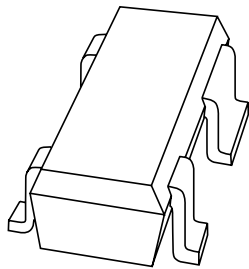


# DATA SHEET



## **BFU540** NPN SiGe wideband transistor

Product specification  
Supersedes data of 2002 Jan 28

2003 Jun 12

## NPN SiGe wideband transistor

## BFU540

## FEATURES

- Very high power gain
- Very low noise figure
- High transition frequency
- Emitter is thermal lead
- Low feedback capacitance
- 45 GHz SiGe process.

## APPLICATIONS

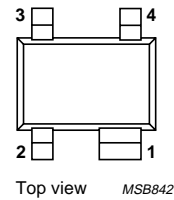
- RF front end
- Wideband applications, e.g. analog and digital cellular telephones, cordless telephones (PHS, DECT, etc.)
- Radar detectors
- Pagers
- Satellite television tuners (SATV)
- High frequency oscillators.

## DESCRIPTION

NPN SiGe wideband transistor for low voltage applications in a plastic, 4-pin dual-emitter SOT343R package.

## PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | base        |
| 3   | emitter     |
| 4   | collector   |



Marking code: A4.

Fig.1 Simplified outline SOT343R.

## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                 | CONDITIONS  | MIN. | TYP. | MAX. | UNIT |
|-----------|---------------------------|---|------|------|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter  | –    | –    | 9    | V    |
| $V_{CEO}$ | collector-emitter voltage | open base   | –    | –    | 2.3  | V    |
| $I_C$     | collector current (DC)    |   | –    | 40   | 50   | mA   |
| $P_{tot}$ | total power dissipation   | $T_s \leq 98\text{ °C}$   | –    | –    | 115  | mW   |
| $h_{FE}$  | DC current gain           | $I_C = 40\text{ mA}; V_{CE} = 2\text{ V}; T_j = 25\text{ °C}$                       | 70   | 140  | 210  |      |
| $G_{max}$ | maximum power gain        | $I_C = 40\text{ mA}; V_{CE} = 2\text{ V}; f = 2\text{ GHz}; T_{amb} = 25\text{ °C}$ | –    | 20   | –    | dB   |
| NF        | noise figure              | $I_C = 2\text{ mA}; V_{CE} = 2\text{ V}; f = 2\text{ GHz}; \Gamma_S = \Gamma_{opt}$ | –    | 0.9  | –    | dB   |

## CAUTION

This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling. For further information, refer to Philips specs.: SNW-EQ-608, SNW-FQ-302A and SNW-FQ-302B.

## NPN SiGe wideband transistor

BFU540

**LIMITING VALUES**

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

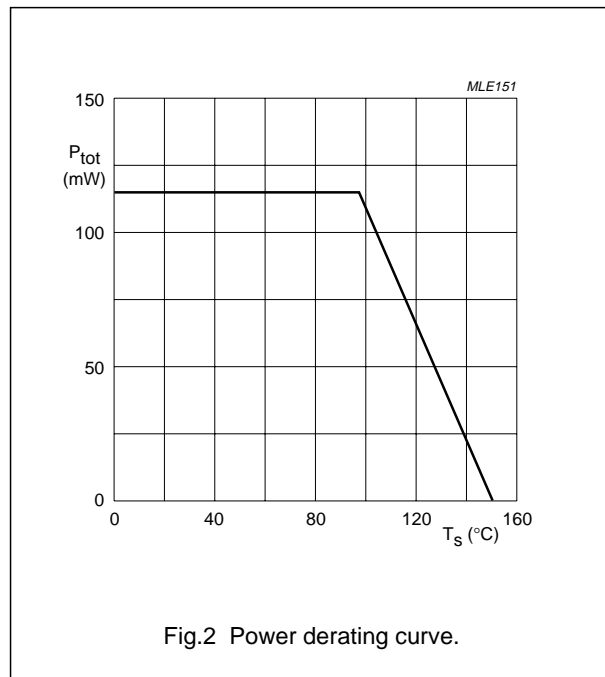
| SYMBOL    | PARAMETER                      | CONDITIONS                                  | MIN. | MAX. | UNIT |
|-----------|--------------------------------|---|------|------|------|
| $V_{CBO}$ | collector-base voltage         | open emitter                                | –    | 9    | V    |
| $V_{CEO}$ | collector-emitter voltage      | open base                                   | –    | 2.3  | V    |
| $V_{EBO}$ | emitter-base voltage           | open collector                              | –    | 2.5  | V    |
| $I_C$     | collector current (DC)         |   | –    | 50   | mA   |
| $P_{tot}$ | total power dissipation        | $T_s \leq 98\text{ °C}$ ; note 1; see Fig.2 | –    | 115  | mW   |
| $T_{stg}$ | storage temperature            |   | –65  | +150 | °C   |
| $T_j$     | operating junction temperature |   | –    | 150  | °C   |

**Note**

- $T_s$  is the temperature at the soldering point of the emitter pins.

