

# DATA SHEET

**BFS540**

**NPN 9 GHz wideband transistor**

Product specification  
File under Discrete Semiconductors, SC14

November 1992

## NPN 9 GHz wideband transistor

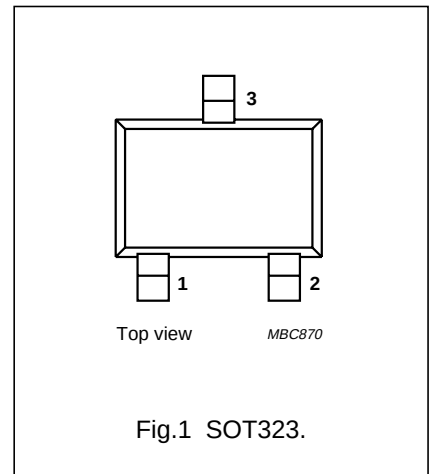
## BFS540

## FEATURES

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability
- SOT323 envelope.

## PINNING

| PIN      | DESCRIPTION |
|----------|-------------|
| Code: N4 |             |
| 1        | base        |
| 2        | emitter     |
| 3        | collector   |



## DESCRIPTION

NPN transistor in a plastic SOT323 envelope.

It is intended for RF wideband amplifier applications such as satellite TV systems and RF portable communication equipment with signal frequencies up to 2 GHz.

## 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          |                                                                                                | —    | —    | 120  | mA   |
| $P_{tot}$ | total power dissipation       | up to $T_s = 80\text{ °C}$ ; note 1                                                            | —    | —    | 500  | mW   |
| $h_{FE}$  | DC current gain               | $I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $T_j = 25\text{ °C}$                            | 60   | 120  | 250  |      |
| $f_T$     | 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 | $I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$ | —    | 14   | —    | dB   |
| $F$       | noise figure                  | $I_C = 10\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$ | —    | 1.3  | 1.7  | 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    |
| $V_{CES}$ | collector-emitter voltage | $R_{BE} = 0$                        | —    | 15   | V    |
| $V_{EBO}$ | emitter-base voltage      | open collector                      | —    | 2.5  | V    |
| $I_C$     | DC collector current      |                                     | —    | 120  | mA   |
| $P_{tot}$ | total power dissipation   | up to $T_s = 80\text{ °C}$ ; 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.

## NPN 9 GHz wideband transistor

## BFS540

## THERMAL RESISTANCE

| SYMBOL        | PARAMETER                                           | CONDITIONS                          | THERMAL RESISTANCE |
|---------------|-----------------------------------------------------|-------------------------------------|--------------------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | up to $T_s = 80\text{ °C}$ ; note 1 | 190 K/W            |

## Note

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

## CHARACTERISTICS

$T_j = 25\text{ °C}$ , unless otherwise specified.

| SYMBOL       | PARAMETER                              | CONDITIONS                                                                                                                 | MIN. | TYP. | MAX. | UNIT |
|--------------|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $I_{CBO}$    | collector cut-off current              | $I_E = 0$ ; $V_{CE} = 8\text{ V}$                                                                                          | –    | –    | 50   | nA   |
| $h_{FE}$     | DC current gain                        | $I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$                                                                               | 60   | 120  | 250  |      |
| $C_e$        | emitter capacitance                    | $I_C = i_c = 0$ ; $V_{EB} = 0.5\text{ V}$ ; $f = 1\text{ MHz}$                                                             | –    | 2    | –    | pF   |
| $C_c$        | collector capacitance                  | $I_E = i_e = 0$ ; $V_{CB} = 8\text{ V}$ ; $f = 1\text{ MHz}$                                                               | –    | 0.9  | –    | pF   |
| $C_{re}$     | feedback capacitance                   | $I_C = 0$ ; $V_{CB} = 8\text{ V}$ ; $f = 1\text{ MHz}$                                                                     | –    | 0.6  | –    | 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 (note 1) | $I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$                             | –    | 14   | –    | dB   |
|              |                                        | $I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$                               | –    | 8    | –    | dB   |
| $ S_{21} ^2$ | insertion power gain                   | $I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$                             | 12   | 13   | –    | dB   |
| F            | noise figure                           | $\Gamma_s = \Gamma_{opt}$ ; $I_C = 10\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$ | –    | 1.3  | 1.8  | dB   |
|              |                                        | $\Gamma_s = \Gamma_{opt}$ ; $I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$ | –    | 1.9  | 2.4  | dB   |
|              |                                        | $\Gamma_s = \Gamma_{opt}$ ; $I_C = 10\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $f = 2\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$   | –    | 2.1  | –    | dB   |
| $P_{L1}$     | output power at 1 dB gain compression  | $I_C = 40\text{ mA}$ ; $V_{CE} = 8\text{ V}$ ; $R_L = 50\text{ }\Omega$ ; $f = 900\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$  | –    | 21   | –    | dBm  |
| ITO          | third order intercept point            | note 2                                                                                                                     | –    | 34   | –    | dBm  |

