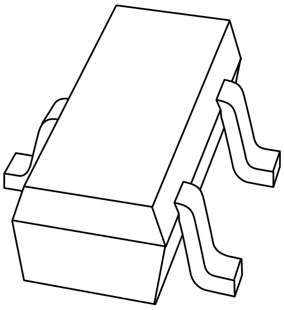
# DATA SHEET



# BFR505T
## NPN 9 GHz wideband transistor

Product specification 2000 May 17
Supersedes data of 2000 Mar 14

Philips
Semiconductors

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# NPN 9 GHz wideband transistor BFR505T

## FEATURES

- Low current consumption
- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability
- SOT416 (SC-75) package.

## APPLICATIONS

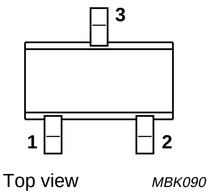
Low power amplifiers, oscillators and mixers particularly in RF portable communication equipment (cellular phones, cordless phones and pagers) up to 2 GHz.

## DESCRIPTION

NPN transistor in a plastic SOT416 (SC-75) package.

## PINNING

| PIN | DESCRIPTION |
|---|---|
| 1 | base |
| 2 | emitter |
| 3 | collector |




**Marking code:** N0.

Fig.1 SOT416.

## 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 |
| $I_C$ | DC collector current | | – | – | 18 | mA |
| $P_{tot}$ | total power dissipation | $T_s \leq 75$ °C; note 1 | – | – | 150 | mW |
| $h_{FE}$ | DC current gain | $I_C = 5$ mA; $V_{CE} = 6$ V; $T_j = 25$ °C | 60 | 120 | 250 | |
| $f_T$ | transition frequency | $I_C = 5$ mA; $V_{CE} = 6$ V; f = 1 GHz; $T_{amb} = 25$ °C | – | 9 | – | GHz |
| $G_{UM}$ | maximum unilateral power gain | $I_C = 5$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C | – | 17 | – | dB |
| F | noise figure | $I_C = 1.25$ mA; $V_{CE} = 6$ V; f = 900 MHz; $T_{amb} = 25$ °C | – | 1.2 | 1.7 | dB |

## LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 60134).

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{CBO}$ | collector-base voltage | open emitter | – | 20 | V |
| $V_{CE}$ | collector-emitter voltage | $R_{BE} = 0$ | – | 15 | V |
| $V_{EBO}$ | emitter-base voltage | open collector | – | 2.5 | V |
| $I_C$ | DC collector current | | – | 18 | mA |
| $P_{tot}$ | total power dissipation | $T_s \leq 75$ °C; note 1 | – | 150 | mW |
| $T_{stg}$ | storage temperature | | –65 | +150 | °C |
| $T_j$ | junction temperature | | – | 150 | °C |

**Note**

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

### THERMAL RESISTANCE

| SYMBOL | PARAMETER | VALUE | UNIT |
|---|---|---|---|
| $R_{th\ j\text{-}s}$ | thermal resistance from junction to soldering point | 500 | K/W |

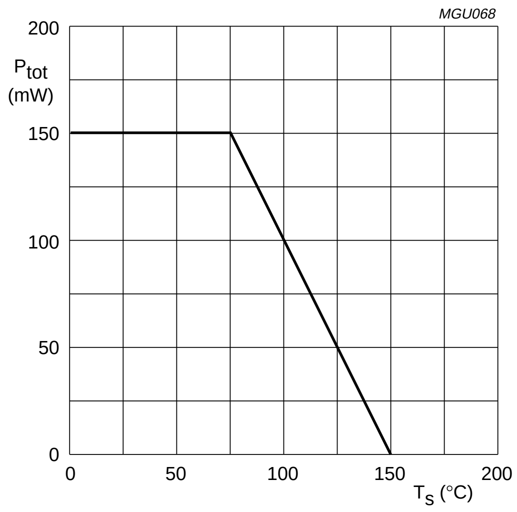



Fig.2 Power derating curve.