**THERMAL CHARACTERISTICS**

| SYMBOL        | PARAMETER   | VALUE | UNIT |
|---------------|---|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | 450   | K/W  |



## NPN SiGe wideband transistor

## BFU540

**CHARACTERISTICS**

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

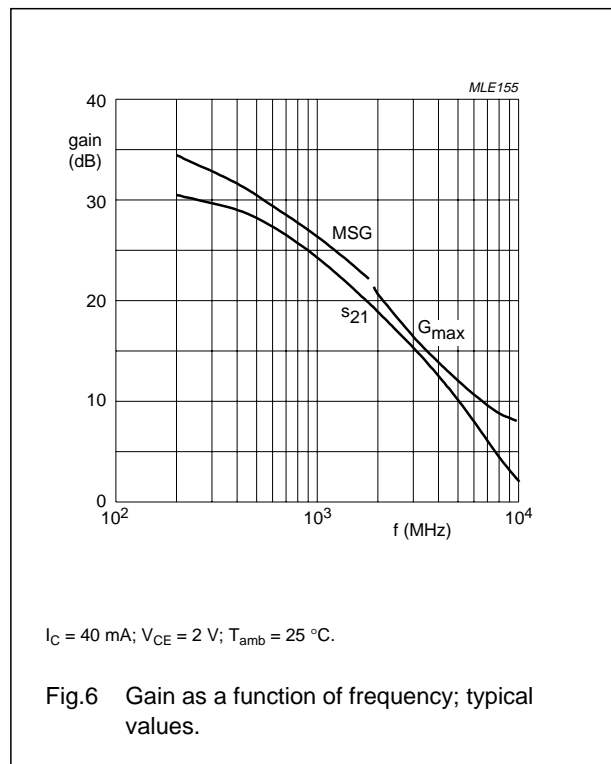
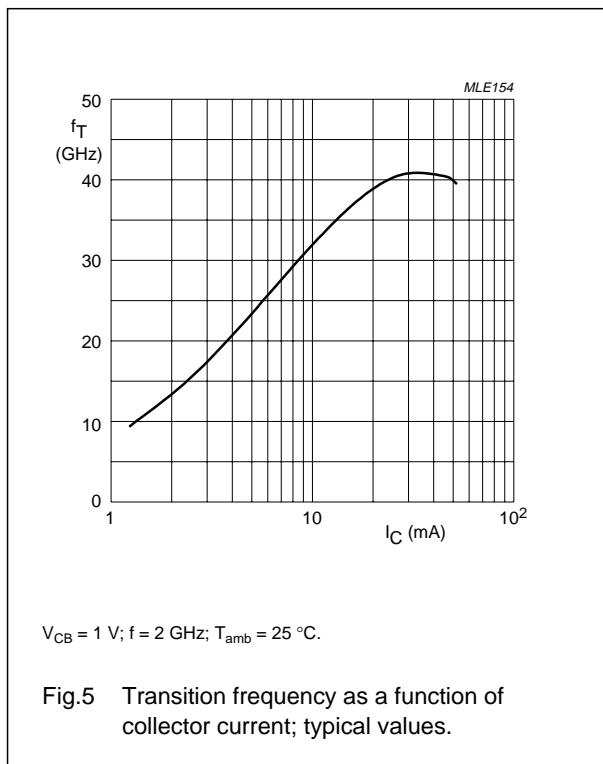
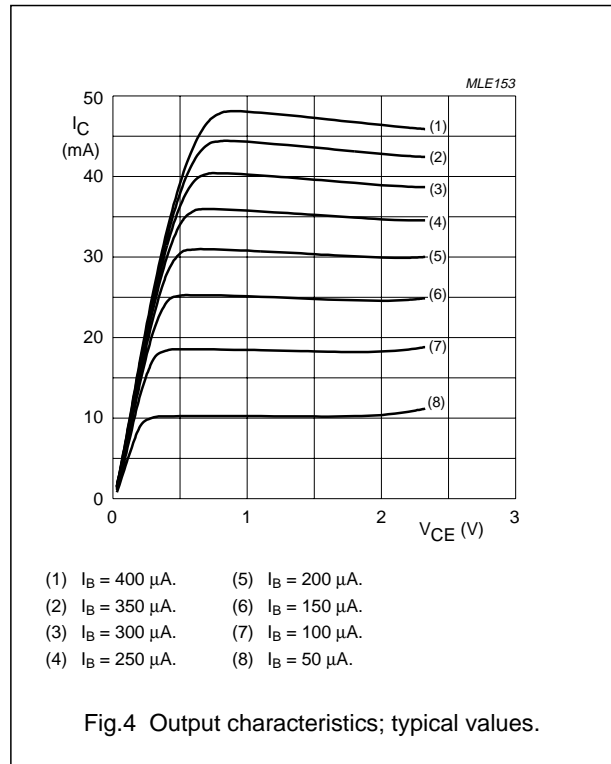
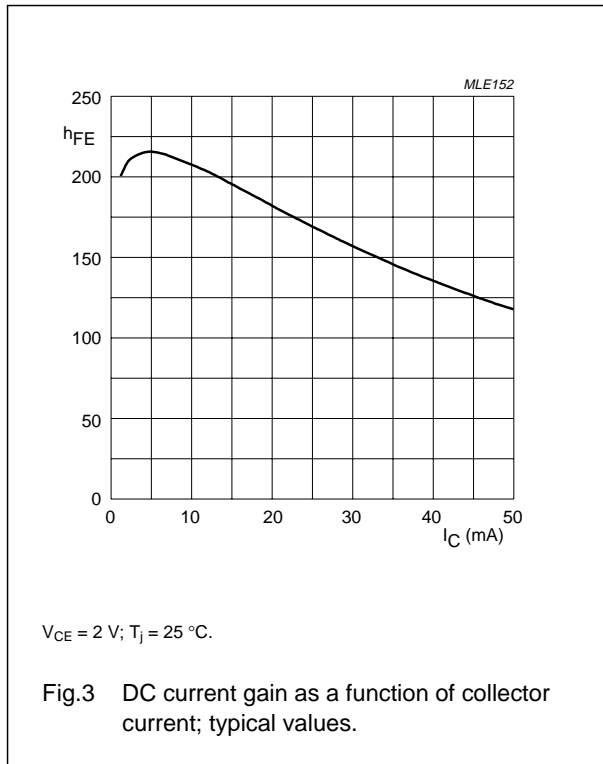
| SYMBOL        | PARAMETER                             | CONDITIONS   | MIN. | TYP. | MAX. | UNIT |
|---------------|---------------------------------------|--|------|------|------|------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage      | $I_C = 2.5\ \mu\text{A}$ ; $I_E = 0$   | 9    | –    | –    | V    |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage   | $I_C = 1\ \text{mA}$ ; $I_B = 0$   | 2.3  | –    | –    | V    |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage        | $I_E = 2.5\ \mu\text{A}$ ; $I_C = 0$   | 2.5  | –    | –    | V    |
| $I_{CBO}$     | collector-base leakage current        | $I_E = 0$ ; $V_{CB} = 4.5\ \text{V}$   | –    | –    | 15   | nA   |
