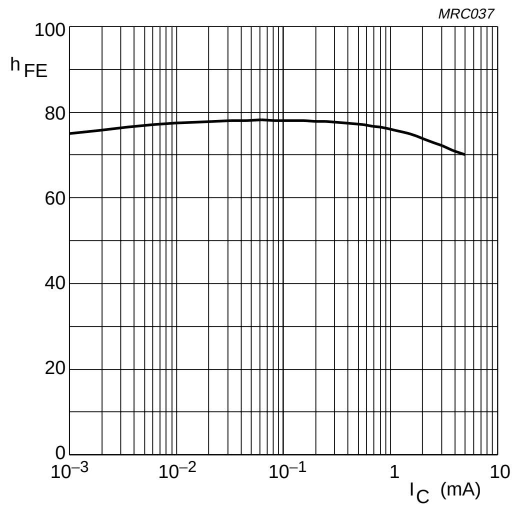
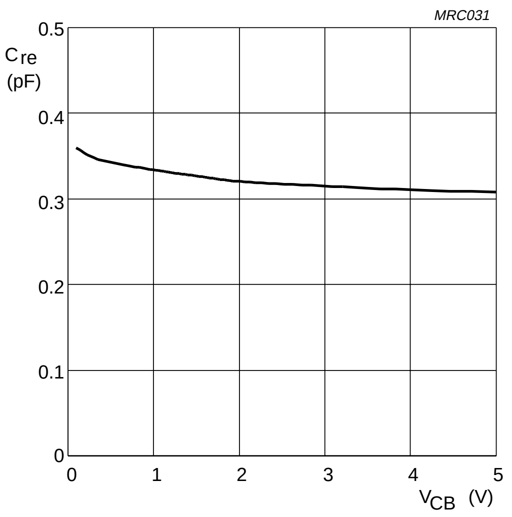



Fig.2 Power derating curve.



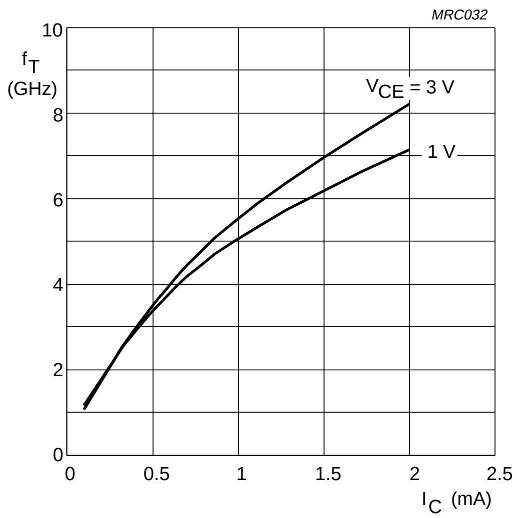

$V_{CE}$ = 1 V; $T_j$ = 25 °C.

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




$I_C$ = 0; f = 1 MHz.

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




f = 1 GHz; $T_{amb}$ = 25 °C.

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

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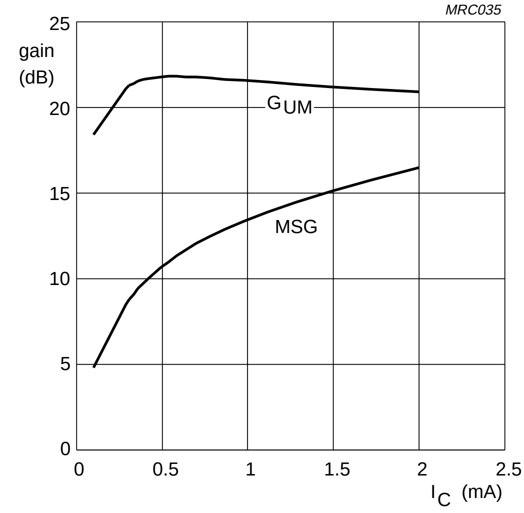
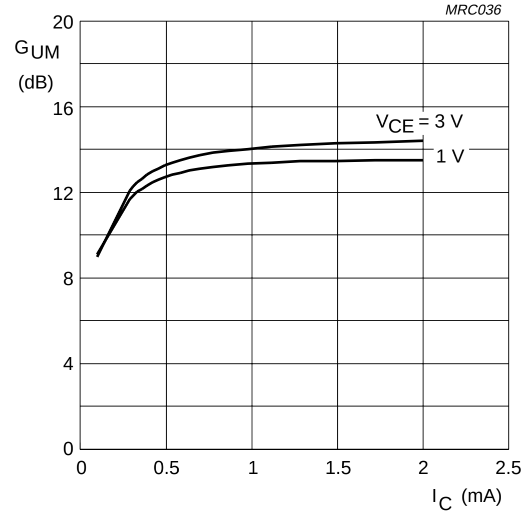
In Figs 6 to 9, $G_{UM}$ = maximum unilateral power gain; MSG = maximum stable gain; $G_{max}$ = maximum available gain.