## CHARACTERISTICS

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

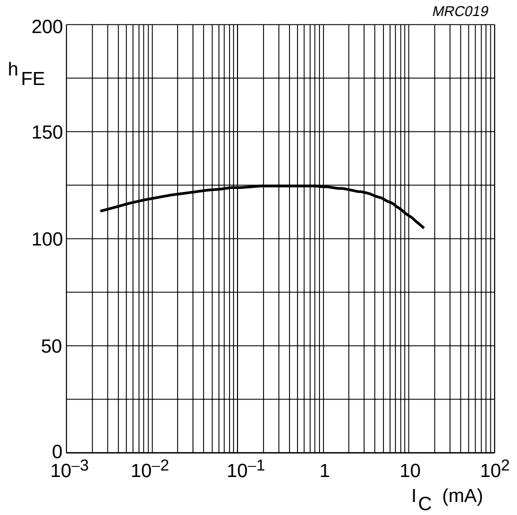
| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $I_{CBO}$ | collector cut-off current | $I_E$ = 0; $V_{CB}$ = 6 V | – | – | 50 | nA |
| $h_{FE}$ | DC current gain | $I_C$ = 5 mA; $V_{CE}$ = 6 V | 60 | 120 | 250 | |
| $C_c$ | collector capacitance | $I_E = i_e$ = 0; $V_{CB}$ = 6 V; f = 1 MHz | – | 0.4 | – | pF |
| $C_e$ | emitter capacitance | $I_C = i_c$ = 0; $V_{EB}$ = 0.5 V; f = 1 MHz | – | 0.4 | – | pF |
| $C_{re}$ | feedback capacitance | $I_C$ = 0; $V_{CB}$ = 6 V; f = 1 MHz | – | 0.3 | – | pF |
| $f_T$ | transition frequency | $I_C$ = 5 mA; $V_{CE}$ = 6 V; f = 1 GHz; $T_{amb}$ = 25 °C | – | 9 | – | GHz |
| $G_{UM}$ | maximum unilateral power gain; note 1 | $I_C$ = 5 mA; $V_{CE}$ = 6 V; $T_{amb}$ = 25 °C; | | | | |
| | | f = 900 MHz | – | 17 | – | dB |
| | | f = 2 GHz | – | 10 | – | dB |
| $\|S_{21}\|^2$ | insertion power gain | $I_C$ = 5 mA; $V_{CE}$ = 6 V; f = 900 MHz; $T_{amb}$ = 25 °C | 13 | 14 | – | dB |
| F | noise figure | $\Gamma_s = \Gamma_{opt}$; $I_C$ = 1.25 mA; $V_{CE}$ = 6 V; f = 900 MHz; $T_{amb}$ = 25 °C | – | 1.2 | 1.7 | dB |
| | | $\Gamma_s = \Gamma_{opt}$; $I_C$ = 5 mA; $V_{CE}$ = 6 V; f = 900 MHz; $T_{amb}$ = 25 °C | – | 1.6 | 2.1 | dB |
| | | $\Gamma_s = \Gamma_{opt}$; $I_C$ = 1.25 mA; $V_{CE}$ = 6 V; f = 2 GHz; $T_{amb}$ = 25 °C | – | 1.9 | – | dB |
| $P_{L1}$ | output power at 1 dB gain compression | $I_C$ = 5 mA; $V_{CE}$ = 6 V; $R_L$ = 50 Ω; f = 900 MHz; $T_{amb}$ = 25 °C | – | 4 | – | dBm |
| ITO | third-order intercept point | note 2 | – | 10 | – | dBm |

**Notes**

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

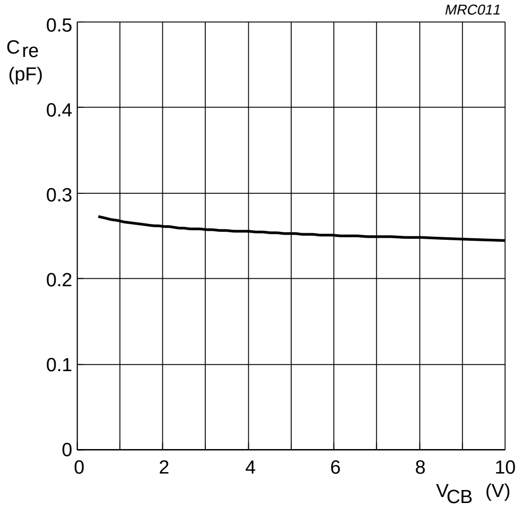
$$G_{UM} = 10 \log \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)} \text{ dB}$$

2. $I_C$ = 5 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 at $f_{(2q-p)}$ = 904 MHz.