| $h_{FE}$      | DC current gain                       | $I_C = 40\ \text{mA}$ ; $V_{CE} = 2\ \text{V}$   | 70   | 140  | 210  |      |
| $C_C$         | collector capacitance                 | $I_E = I_e = 0$ ; $V_{CB} = 2\ \text{V}$ ; $f = 1\ \text{MHz}$   | –    | 520  | –    | fF   |
| $C_{re}$      | feedback capacitance                  | $I_C = 0$ ; $V_{CB} = 2\ \text{V}$ ; $f = 1\ \text{MHz}$   | –    | 105  | –    | fF   |
| $G_{max}$     | maximum power gain; note 1            | $I_C = 40\ \text{mA}$ ; $V_{CE} = 2\ \text{V}$ ; $f = 2\ \text{GHz}$ ;<br>$T_{amb} = 25\text{ °C}$                         | –    | 20   | –    | dB   |
| NF            | noise figure                          | $I_C = 2\ \text{mA}$ ; $V_{CE} = 2\ \text{V}$ ; $f = 2\ \text{GHz}$ ;<br>$\Gamma_S = \Gamma_{opt}$                         | –    | 0.9  | –    | dB   |
| $P_{L1}$      | output power at 1 dB gain compression | $I_C = 20\ \text{mA}$ ; $V_{CE} = 2\ \text{V}$ ; $f = 2\ \text{GHz}$ ;<br>$Z_S = Z_{S\ opt}$ ; $Z_L = Z_{L\ opt}$ ; note 2 | –    | 11   | –    | dBm  |
| ITO           | third order intercept point           | $I_C = 40\ \text{mA}$ ; $V_{CE} = 2\ \text{V}$ ; $f = 2\ \text{GHz}$ ;<br>$Z_S = Z_{S\ opt}$ ; $Z_L = Z_{L\ opt}$ ; note 2 | –    | 21   | –    | dBm  |