## Notes

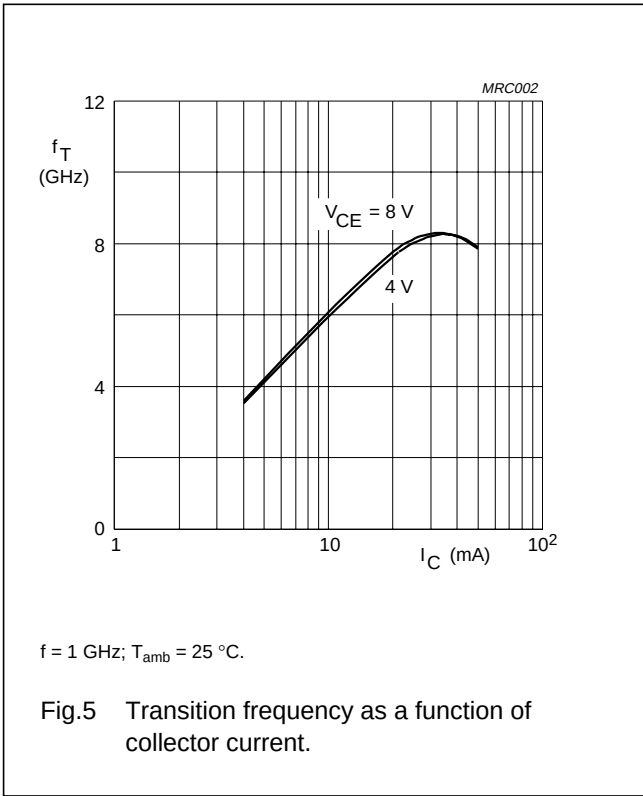
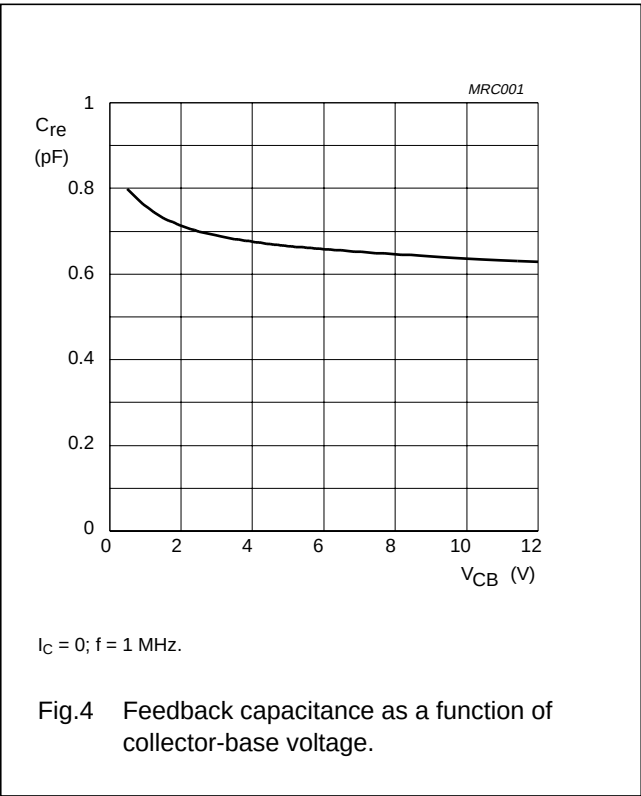
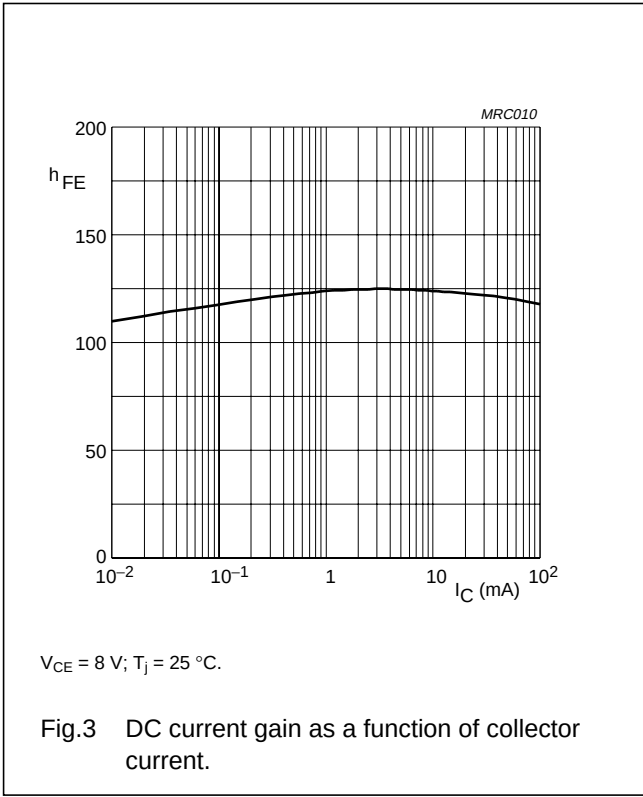
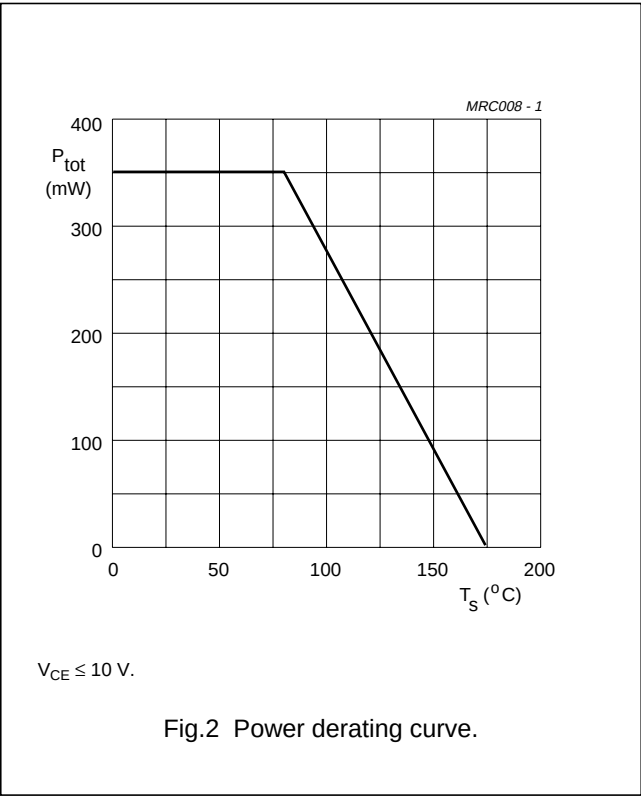
- $G_{UM}$  is the maximum unilateral power gain, assuming  $S_{12}$  is zero and