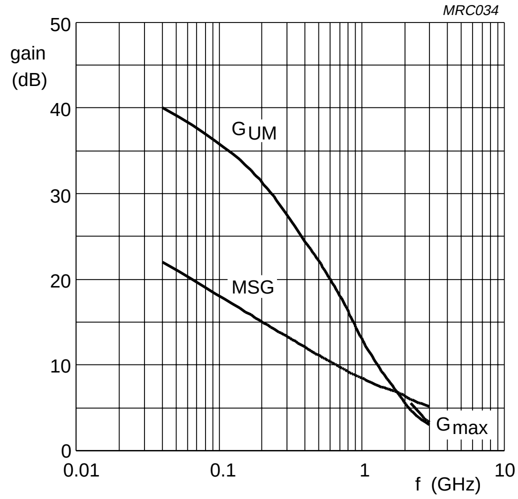

$V_{CE}$ = 1 V; f = 500 MHz; $T_{amb}$ = 25 °C.

Fig.6 Gain as a function of collector current.



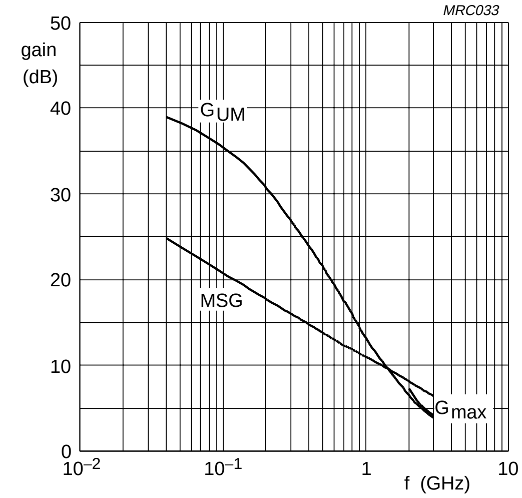

f = 1 GHz; $T_{amb}$ = 25 °C.

Fig.7 Maximum unilateral power gain as a function of collector current.



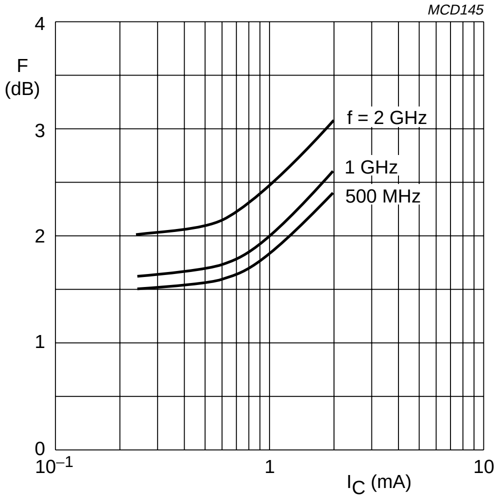

$I_C$ = 0.5 mA; $V_{CE}$ = 1 V; $T_{amb}$ = 25 °C.

Fig.8 Gain as a function of frequency.



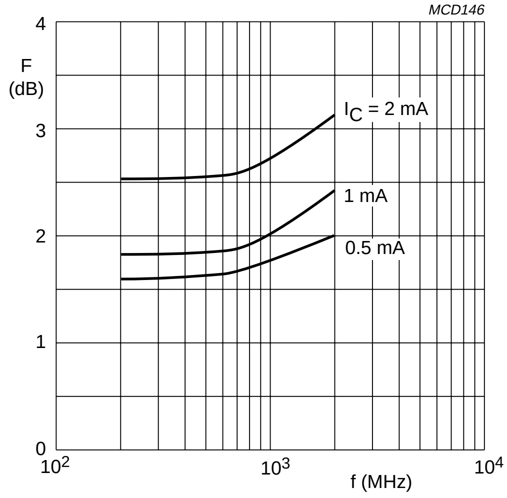

$I_C$ = 1 mA; $V_{CE}$ = 1 V; $T_{amb}$ = 25 °C.