**Notes**

- $G_{max}$  is the maximum power gain, if  $K > 1$ . If  $K < 1$  then  $G_{max} = \text{MSG}$ .
- $Z_S$  and  $Z_L$  are optimized for gain.

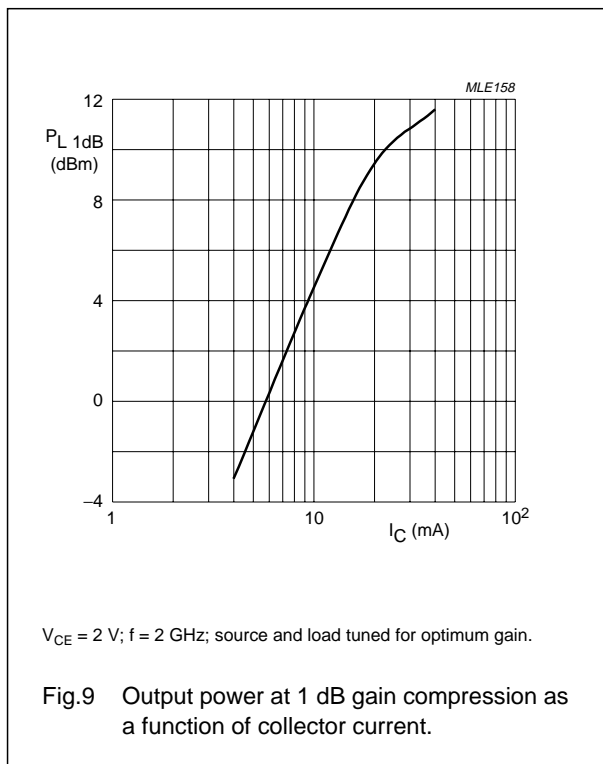
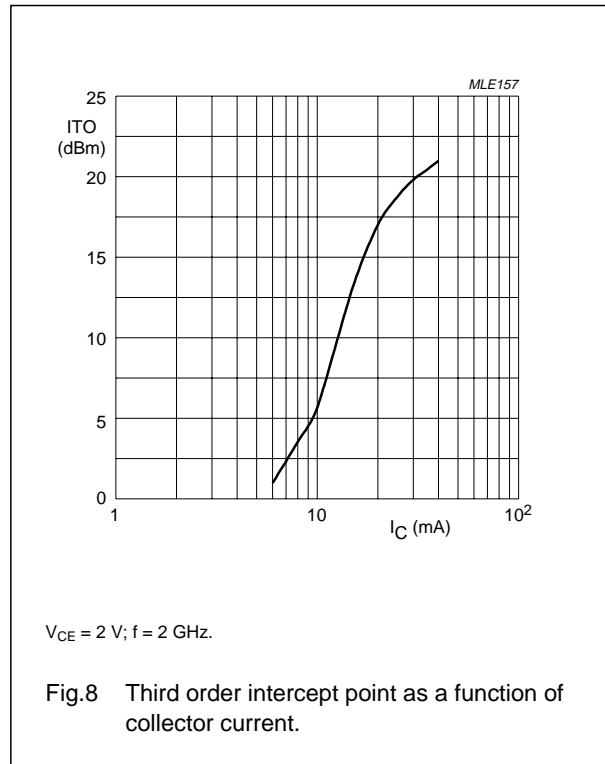
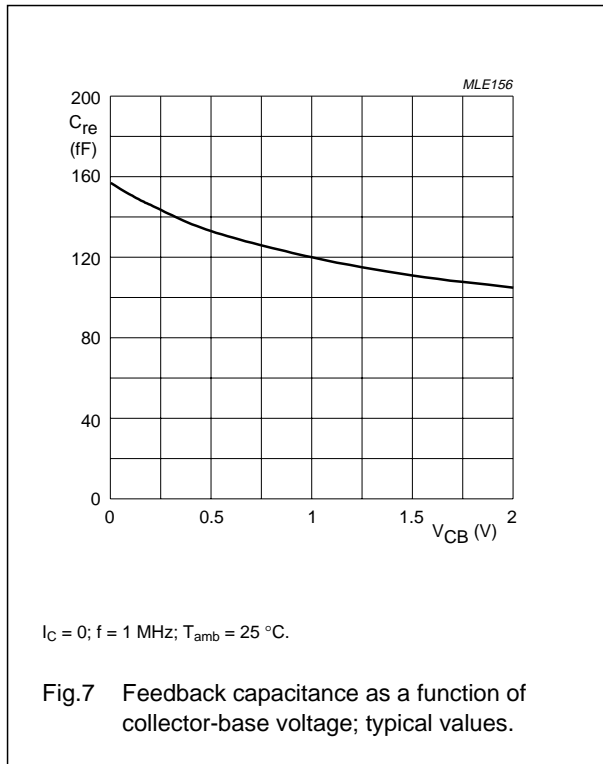
NPN SiGe wideband transistor