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

- $I_C = 40\text{ mA}$ ;  $V_{CE} = 8\text{ V}$ ;  $R_L = 50\text{ }\Omega$ ;  $f = 900\text{ MHz}$ ;  $T_{amb} = 25\text{ °C}$ ;  
 $f_p = 900\text{ MHz}$ ;  $f_q = 902\text{ MHz}$ ; measured at  $f_{(2p-q)} = 898\text{ MHz}$  and at  $f_{(2q-p)} = 904\text{ MHz}$ .

NPN 9 GHz wideband transistor

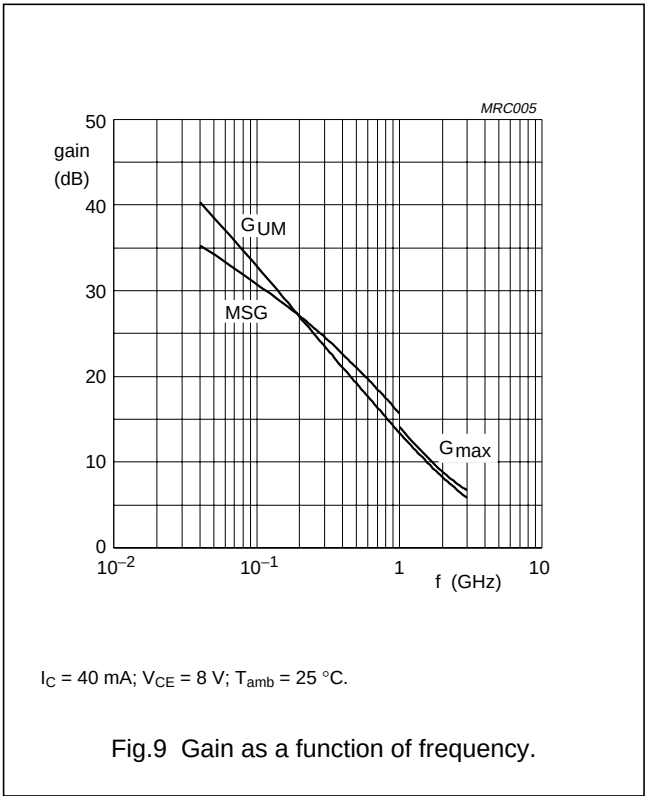
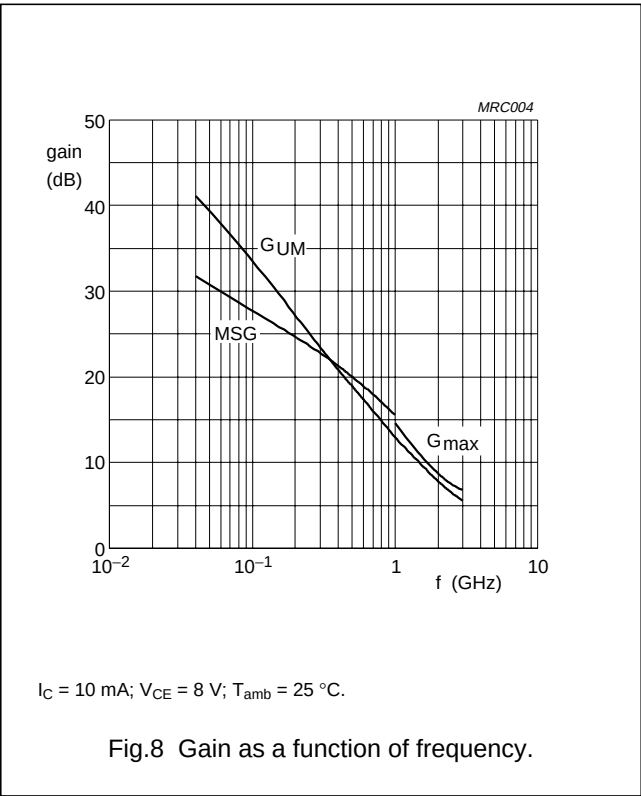
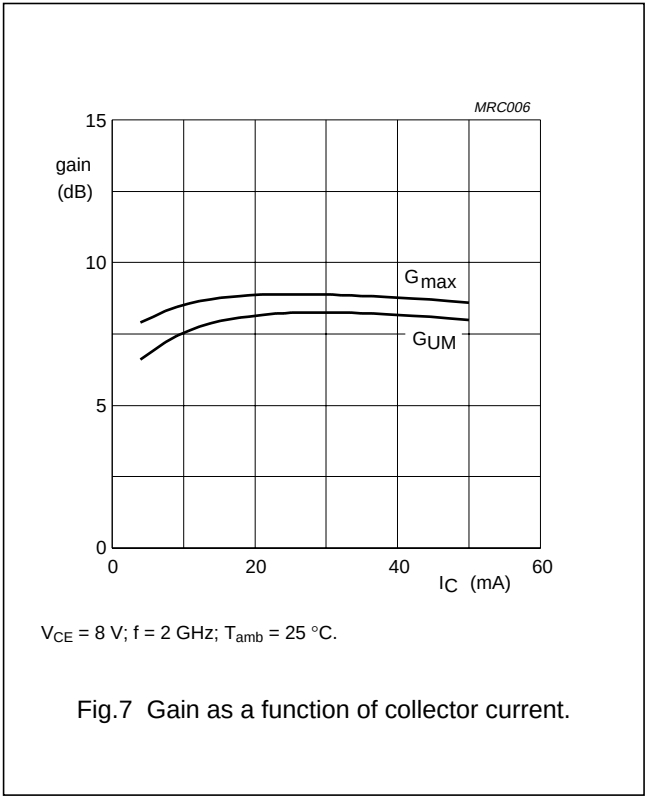
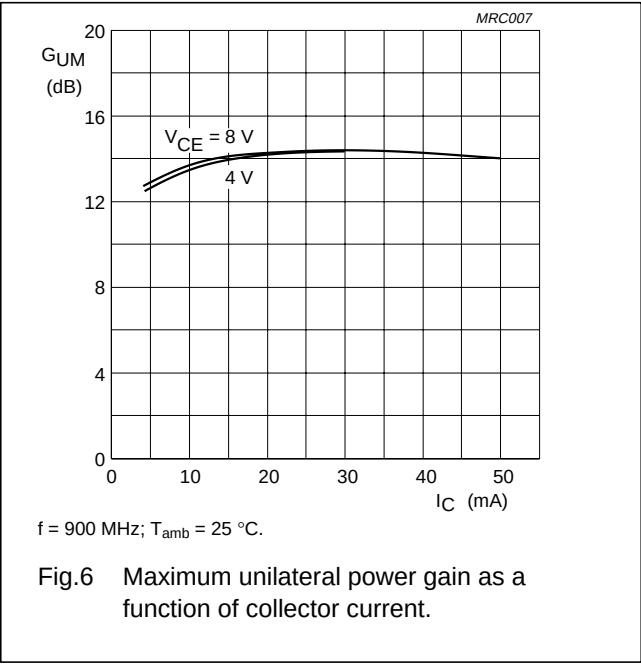
BFS540