Fig.9 Gain as a function of frequency.



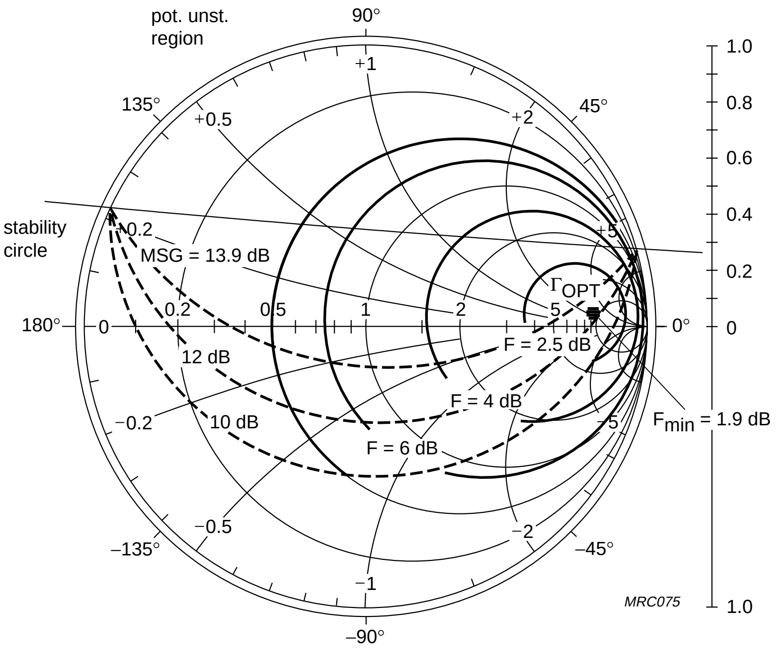

$V_{CE}$ = 1 V; $T_{amb}$ = 25 °C.

Fig.10 Minimum noise figure as a function of collector current.



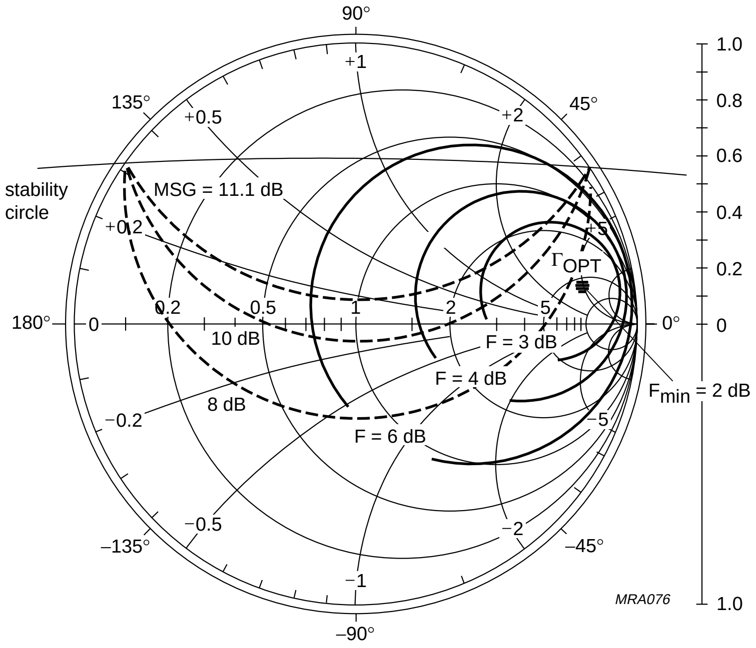

$V_{CE}$ = 1 V; $T_{amb}$ = 25 °C.

Fig.11 Minimum noise figure as a function of frequency.