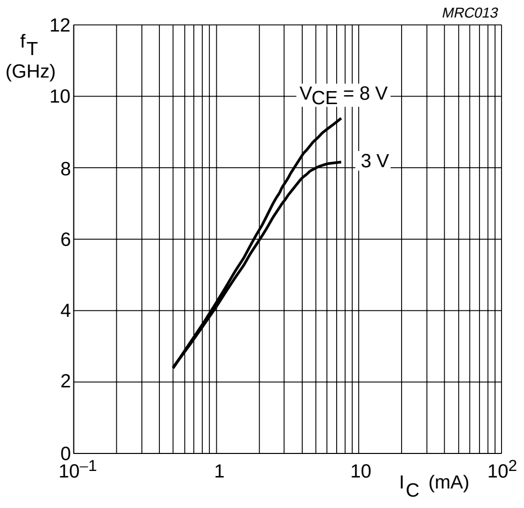

$V_{CE}$ = 6 V; $T_j$ = 25 °C.

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




$I_C$ = 0; f = 1 MHz.

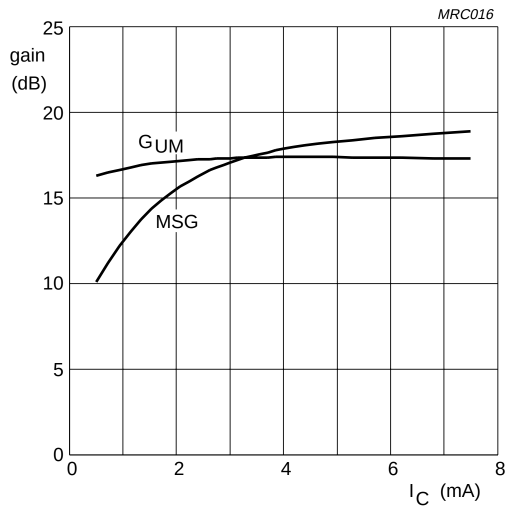
Fig.4 Feedback capacitance as a function of collector-base voltage.




f = 1 GHz; $T_{amb}$ = 25 °C.

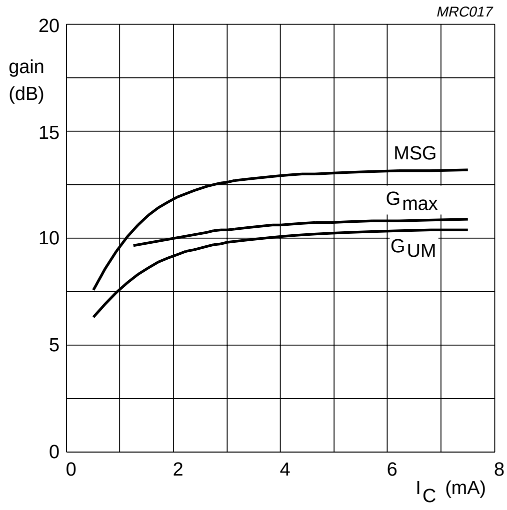
Fig.5 Transition frequency as a function of collector current.

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



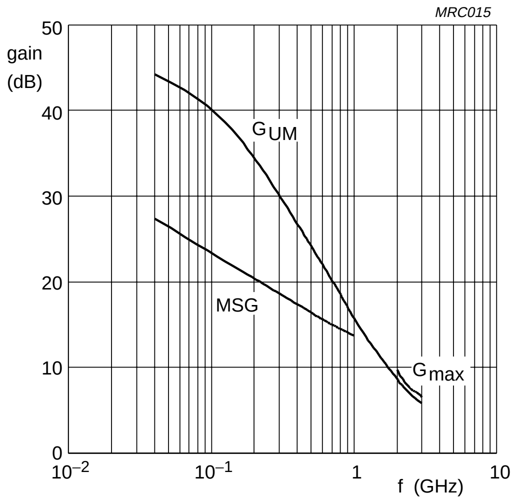

$V_{CE}$ = 6 V; f = 900 MHz; $T_{amb}$ = 25 °C.

Fig.6 Gain as a function of collector current.