NPN 9 GHz wideband transistor

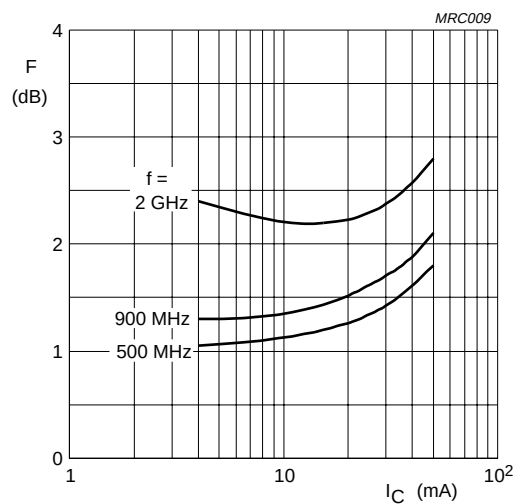
BFS540

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



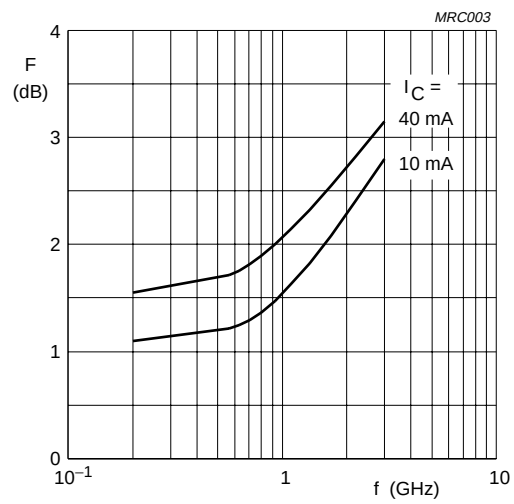
NPN 9 GHz wideband transistor

BFS540



V<sub>CE</sub> = 8 V; T<sub>amb</sub> = 25 °C.