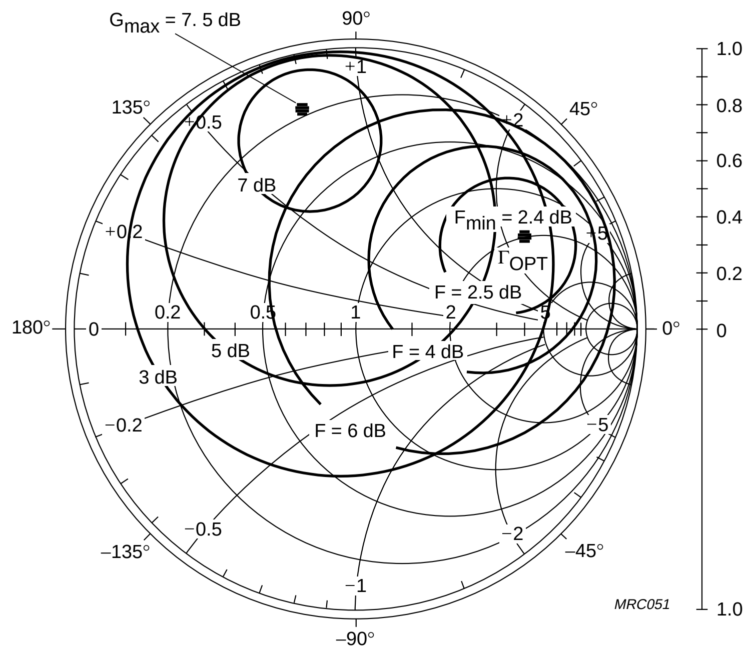

$I_C$ = 1 mA; $V_{CE}$ = 1 V;
f = 500 MHz; $Z_o$ = 50 Ω.

Fig.12 Noise circle.



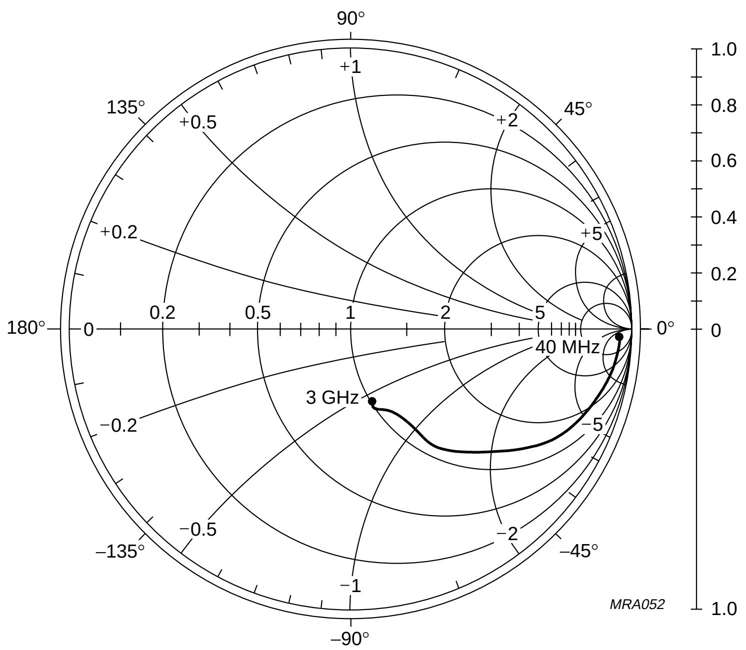

$I_C$ = 1 mA; $V_{CE}$ = 1 V;
f = 1 GHz; $Z_o$ = 50 Ω.

Fig.13 Noise circle.



