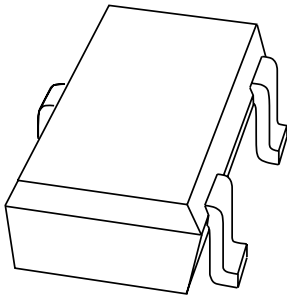


# DATA SHEET



## **PRF957** UHF wideband transistor

Product specification  
Supersedes data of 1999 Mar 01

1999 Jul 23

# UHF wideband transistor

# PRF957

## FEATURES

- Small size
- Low noise
- Low distortion
- High gain
- Gold metallization ensures excellent reliability.

## APPLICATIONS

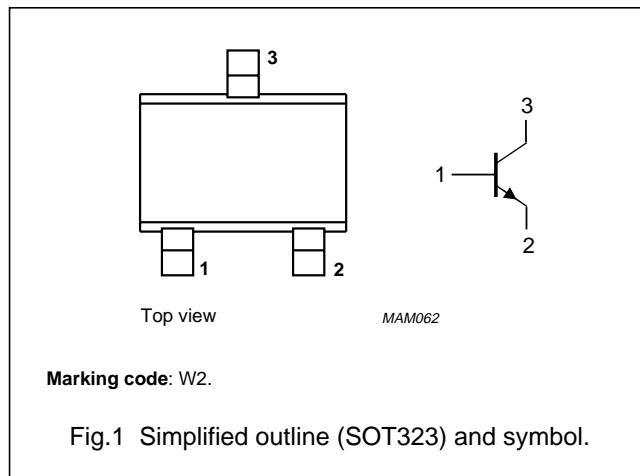
- Communication and instrumentation systems.

## DESCRIPTION

Silicon NPN transistor in a surface mount 3-pin SOT323 package. The transistor is primarily intended for wideband applications in the GHz-range in the RF front end of analog and digital cellular telephones, cordless phones, radar detectors, pagers and satellite TV-tuners.

## PINNING

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



## QUICK REFERENCE DATA

| SYMBOL        | PARAMETER   | CONDITIONS  | MIN. | TYP. | MAX. | UNIT |
|---------------|---|---|------|------|------|------|
| $C_{re}$      | feedback capacitance                                | $I_C = 0$ ; $V_{CB} = 6$ V; $f = 1$ MHz                               | –    | 0.4  | –    | pF   |
| $f_T$         | transition frequency                                | $I_C = 30$ mA; $V_{CE} = 6$ V; $f_m = 1$ GHz                          | –    | 8.5  | –    | GHz  |
| $G_{UM}$      | maximum unilateral power gain                       | $I_C = 30$ mA; $V_{CE} = 6$ V; $T_{amb} = 25$ °C; $f = 1$ GHz         | –    | 15   | –    | dB   |
| NF            | noise figure  | $\Gamma_S = \Gamma_{opt}$ ; $I_C = 5$ mA; $V_{CE} = 6$ V; $f = 1$ GHz | –    | 1.3  | –    | dB   |
| $P_{tot}$     | total power dissipation                             | $T_s = 60$ °C; note 1   | –    | –    | 270  | mW   |
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $P_{tot} = 270$ mW  | –    | –    | 425  | K/W  |

## Note

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

## UHF wideband transistor

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**LIMITING VALUES**

In accordance with the Absolute Maximum Rating 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                     | –    | 10   | V    |
| $V_{EBO}$   | emitter-base voltage      | open collector                | –    | 1.5  | V    |
| $I_C$       | DC collector current      |                               | –    | 100  | mA   |
| $I_{C(AV)}$ | average collector current |                               | –    | 100  | mA   |
| $P_{tot}$   | total power dissipation   | $T_s = 60\text{ °C}$ ; note 1 | –    | 270  | mW   |
| $T_{stg}$   | storage temperature       |                               | –65  | +150 | °C   |
| $T_j$       | junction temperature      |                               | –    | 175  | °C   |

**Note**

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

**THERMAL CHARACTERISTICS**

| SYMBOL        | PARAMETER   | CONDITIONS  | VALUE | UNIT |
|---------------|---|---|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $P_{tot} = 270\text{ mW}$ ; $T_s = 60\text{ °C}$ ; note 1 | 425   | K/W  |

