# DATA SHEET

## BFR106
NPN 5 GHz wideband transistor

Product specification

September 1995

# NPN 5 GHz wideband transistor BFR106

## DESCRIPTION

NPN silicon planar epitaxial transistor in a plastic SOT23 envelope. It is primarily intended for low noise, general RF applications.

## PINNING

| PIN | DESCRIPTION |
|---|---|
| Code: R7p | |
| 1 | base |
| 2 | emitter |
| 3 | collector |

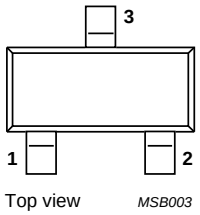



Fig.1 SOT23.

## 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 | | – | – | 100 | mA |
| $P_{tot}$ | total power dissipation | up to $T_s$ = 70 °C; note 1 | – | – | 500 | mW |
| $h_{FE}$ | DC current gain | $I_C$ = 50 mA; $V_{CE}$ = 9 V; $T_{amb}$ = 25 °C | 25 | 80 | – | |
| $f_T$ | transition frequency | $I_C$ = 50 mA; $V_{CE}$ = 9 V; f = 500 MHz; $T_{amb}$ = 25 °C | – | 5 | – | GHz |
| $G_{UM}$ | maximum unilateral power gain | $I_C$ = 30 mA; $V_{CE}$ = 6 V; f = 800 MHz; $T_{amb}$ = 25 °C | – | 11.5 | – | dB |
| $V_o$ | output voltage | $I_C$ = 50 mA; $V_{CE}$ = 9 V; $R_L$ = 75 Ω; $T_{amb}$ = 25 °C; $d_{im}$ = −60 dB; $f_{(p+q-r)}$ = 793.25 MHz | – | 350 | – | mV |

## 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 | – | 3 | V |
| $I_C$ | DC collector current | | – | 100 | mA |
| $P_{tot}$ | total power dissipation | up to $T_s$ = 70 °C; 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 tab.

## THERMAL RESISTANCE

| SYMBOL | PARAMETER | CONDITIONS | THERMAL RESISTANCE |
|---|---|---|---|
| $R_{th\ j\text{-}s}$ | thermal resistance from junction to soldering point | up to $T_s$ = 70 °C; note 1 | 210 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; $V_{CB}$ = 10 V | – | – | 100 | nA |
| $h_{FE}$ | DC current gain | $I_C$ = 50 mA; $V_{CE}$ = 9 V | 25 | 80 | – | |
| $f_T$ | transition frequency | $I_C$ = 50 mA; $V_{CE}$ = 9 V; f = 500 MHz; $T_{amb}$ = 25 °C | – | 5 | – | GHz |
| $C_c$ | collector capacitance | $I_E = i_e$ = 0; $V_{CB}$ = 10 V; f = 1 MHz | – | 1.5 | – | pF |
| $C_e$ | emitter capacitance | $I_C = i_c$ = 0; $V_{EB}$ = 0.5 V; f = 1 MHz | – | 4.5 | – | pF |
| $C_{re}$ | feedback capacitance | $I_C$ = 0; $V_{CE}$ = 10 V; f = 1 MHz | – | 1.2 | – | pF |
| $G_{UM}$ | maximum unilateral power gain (note 1) | $I_C$ = 30 mA; $V_{CE}$ = 6 V; f = 800 MHz; $T_{amb}$ = 25 °C | – | 11.5 | – | dB |
| F | noise figure | $I_C$ = 30 mA; $V_{CE}$ = 6 V; f = 800 MHz; $T_{amb}$ = 25 °C | – | 3.5 | – | dB |
| $d_2$ | second order intermodulation distortion | note 2 | – | –50 | – | dB |
| $V_o$ | output voltage | note 3 | – | 350 | – | mV |

**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. $I_C$ = 30 mA; $V_{CE}$ = 6 V; $R_L$ = 75 Ω; $T_{amb}$ = 25 °C; $f_{(p+q)}$ = 810 MHz; $V_o$ = 100 mV.
3. $d_{im}$ = −60 dB (DIN 45004B); $I_C$ = 50 mA; $V_{CE}$ = 9 V; $R_L$ = 75 Ω; $T_{amb}$ = 25 °C; $f_{(p+q-r)}$ = 793.25 MHz.