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

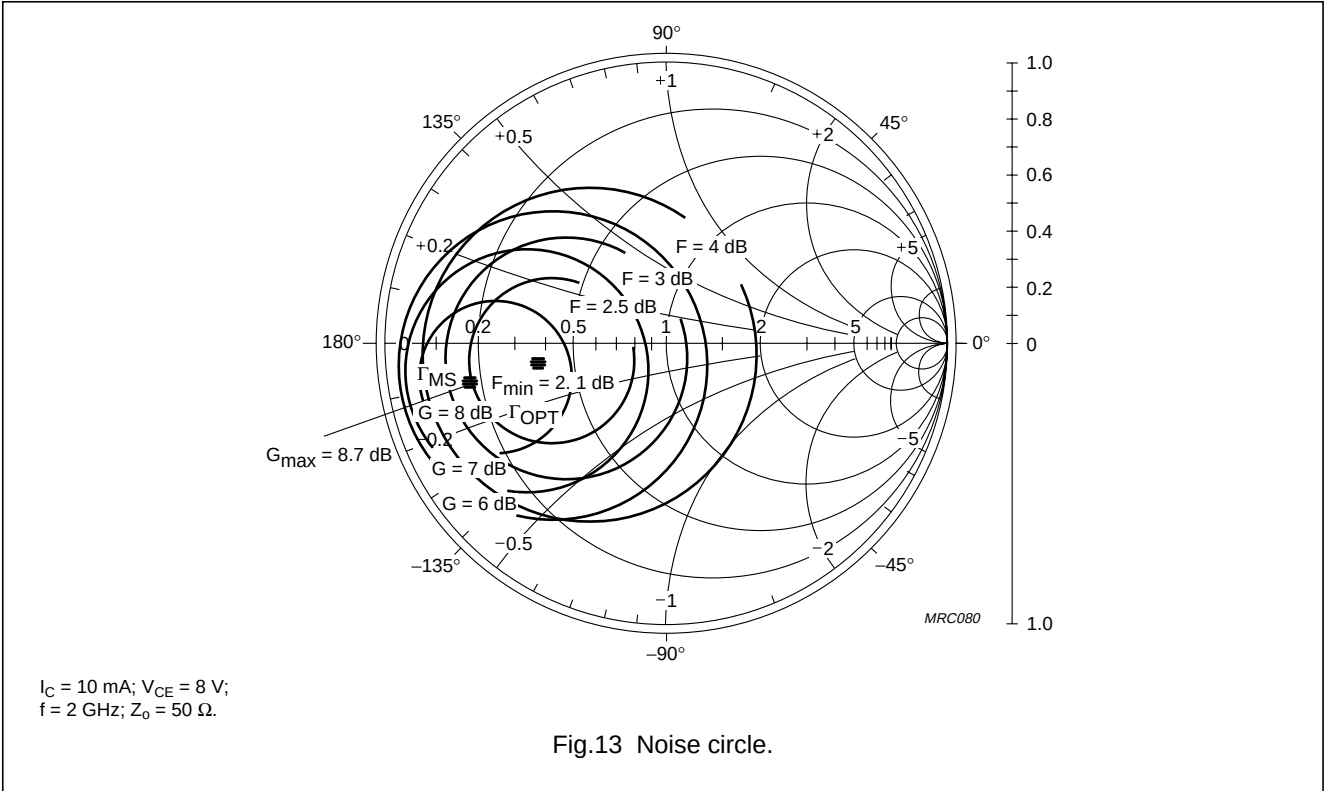