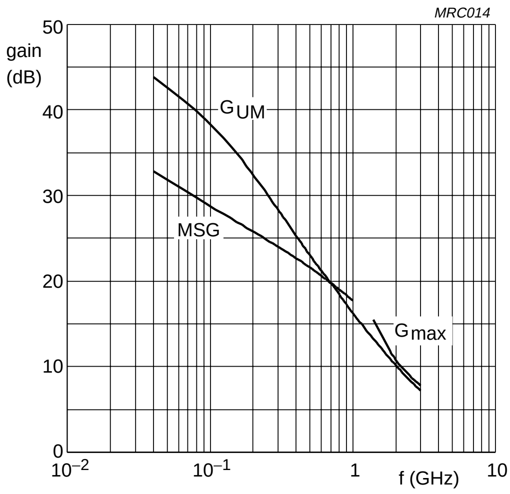

$V_{CE}$ = 6 V; f = 2 GHz; $T_{amb}$ = 25 °C.

Fig.7 Gain as a function of collector current.



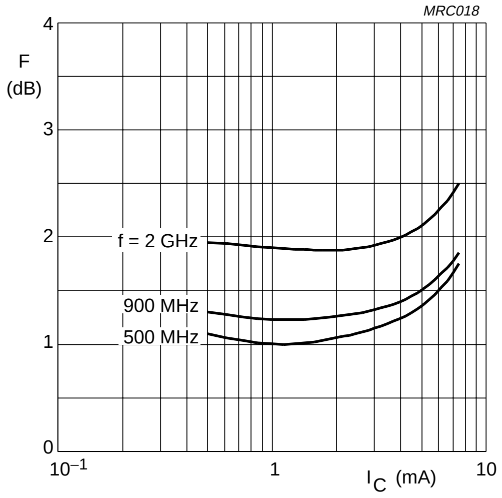

$I_C$ = 1.25 mA; $V_{CE}$ = 6 V; $T_{amb}$ = 25 °C.

Fig.8 Gain as a function of frequency.



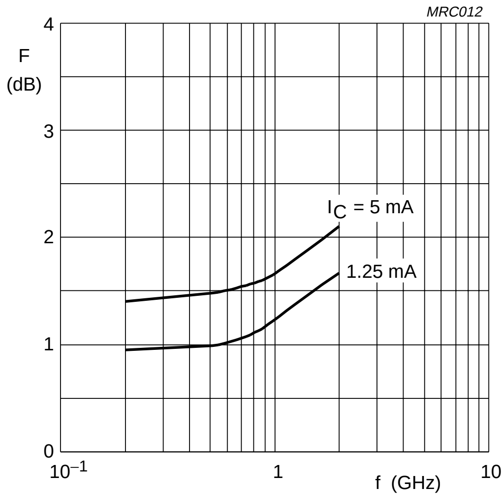

$I_C$ = 5 mA; $V_{CE}$ = 6 V; $T_{amb}$ = 25 °C.

Fig.9 Gain as a function of frequency.



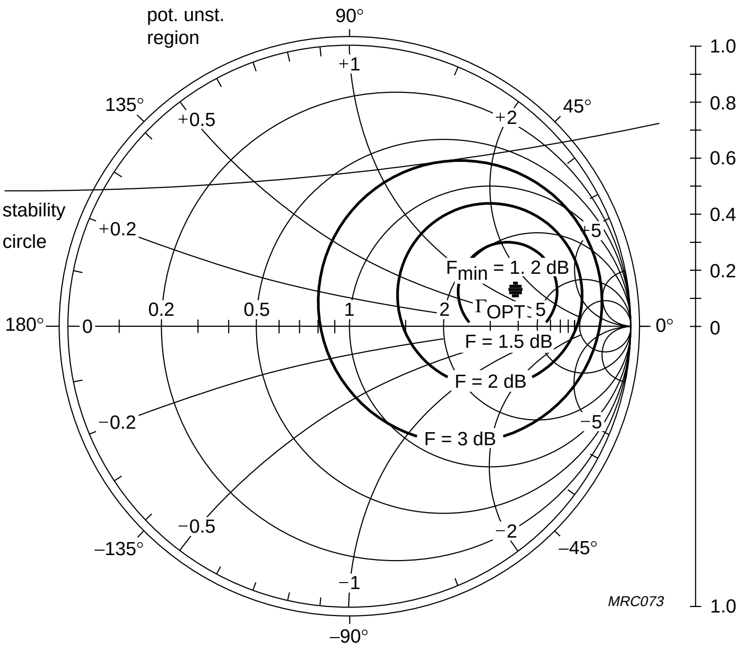

$V_{CE}$ = 6 V; $T_{amb}$ = 25 °C.