BFU540



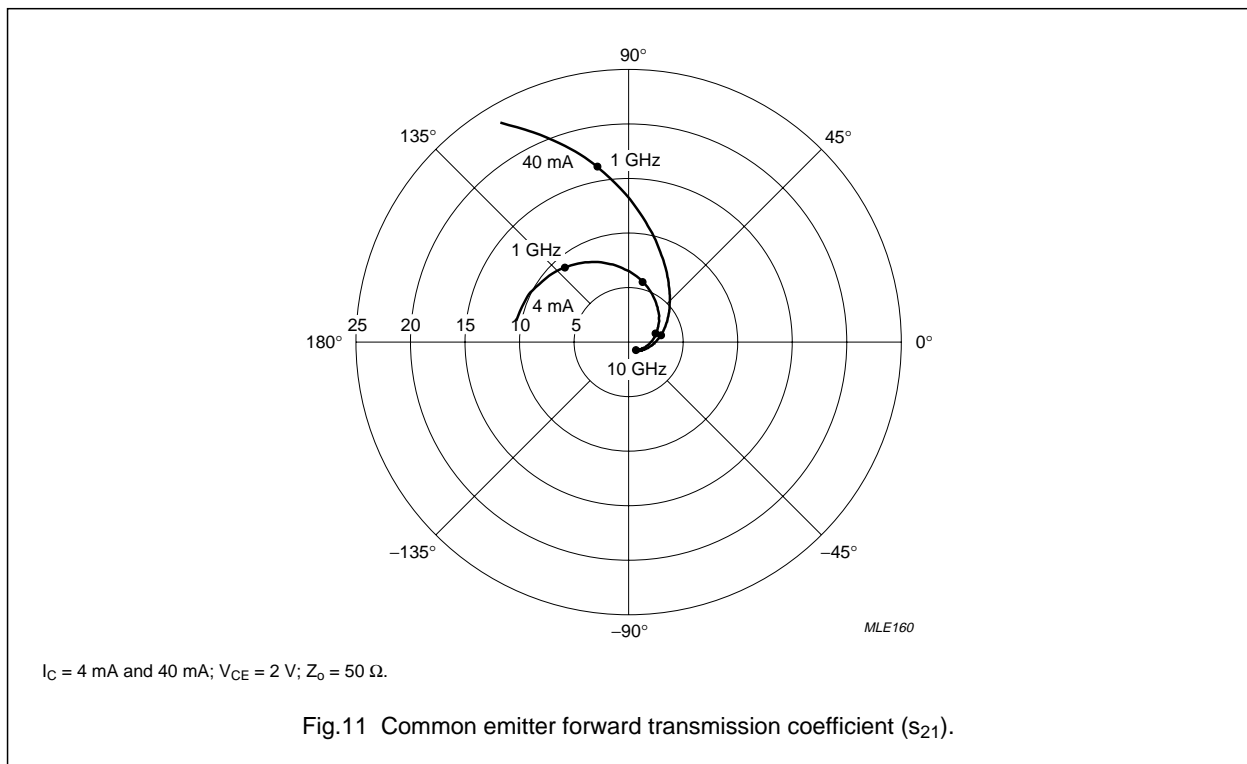
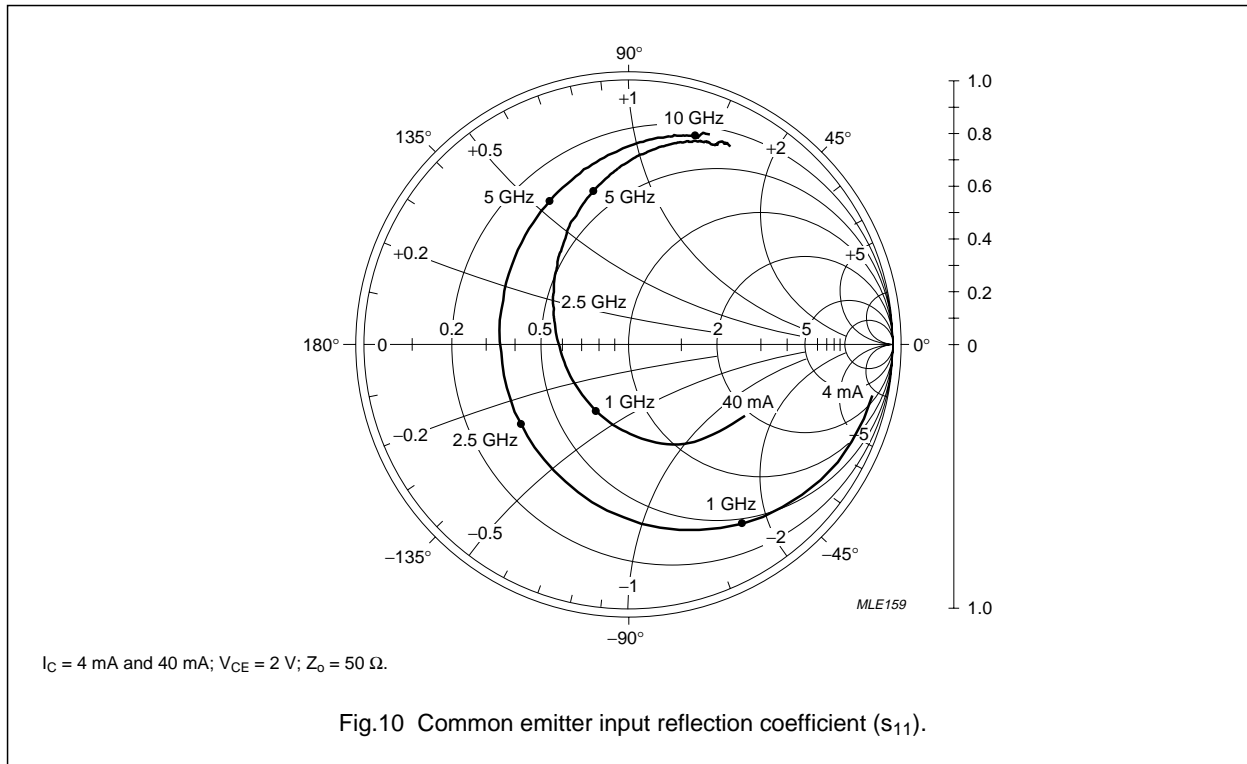
NPN SiGe wideband transistor