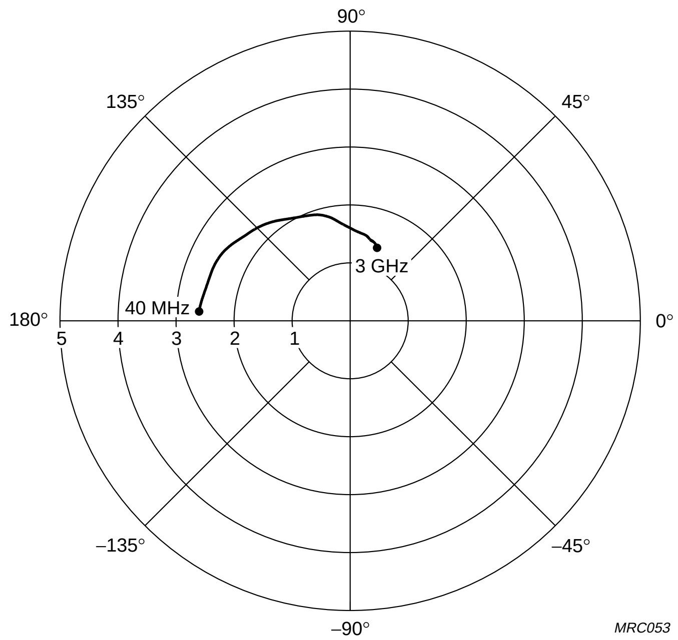

$I_C$ = 1 mA; $V_{CE}$ = 1 V;
f = 2 GHz; $Z_o$ = 50 Ω.

Fig.14 Noise circle.



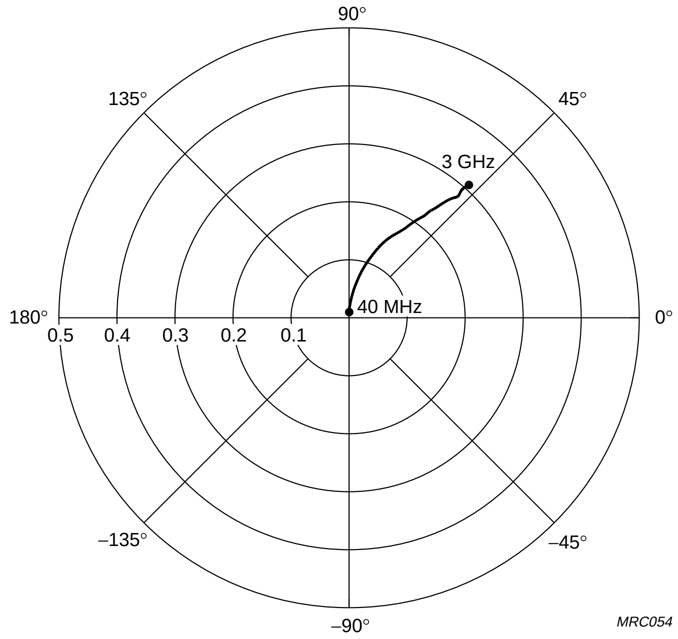

$I_C$ = 1 mA; $V_{CE}$ = 1 V;
$Z_o$ = 50 Ω.

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



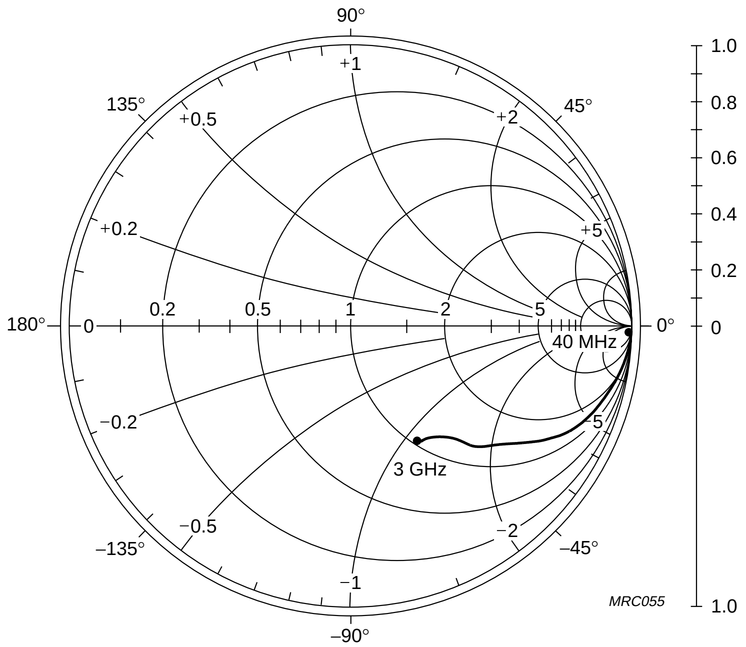

$I_C$ = 1 mA; $V_{CE}$ = 1 V.

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




$I_C$ = 1 mA; $V_{CE}$ = 1 V.