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



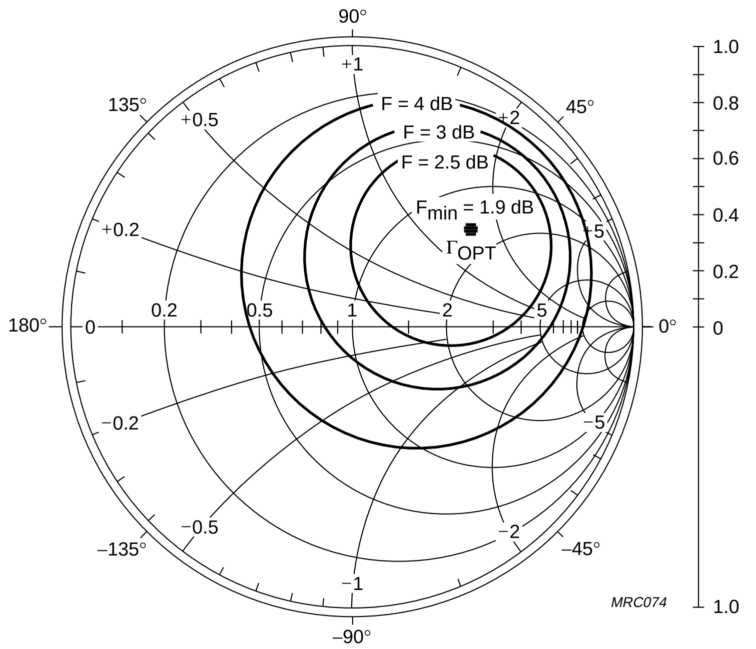

$V_{CE}$ = 6 V; $T_{amb}$ = 25 °C.

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



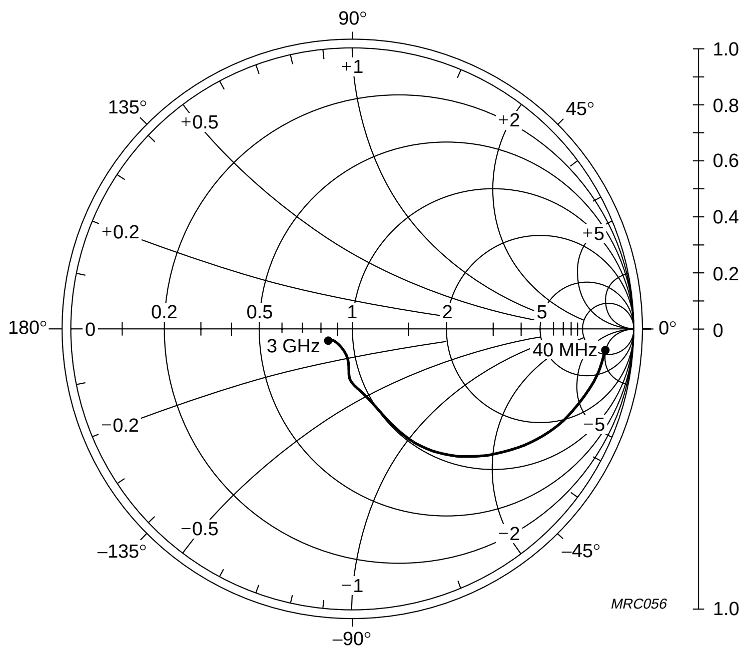

$I_C$ = 1.25 mA; $V_{CE}$ = 6 V;
f = 900 MHz; $Z_o$ = 50 Ω.

Fig.12 Noise circle.