**Note**

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

## UHF wideband transistor

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

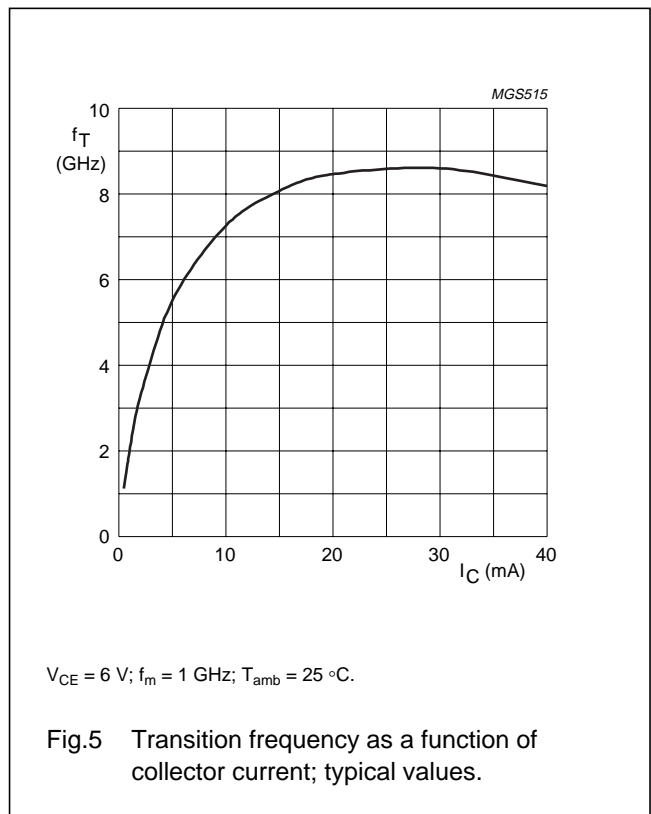
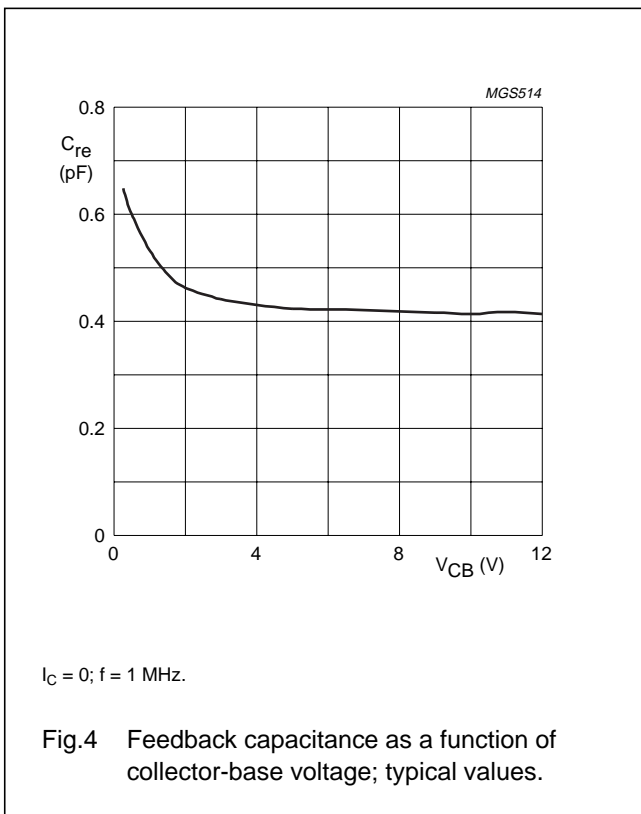
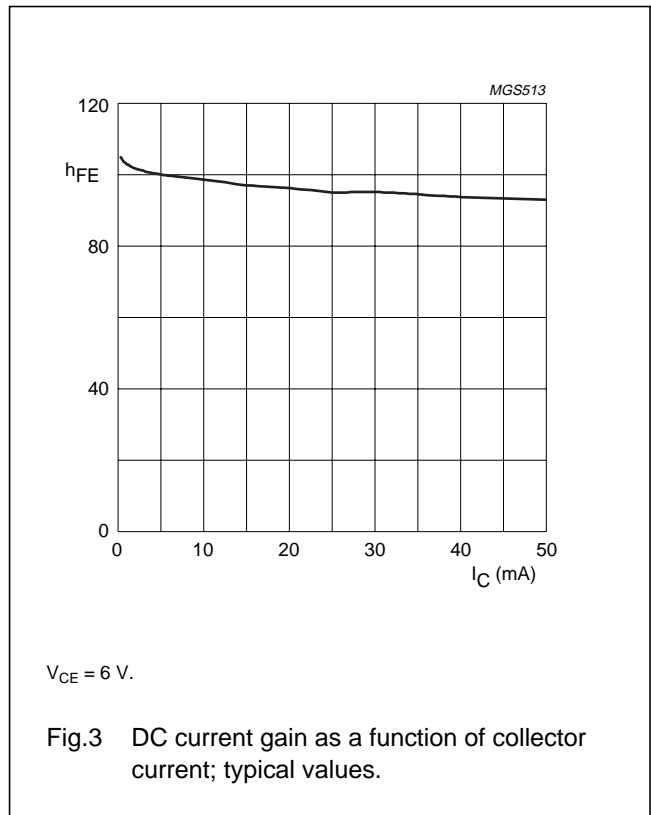
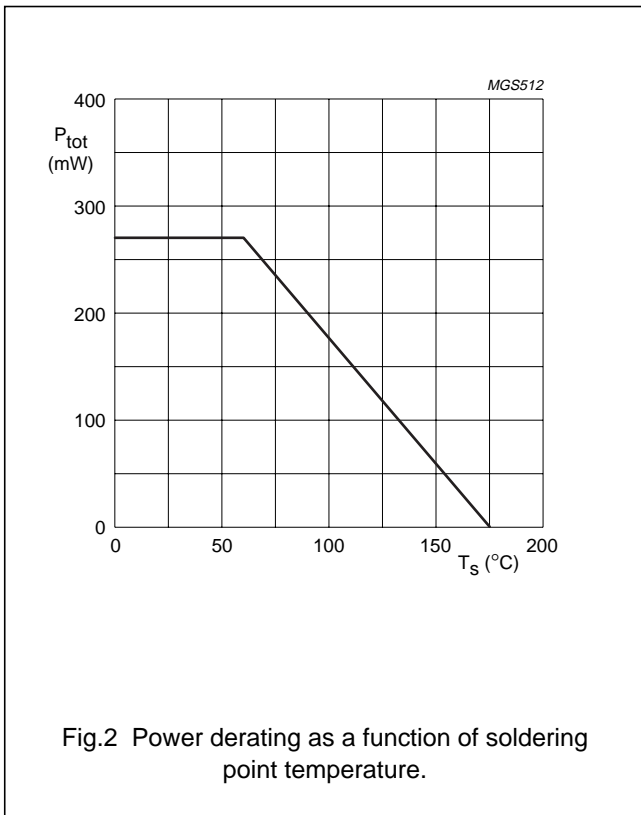
| SYMBOL                    | PARAMETER                             | CONDITIONS   | MIN. | TYP. | MAX. | UNIT |
|---------------------------|---------------------------------------|--|------|------|------|------|
| <b>DC characteristics</b> |                                       |  |      |      |      |      |
| $V_{(BR)CBO}$             | collector-base breakdown voltage      | $I_C = 100\ \mu\text{A}; I_E = 0$  | 20   | –    | –    | V    |
| $V_{(BR)CEO}$             | collector-emitter breakdown voltage   | $I_C = 100\ \mu\text{A}; I_B = 0$  | 10   | –    | –    | V    |
| $V_{(BR)EBO}$             | emitter-base breakdown voltage        | $I_E = 10\ \mu\text{A}; I_C = 0$   | 1.5  | –    | –    | V    |
| $I_{CBO}$                 | collector-base leakage current        | $V_{CB} = 10\ \text{V}; I_E = 0$   | –    | –    | 100  | nA   |
| $I_{EBO}$                 | emitter-base leakage current          | $V_{EB} = 1\ \text{V}; I_C = 0$  | –    | –    | 100  | nA   |
| $h_{FE}$                  | DC current gain                       | $I_C = 5\ \text{mA}; V_{CE} = 6\ \text{V}$   | 50   | 100  | 200  |      |