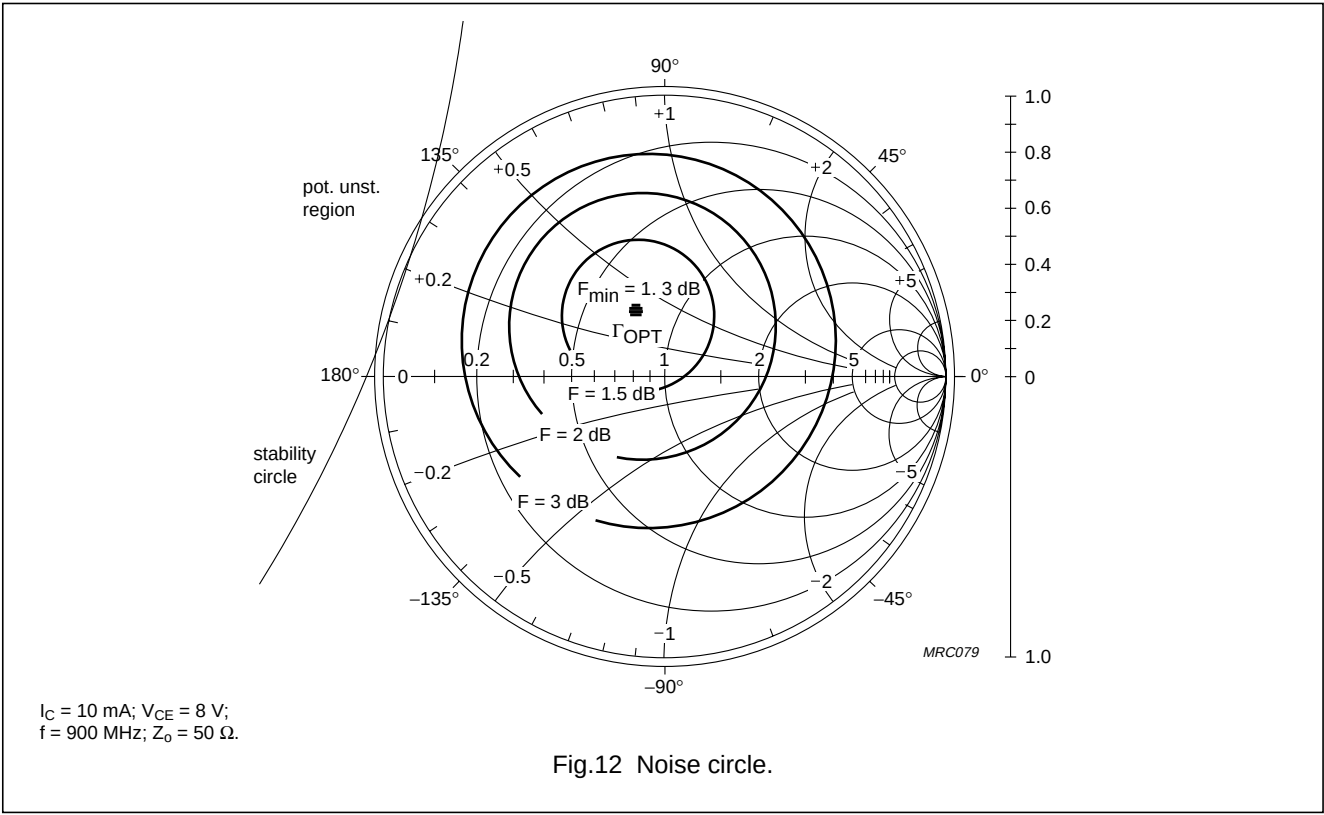


V<sub>CE</sub> = 8 V; T<sub>amb</sub> = 25 °C.