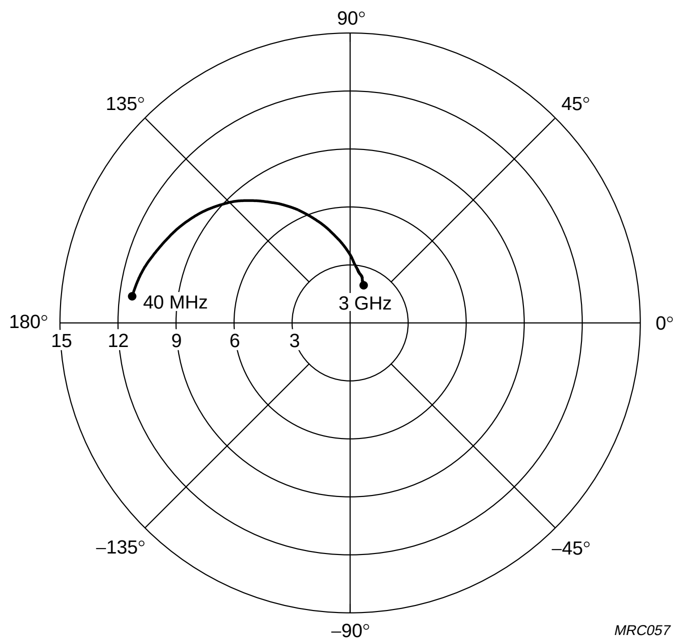

$I_C$ = 1.25 mA; $V_{CE}$ = 6 V;
f = 2 GHz; $Z_o$ = 50 Ω.

Fig.13 Noise circle.



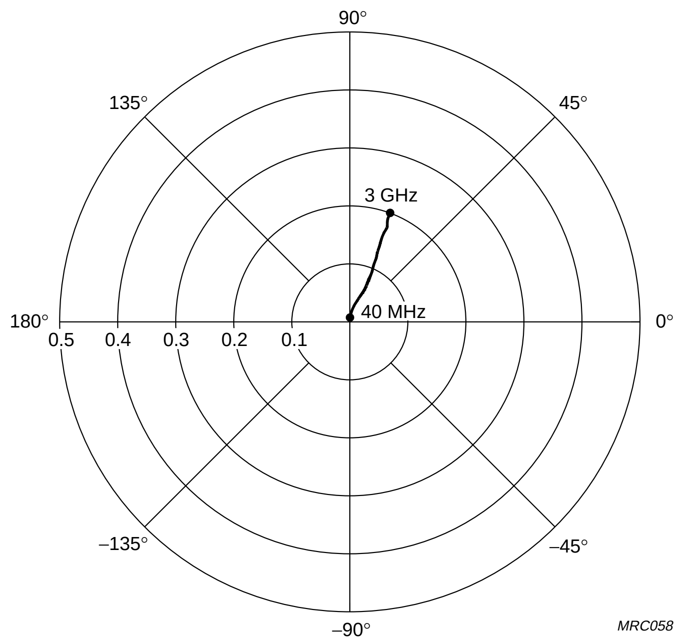

$I_C$ = 5 mA; $V_{CE}$ = 6 V;
$Z_o$ = 50 Ω.

Fig.14 Common emitter input reflection coefficient ($S_{11}$).



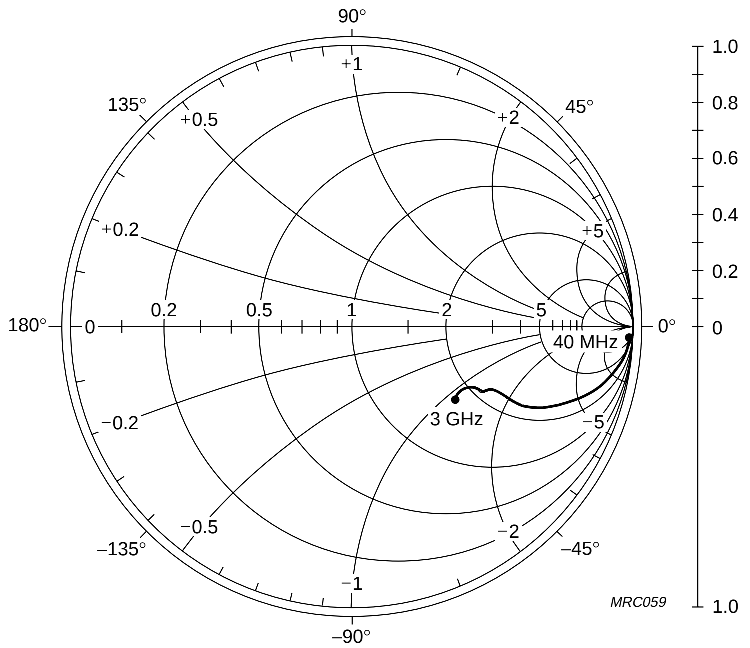

$I_C$ = 5 mA; $V_{CE}$ = 6 V.