|                           |                                       | $I_C = 15\ \text{mA}; V_{CE} = 6\ \text{V}$  | –    | 100  | –    |      |
| <b>AC characteristics</b> |                                       |  |      |      |      |      |
| $C_{re}$                  | feedback capacitance                  | $I_C = 0; V_{CB} = 6\ \text{V}; f = 1\ \text{MHz}$                                     | –    | 0.4  | –    | pF   |
| $f_T$                     | transition frequency                  | $I_C = 30\ \text{mA}; V_{CE} = 6\ \text{V}; f_m = 1\ \text{GHz}$                       | –    | 8.5  | –    | GHz  |
| $ s_{21} ^2$              | insertion gain                        | $I_C = 30\ \text{mA}; V_{CE} = 6\ \text{V}; f = 1\ \text{GHz}$                         | –    | 14   | –    | dB   |
| $G_{UM}$                  | maximum unilateral power gain; note 1 | $I_C = 30\ \text{mA}; V_{CE} = 6\ \text{V}; T_{amb} = 25\text{ °C}; f = 1\ \text{GHz}$ | –    | 15   | –    | dB   |
|                           |                                       | $I_C = 30\ \text{mA}; V_{CE} = 6\ \text{V}; T_{amb} = 25\text{ °C}; f = 2\ \text{GHz}$ | –    | 9.2  | –    | dB   |
| NF                        | noise figure                          | $\Gamma_S = \Gamma_{opt}; I_C = 5\ \text{mA}; V_{CE} = 6\ \text{V}; f = 1\ \text{GHz}$ | –    | 1.3  | –    | dB   |
|                           |                                       | $\Gamma_S = \Gamma_{opt}; I_C = 5\ \text{mA}; V_{CE} = 6\ \text{V}; f = 2\ \text{GHz}$ | –    | 1.8  | –    | dB   |