BFU540



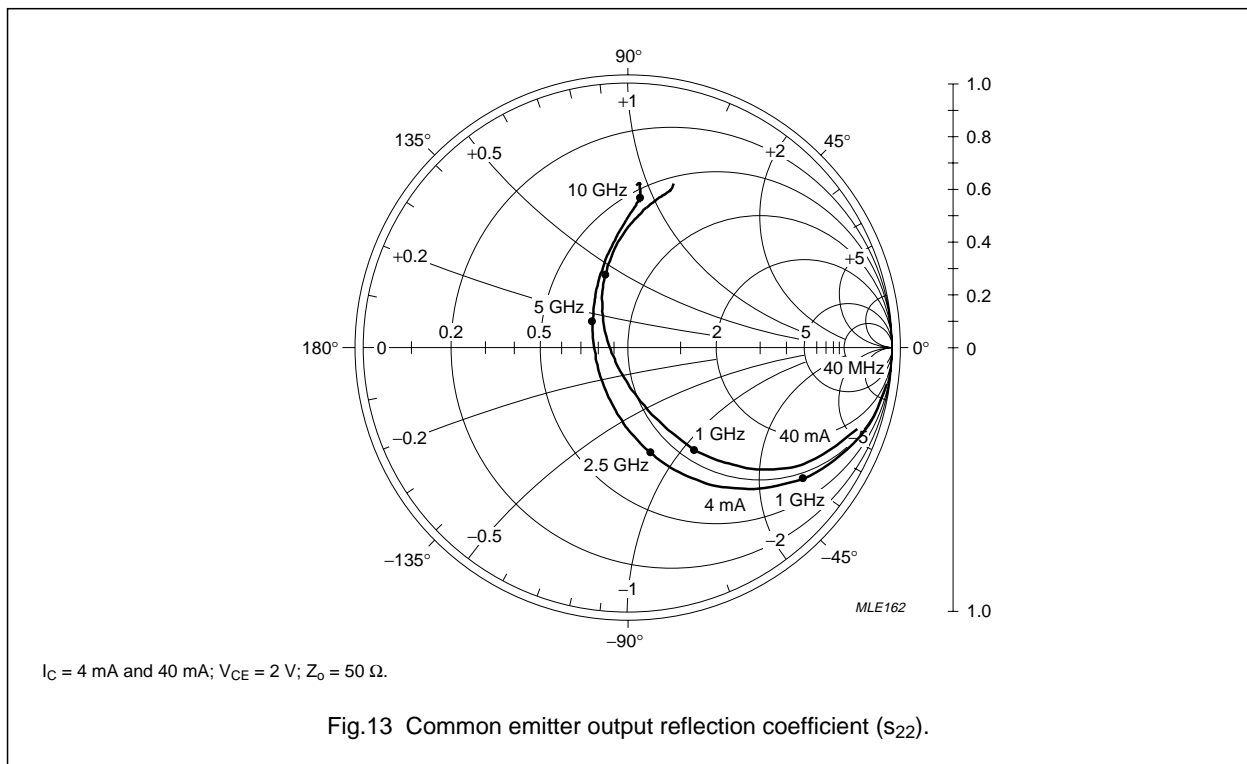
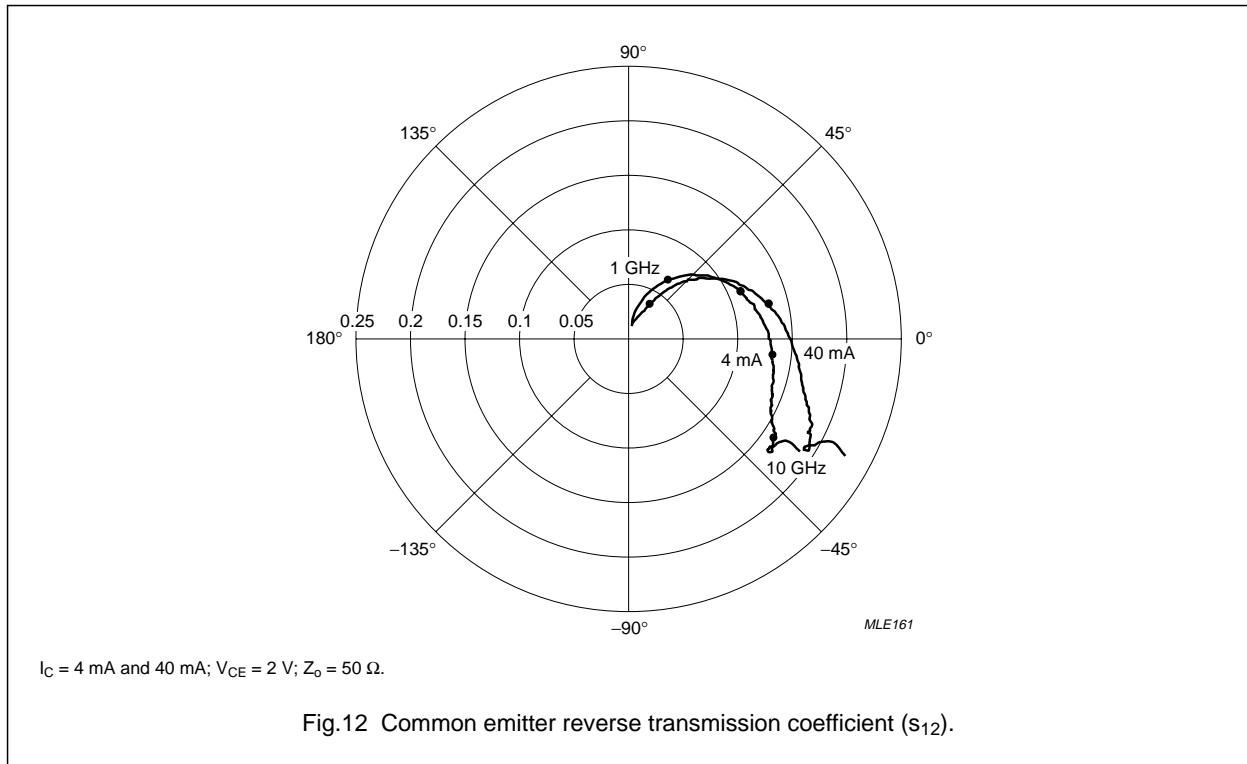
NPN SiGe wideband transistor

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NPN SiGe wideband transistor