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

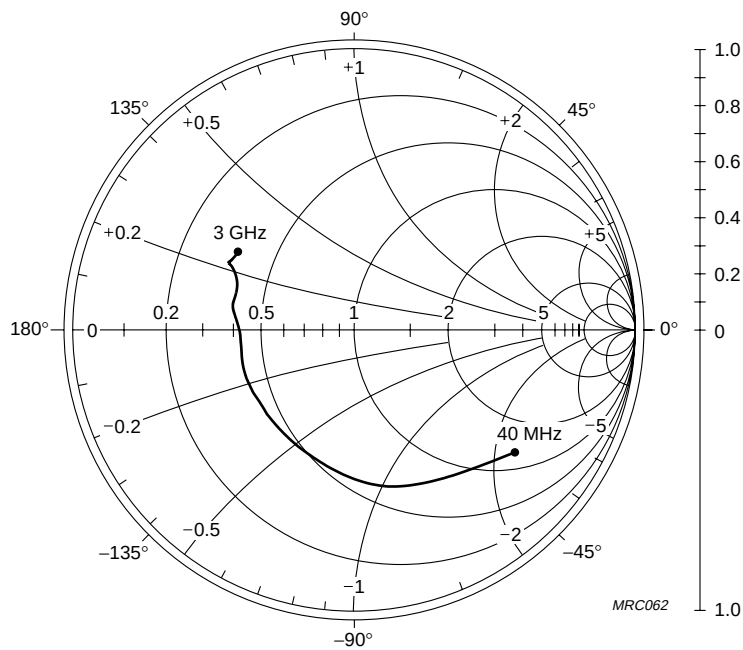
NPN 9 GHz wideband transistor

BFS540



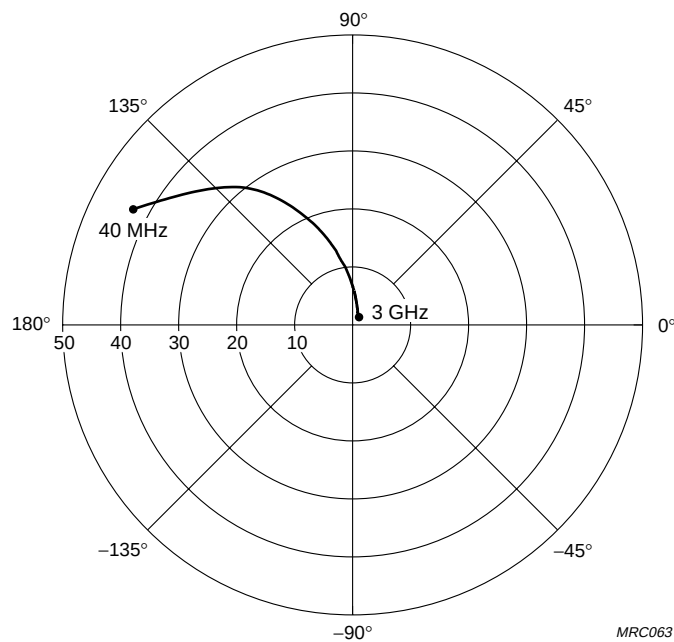
NPN 9 GHz wideband transistor

BFS540



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

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



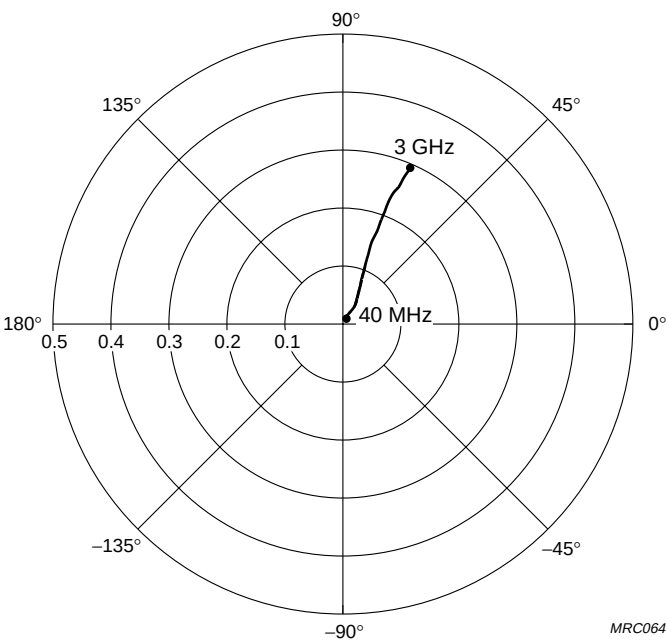
$I_C = 40 \text{ mA}$ ;  $V_{CE} = 8 \text{ V}$ .

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



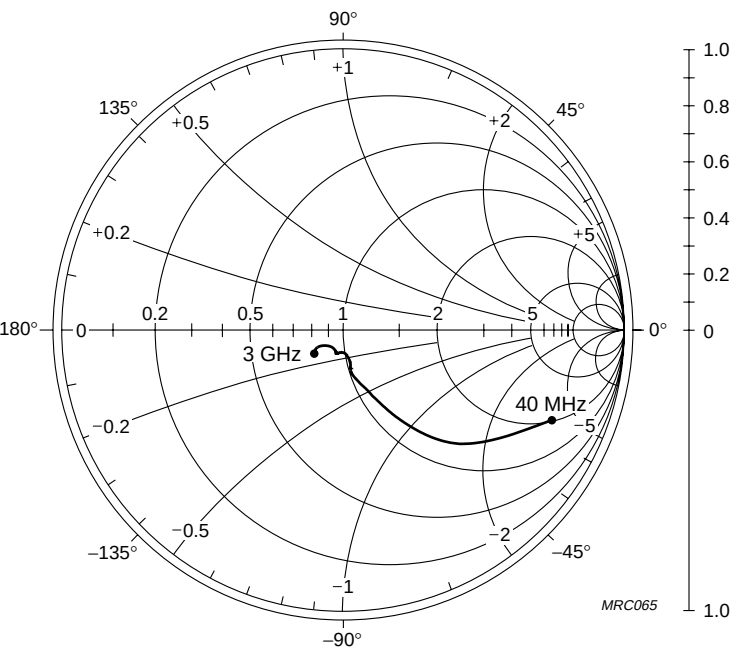
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BFS540