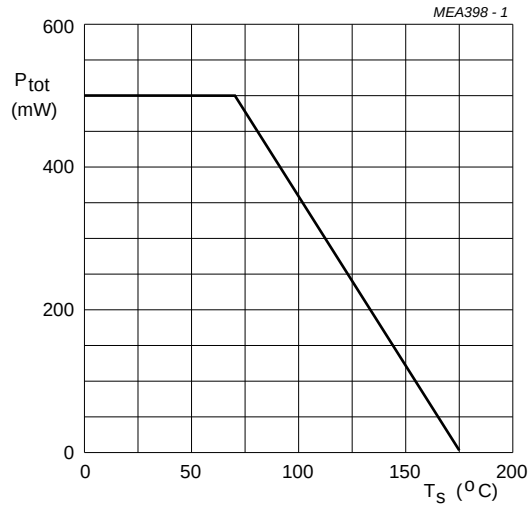
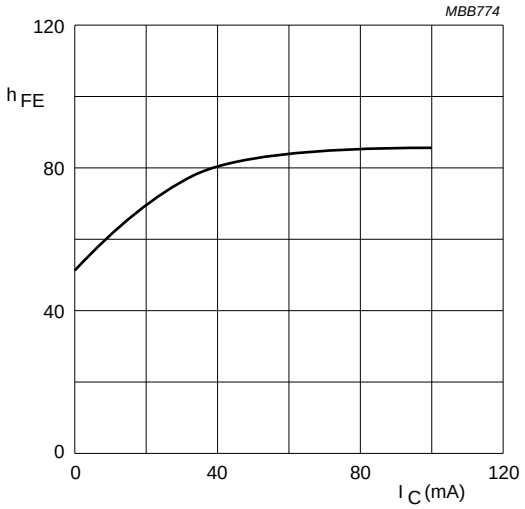
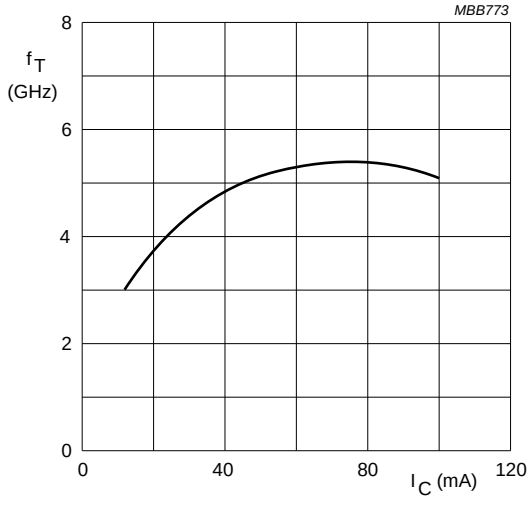



Fig.2 Power derating curve.



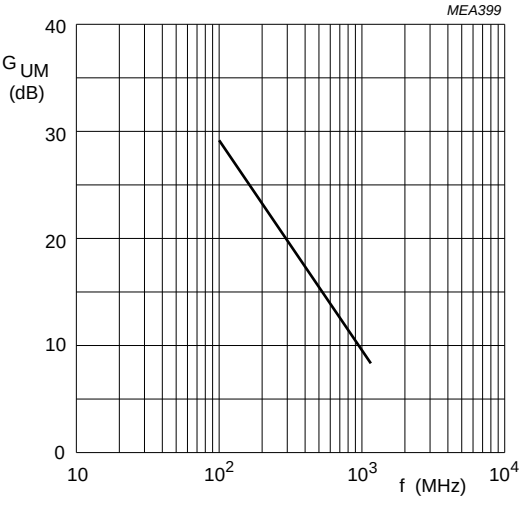

$V_{CE}$ = 9 V; $T_{amb}$ = 25 °C.

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



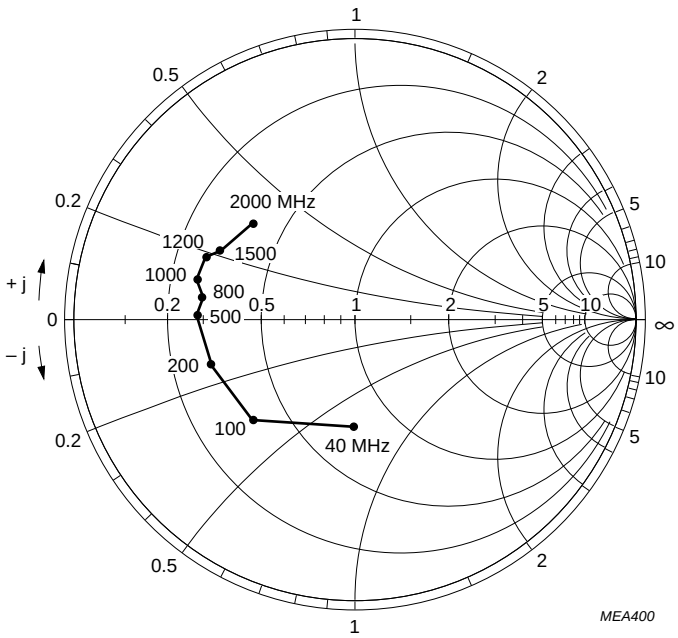

$V_{CE}$ = 9 V; f = 500 MHz; $T_j$ = 25 °C.