Fig.15 Common emitter forward transmission coefficient ($S_{21}$).




$I_C$ = 5 mA; $V_{CE}$ = 6 V.

Fig.16 Common emitter reverse transmission coefficient ($S_{12}$).

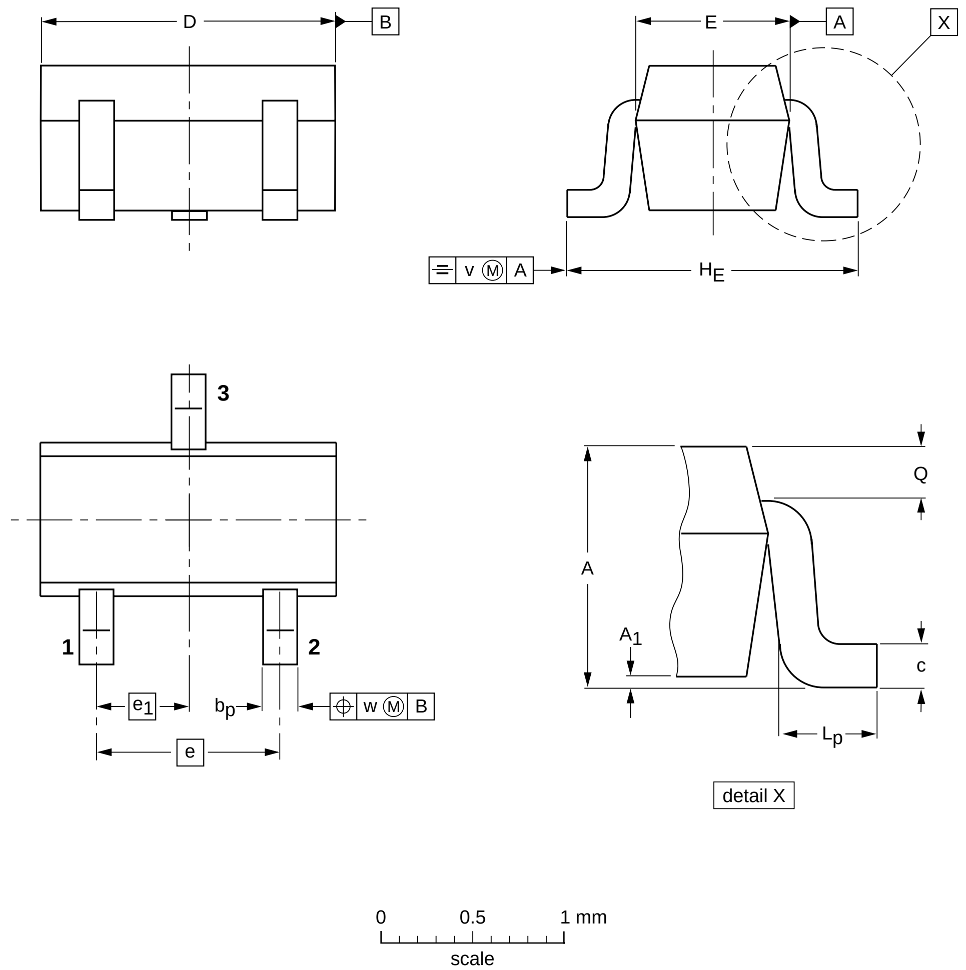



$I_C$ = 5 mA; $V_{CE}$ = 6 V;
$Z_o$ = 50 Ω.

Fig.17 Common emitter output reflection coefficient ($S_{22}$).

## PACKAGE OUTLINE

**Plastic surface mounted package; 3 leads** **SOT416**




**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 | 0.95<br>0.60 | 0.1 | 0.30<br>0.15 | 0.25<br>0.10 | 1.8<br>1.4 | 0.9<br>0.7 | 1 | 0.5 | 1.75<br>1.45 | 0.45<br>0.15 | 0.23<br>0.13 | 0.2 | 0.2 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT416 | | | SC-75 | | | 97-02-28 |

## DATA SHEET STATUS

| DATA SHEET STATUS | PRODUCT STATUS | DEFINITIONS [1] |
|---|---|---|
| Objective specification | Development | This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice. |
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**Note**

1. Please consult the most recently issued data sheet before initiating or completing a design.

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