**Note**

1.  $G_{UM}$  is the maximum unilateral power gain, assuming  $s_{12}$  is zero.  $G_{UM} = 10 \log \frac{|s_{21}|^2}{(1 - |s_{11}|^2)(1 - |s_{22}|^2)}$  dB

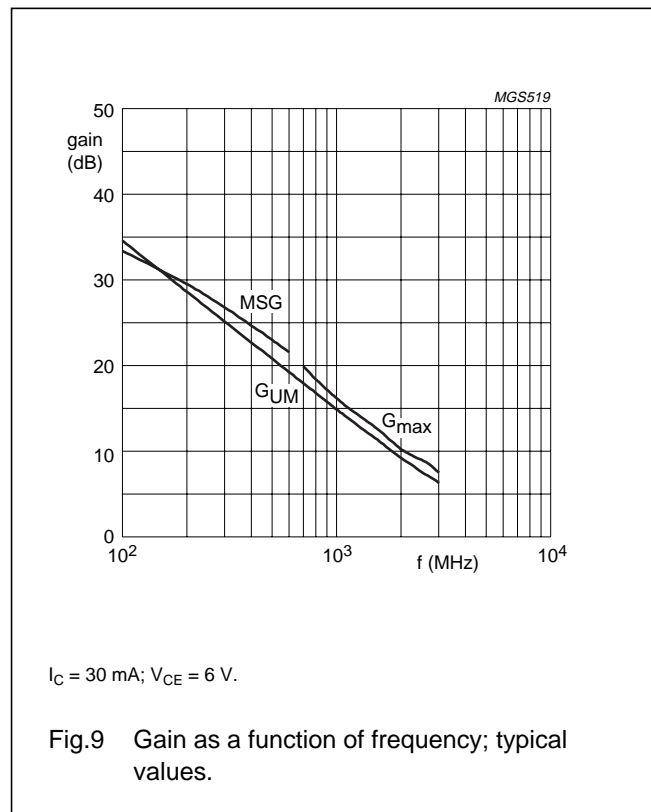
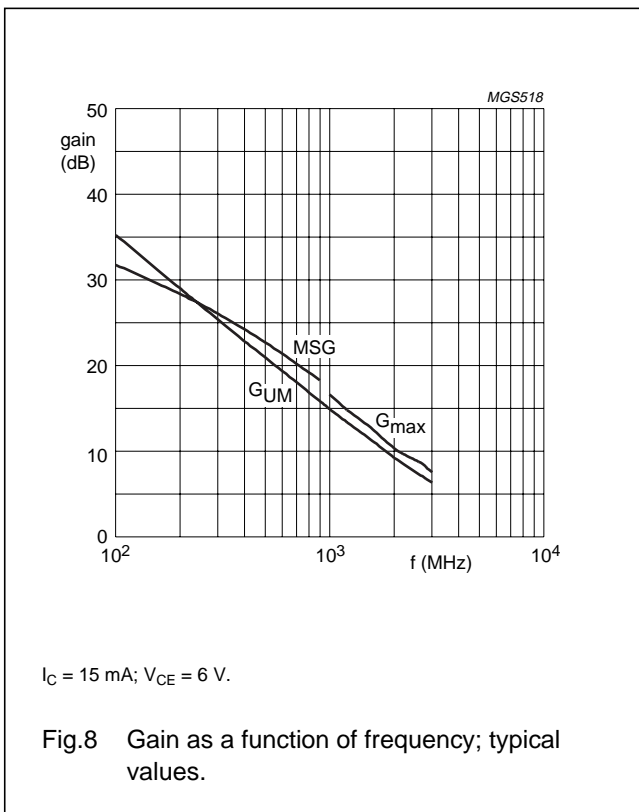
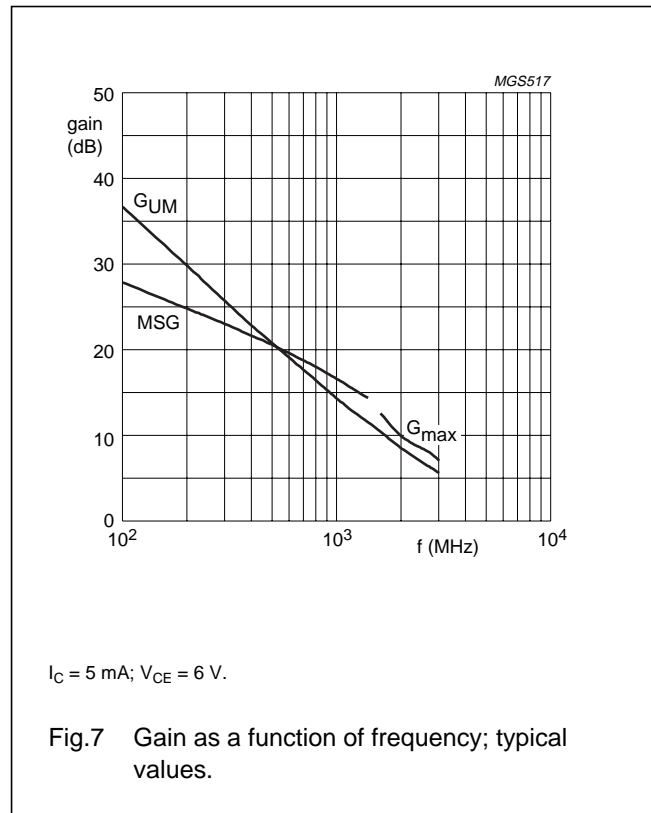
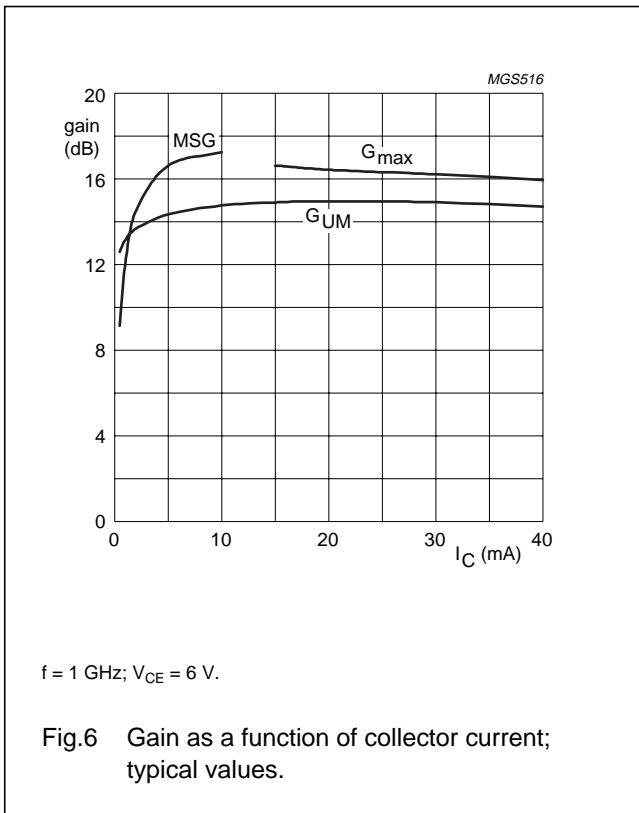
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