Fig.4 Transition frequency as a function of collector current.



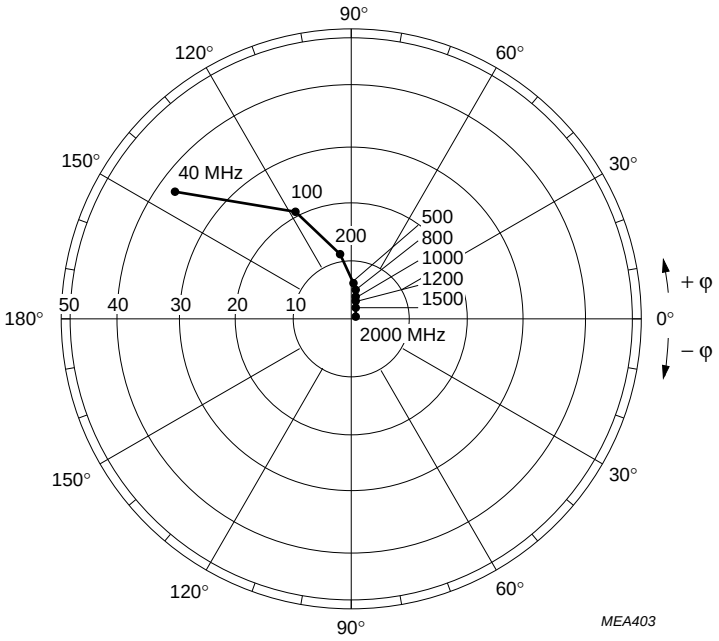

$I_C$ = 30 mA; $V_{CE}$ = 6 V; $T_{amb}$ = 25 °C.

Fig.5 Maximum unilateral power gain as a function of frequency.



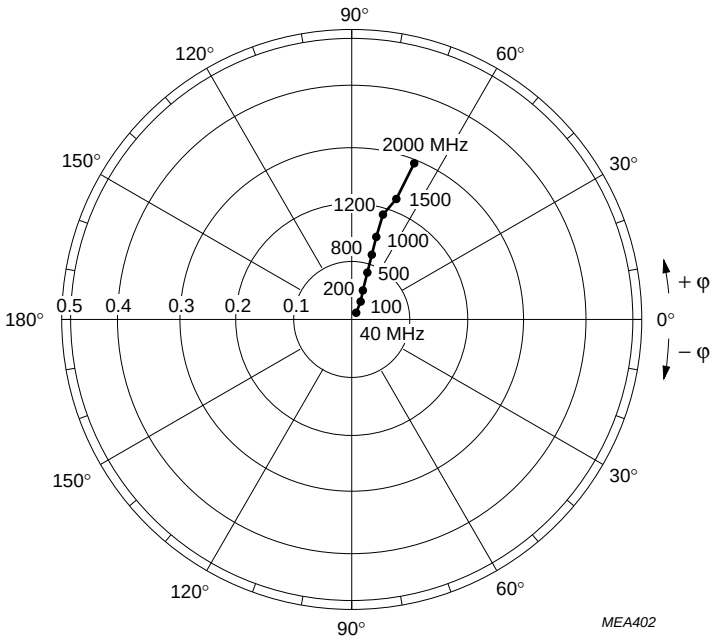

$I_C$ = 30 mA; $V_{CE}$ = 6 V; $T_{amb}$ = 25 °C.
$Z_o$ = 50 Ω.

Fig.6 Common emitter input reflection coefficient ($S_{11}$).



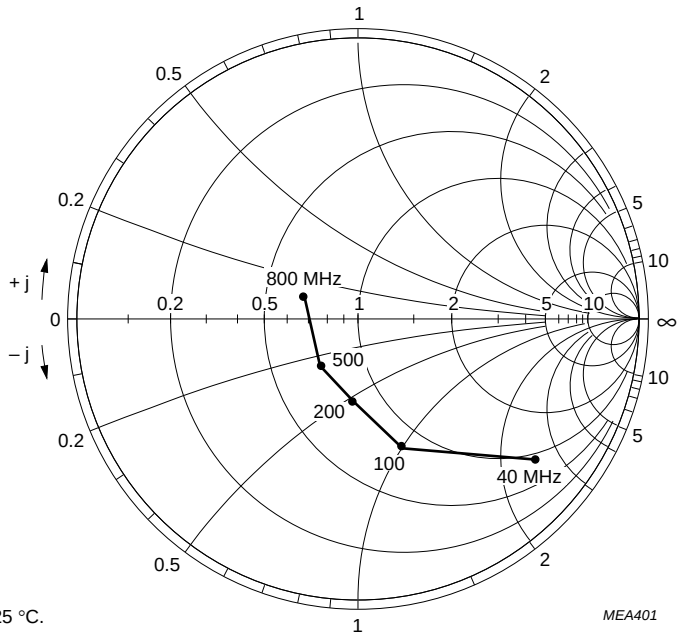

$I_C$ = 30 mA; $V_{CE}$ = 6 V; $T_{amb}$ = 25 °C.