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

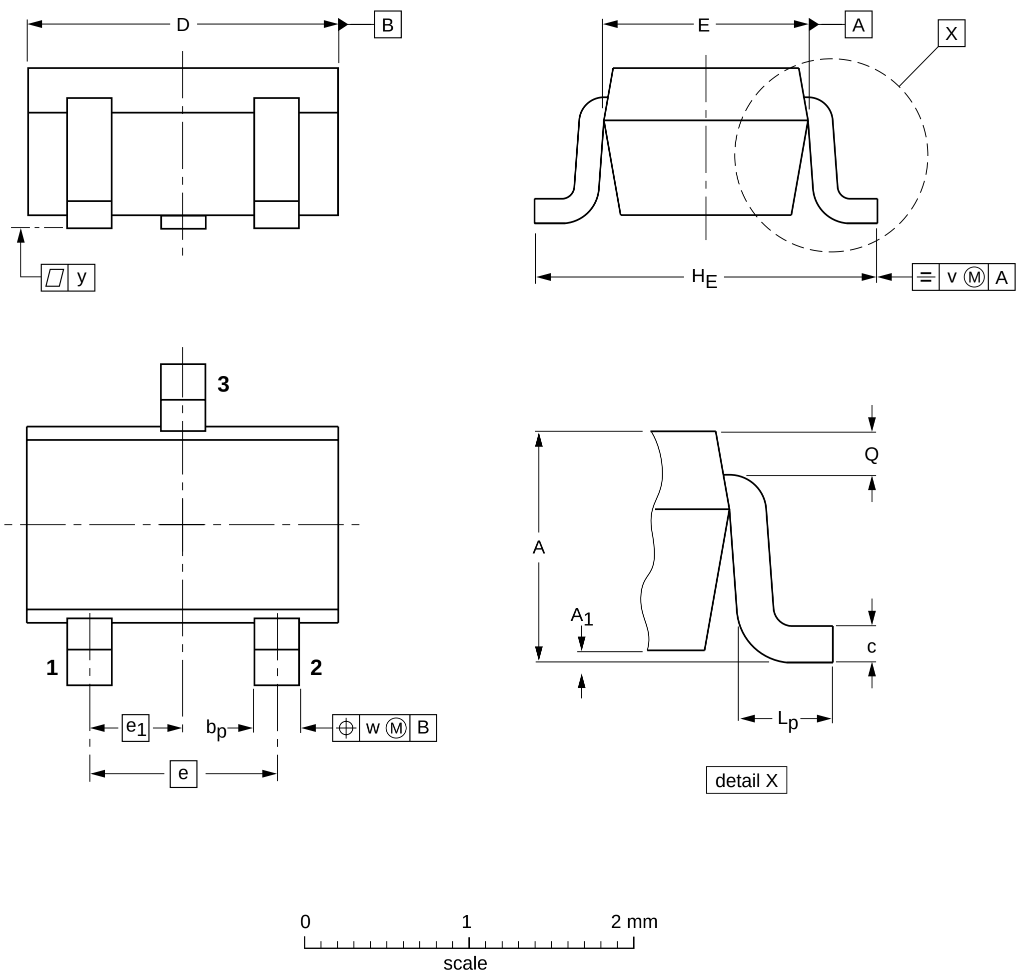



$I_C$ = 1 mA; $V_{CE}$ = 1 V;
$Z_o$ = 50 Ω.

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

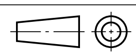
## PACKAGE OUTLINE

**Plastic surface mounted package; 3 leads** **SOT323**




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

| UNIT | A | $A_1$ max | $b_p$ | c | D | E | e | $e_1$ | $H_E$ | $L_p$ | Q | v | w |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1<br>0.8 | 0.1 | 0.4<br>0.3 | 0.25<br>0.10 | 2.2<br>1.8 | 1.35<br>1.15 | 1.3 | 0.65 | 2.2<br>2.0 | 0.45<br>0.15 | 0.23<br>0.13 | 0.2 | 0.2 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT323 | | | SC-70 | |  | 97-02-28 |

## DEFINITIONS

| Data Sheet Status | |
|---|---|
| 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. |
| **Limiting values** | |
| 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. | |
| **Application information** | |
| Where application information is given, it is advisory and does not form part of the specification. | |

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