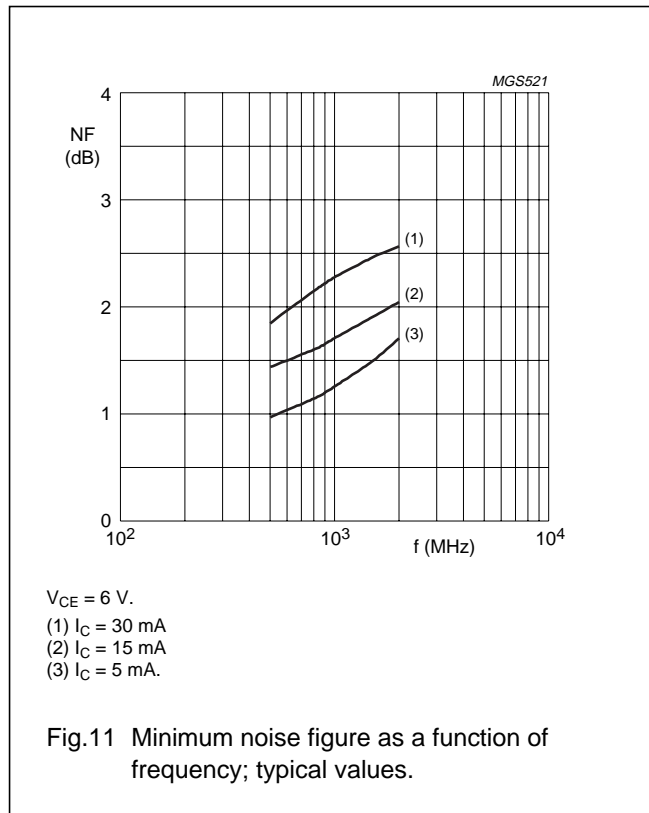
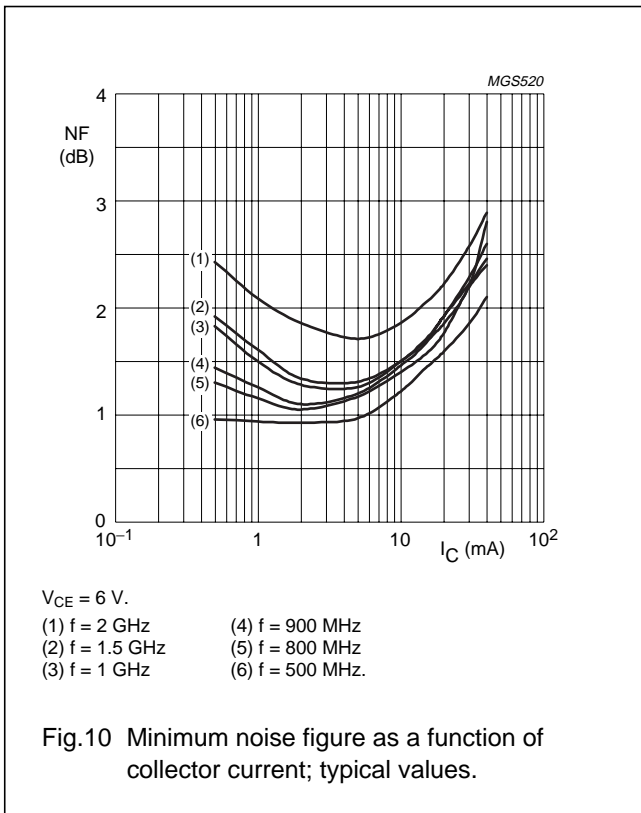
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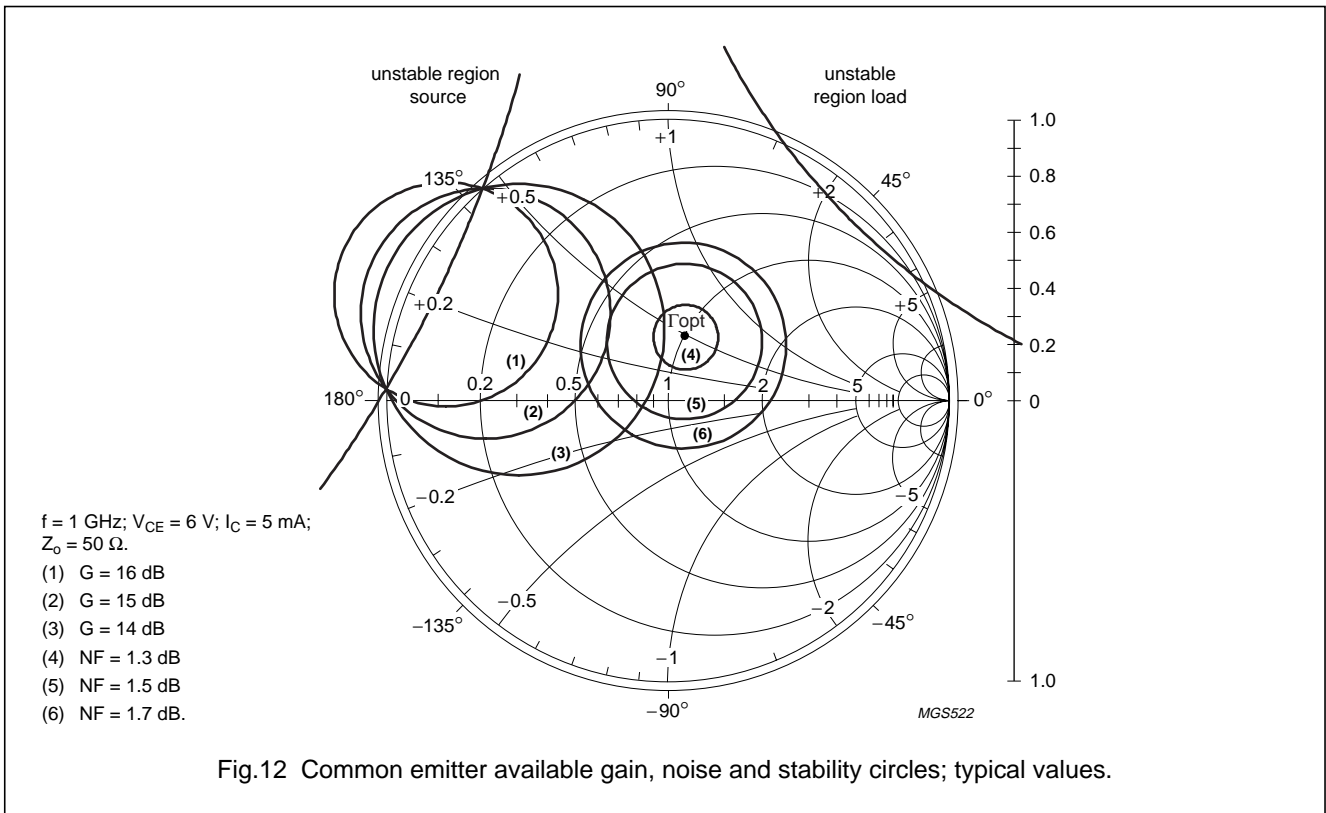