Fig.7 Common emitter forward transmission coefficient ($S_{21}$).




$I_C$ = 30 mA; $V_{CE}$ = 6 V; $T_{amb}$ = 25 °C.

Fig.8 Common emitter reverse transmission coefficient ($S_{12}$).

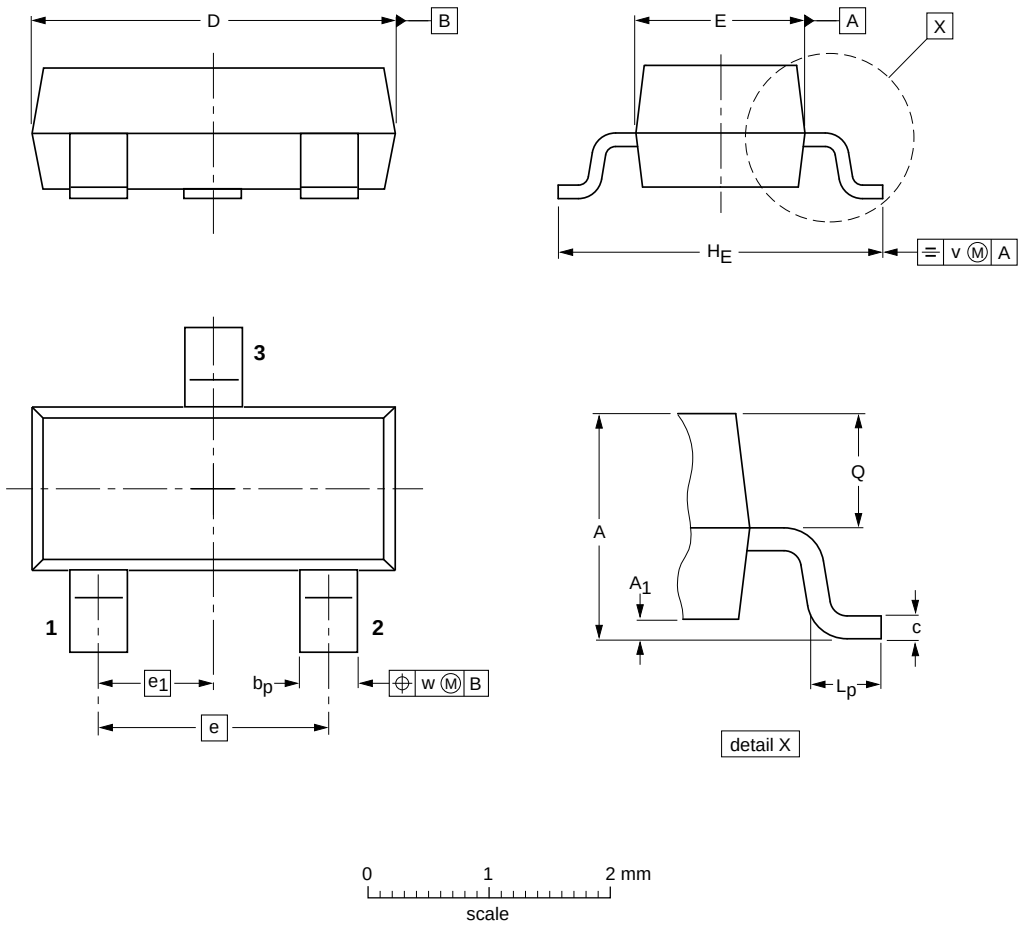



$I_C$ = 30 mA; $V_{CE}$ = 6 V; $T_{amb}$ = 25 °C.
$Z_o$ = 50 Ω.

Fig.9 Common emitter output reflection coefficient ($S_{22}$).

## PACKAGE OUTLINE

**Plastic surface-mounted package; 3 leads** **SOT23**




**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>0.9 | 0.1 | 0.48<br>0.38 | 0.15<br>0.09 | 3.0<br>2.8 | 1.4<br>1.2 | 1.9 | 0.95 | 2.5<br>2.1 | 0.45<br>0.15 | 0.55<br>0.45 | 0.2 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT23 | | TO-236AB | | | | ~~04-11-04~~<br>06-03-16 |

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| 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. |
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