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

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



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

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

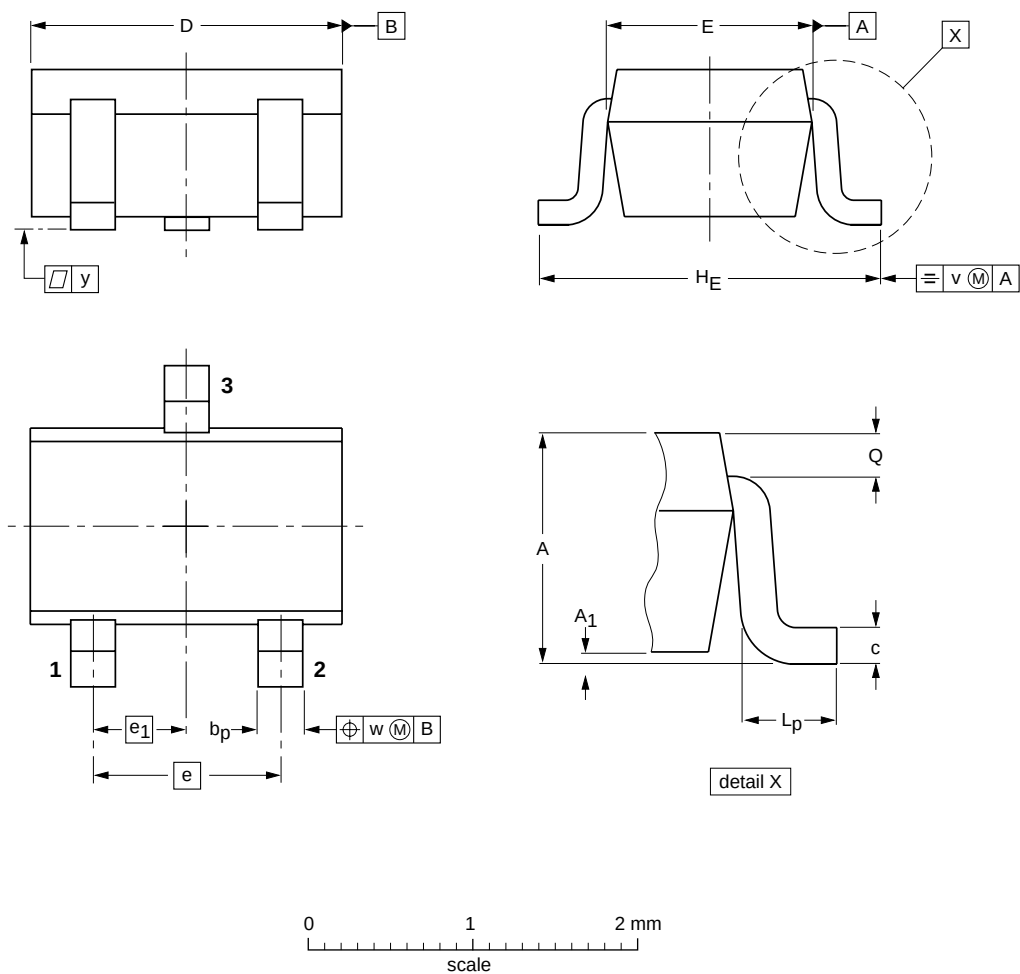
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PACKAGE OUTLINE

Plastic surface mounted package; 3 leads

SOT323



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | A <sub>1</sub><br>max | b <sub>p</sub> | c            | D          | E            | e   | e <sub>1</sub> | H <sub>E</sub> | L <sub>p</sub> | 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<br>VERSION | REFERENCES |       |       |  | EUROPEAN<br>PROJECTION                                                                | ISSUE DATE |
|--------------------|------------|-------|-------|--|---------------------------------------------------------------------------------------|------------|
|                    | IEC        | JEDEC | EIAJ  |  |                                                                                       |            |
| SOT323             |            |       | SC-70 |  |  | 97-02-28   |

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NPN 9 GHz wideband transistor

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BFS540

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**DEFINITIONS**

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

**LIFE SUPPORT APPLICATIONS**

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