Fig.12 Common emitter available gain, noise and stability circles; typical values.

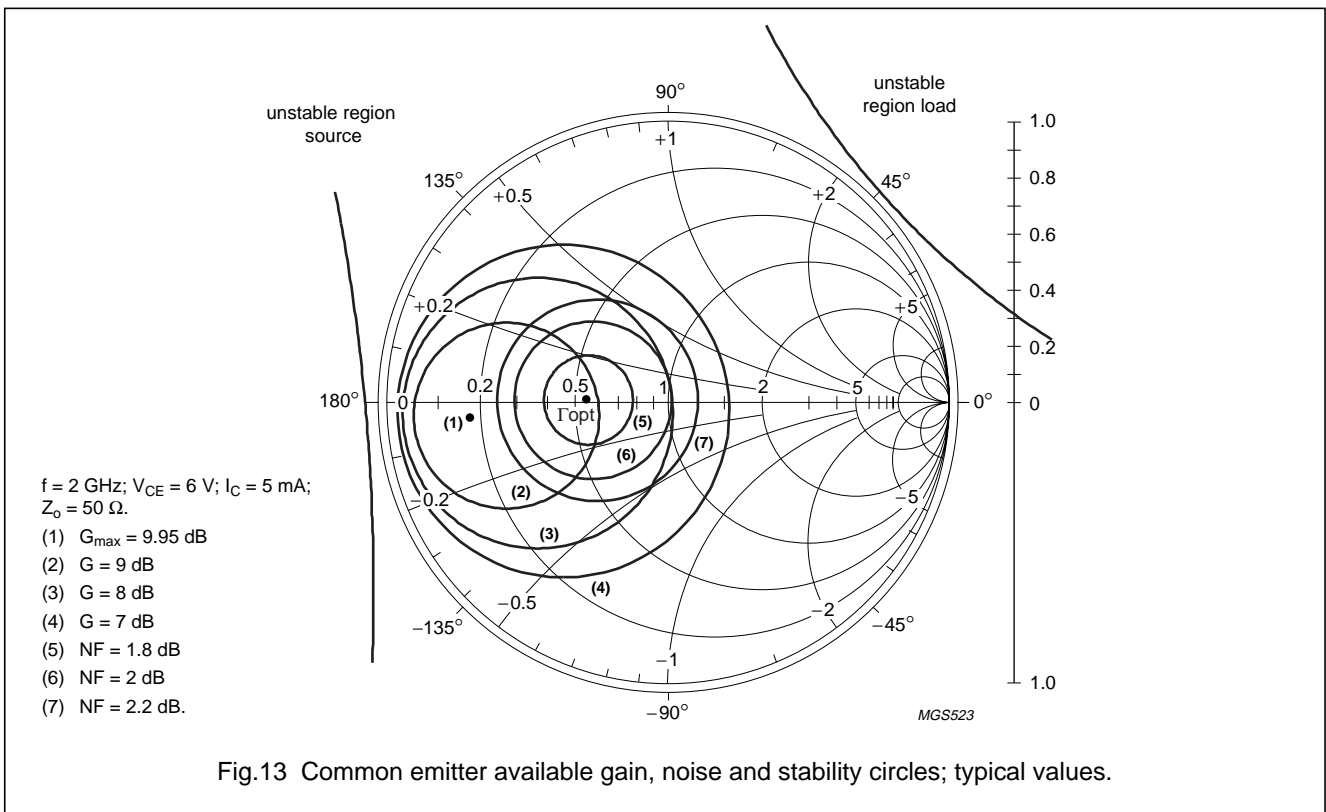


Fig.13 Common emitter available gain, noise and stability circles; typical values.