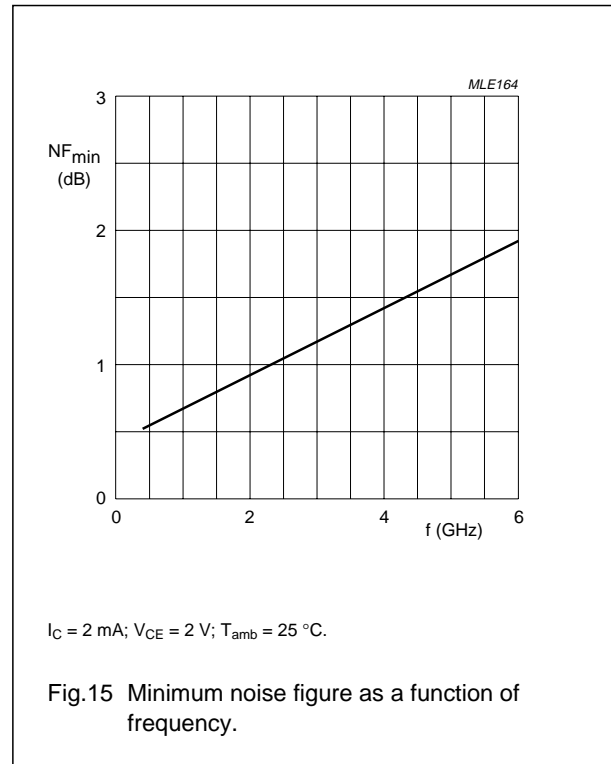
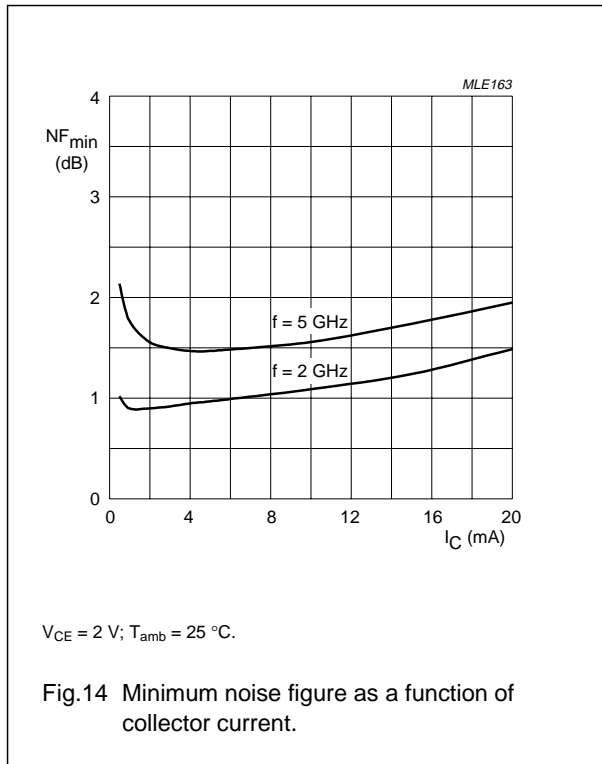
BFU540





## NPN SiGe wideband transistor

## BFU540



**Noise data:**  $V_{CE} = 2 \text{ V}; I_C = 4 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C};$  typical values

| f<br>(GHz) | $F_{min}$<br>(dB) | $\Gamma_{opt}$ |        | $r_n$<br>( $\Omega$ ) |
|------------|-------------------|----------------|--------|-----------------------|
|            |                   | (mag)          | (deg)  |                       |
| 2          | 1.0               | 0.39           | 55.9   | 0.20                  |
| 3          | 1.2               | 0.23           | 86.8   | 0.15                  |
| 4          | 1.4               | 0.11           | 142.5  | 0.13                  |
| 5          | 1.6               | 0.14           | -121.0 | 0.16                  |
| 6          | 1.7               | 0.28           | -74.2  | 0.27                  |
| 7          | 1.9               | 0.41           | -52.1  | 0.43                  |
| 8          | 2.1               | 0.47           | -32.6  | 0.66                  |
| 9          | 2.3               | 0.54           | -14.1  | 0.91                  |
| 10         | 2.6               | 0.62           | 3.7    | 1.22                  |
| 11         | 2.8               | 0.63           | 22.7   | 1.44                  |
| 12         | 3.0               | 0.61           | 36.8   | 1.65                  |

## NPN SiGe wideband transistor

## BFU540

## SPICE parameters for the BFU540 die

| SEQUENCE No.      | PARAMETER | VALUE | UNIT       |
|-------------------|-----------|-------|------------|
| 1                 | IS        | 1.5   | aA         |
| 2                 | BF        | 271.5 | –          |
| 3                 | NF        | 1.061 | –          |
| 4                 | VAF       | 25    | V          |
| 5                 | IKF       | 68    | mA         |
| 6                 | ISE       | 1060  | fA         |
| 7                 | NE        | 2.9   | –          |
| 8                 | BR        | 50    | –          |
| 9                 | NR        | 1.01  | –          |
| 10                | VAR       | 1     | MV         |
| 11                | IKR       | 6.4   | mA         |
| 12                | ISC       | 1.2   | fA         |
| 13                | NC        | 1.21  | –          |
| 14                | RB        | 8.75  | $\Omega$   |
| 15 <sup>(1)</sup> | IRB       | –     | –          |
| 16                | RBM       | 5     | $\Omega$   |
| 17                | RE        | 0.9   | m $\Omega$ |
| 18                | RC        | 9.25  | $\Omega$   |
| 19                | XTB       | –2.2  | –          |
| 20                | EG        | 1.014 | eV         |
| 21                | XTI       | 3     | –          |
| 22                | CJE       | 222   | fF         |
| 23                | VJE       | 918   | mV         |
| 24                | MJE       | 0.27  | –          |
| 25                | TF        | 2.1   | ps         |
| 26                | XTF       | 10    | –          |
| 27                | VTF       | 1.5   | V          |
| 28                | ITF       | 0.92  | A          |
| 29                | PTF       | 30    | deg        |
| 30                | CJC       | 147   | fF         |
| 31                | VJC       | 587   | mV         |
| 32                | MJC       | 0.246 | –          |
| 33                | XCJC      | 0.44  | –          |
| 34                | TR        | 20    | ps         |
| 35                | CJS       | 51    | fF         |
| 36                | VJS       | 441   | mV         |
| 37                | MJS       | 0.313 | –          |
| 38                | FC        | 0.7   | –          |

**Note**

1. Not used.

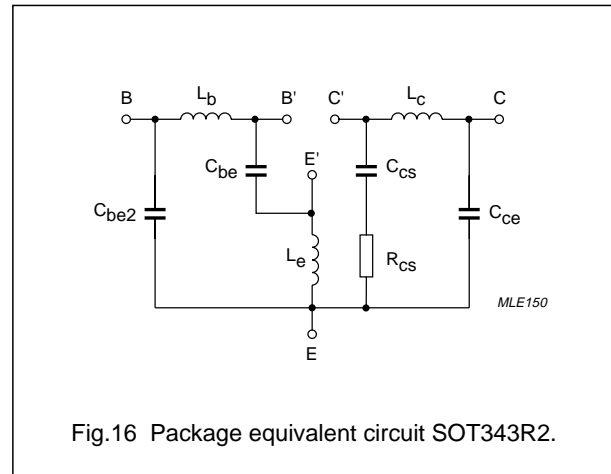


Fig.16 Package equivalent circuit SOT343R2.

**List of components** (see Fig.16)

| DESIGNATION | VALUE | UNIT     |
|-------------|-------|----------|
| $L_b$       | 1.18  | nH       |
| $L_c$       | 1.04  | nH       |
| $L_e$       | 0.32  | nH       |
| $C_{be1}$   | 146   | fF       |
| $C_{be2}$   | 55    | fF       |
| $C_{ce}$    | 56    | fF       |
| $C_{cs}$    | 100   | fF       |
| $R_{cs}$    | 170   | $\Omega$ |

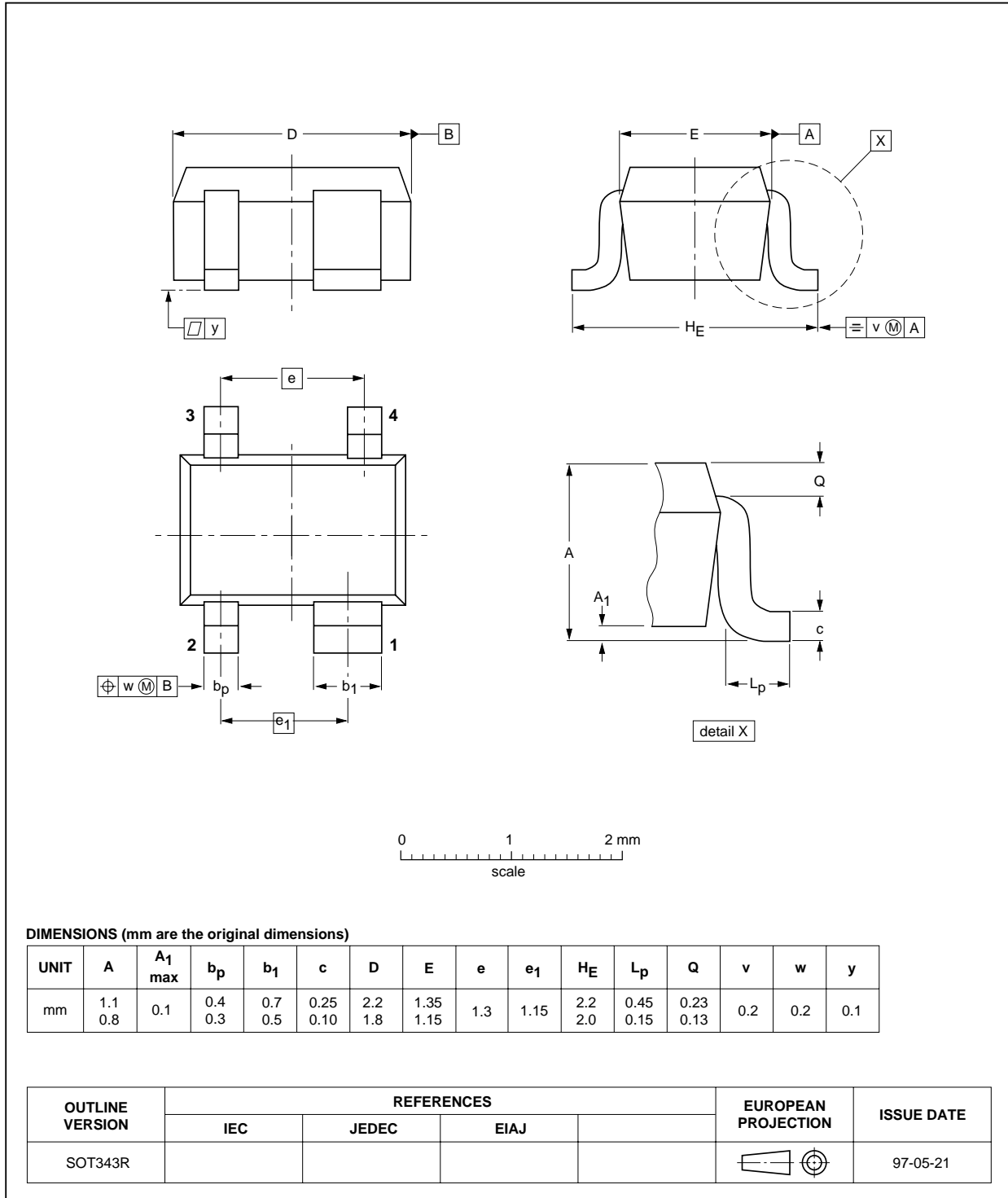
NPN SiGe wideband transistor

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PACKAGE OUTLINE

Plastic surface mounted package; reverse pinning; 4 leads

SOT343R



## NPN SiGe wideband transistor

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## DATA SHEET STATUS

| LEVEL | DATA SHEET STATUS <sup>(1)</sup> | PRODUCT STATUS <sup>(2)(3)</sup> | DEFINITION   |
|-------|----------------------------------|----------------------------------|--|
| I     | Objective data                   | Development                      | This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.  |
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**NOTES**

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**NOTES**

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