UHF wideband transistor

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APPLICATION INFORMATION

SPICE parameters for the PRF957 die

| SEQUENCE No.      | PARAMETER | VALUE | UNIT |
|-------------------|-----------|-------|------|
| 1                 | IS        | 0.963 | fA   |
| 2                 | BF        | 102.3 | –    |
| 3                 | NF        | 1.002 | –    |
| 4                 | VAF       | 64.75 | V    |
| 5                 | IKF       | 841.1 | mA   |
| 6                 | ISE       | 35.77 | fA   |
| 7                 | NE        | 2.138 | –    |
| 8                 | BR        | 90.16 | –    |
| 9                 | NR        | 1.000 | –    |
| 10                | VAR       | 3.198 | V    |
| 11                | IKR       | 25.77 | mA   |
| 12                | ISC       | 156.6 | aA   |
| 13                | NC        | 1.047 | –    |
| 14                | RB        | 6.071 | Ω    |
| 15                | IRB       | 0.000 | μA   |
| 16                | RBM       | 2.478 | Ω    |
| 17                | RE        | 0.164 | Ω    |
| 18                | RC        | 1.315 | Ω    |
| 19 <sup>(1)</sup> | XTB       | 0.000 | –    |
| 20 <sup>(1)</sup> | EG        | 1.110 | eV   |
| 21 <sup>(1)</sup> | XTI       | 3.000 | –    |
| 22                | CJE       | 1.161 | pF   |
| 23                | VJE       | 600.0 | mV   |
| 24                | MJE       | 0.394 | –    |
| 25                | TF        | 3.073 | ps   |
| 26                | XTF       | 10.25 | –    |
| 27                | VTF       | 4.599 | V    |
| 28                | ITF       | 53.49 | mA   |
| 29                | PTF       | 0.000 | deg  |
| 30                | CJC       | 409.9 | fF   |
| 31                | VJC       | 287.1 | mV   |
| 32                | MJC       | 0.111 | –    |
| 33                | XCJC      | 0.104 | –    |
| 34                | TR        | 0.000 | ps   |
| 35 <sup>(1)</sup> | CJS       | 0.000 | F    |
| 36 <sup>(1)</sup> | VJS       | 700.0 | mV   |
| 37 <sup>(1)</sup> | MJS       | 0.000 | –    |

| SEQUENCE No.      | PARAMETER        | VALUE  | UNIT |
|-------------------|------------------|--------|------|
| 38                | FC               | 0.888  | –    |
| 39 <sup>(2)</sup> | C <sub>bbp</sub> | 73.00  | fF   |
| 40 <sup>(2)</sup> | C <sub>bpe</sub> | 131.00 | fF   |

Notes

1. These parameters have not been extracted, the default values are shown.
2. C<sub>bbp</sub>, C<sub>bpe</sub>: base-bondpad and emitter-bondpad capacitance to collector.

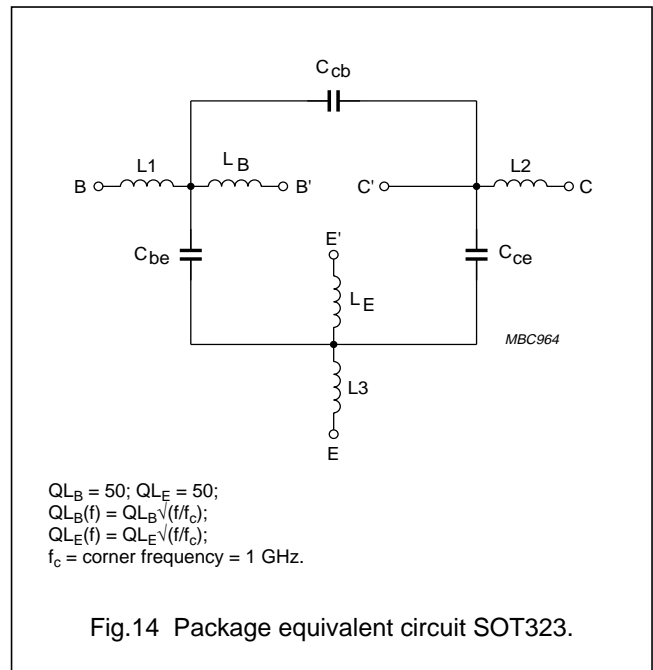


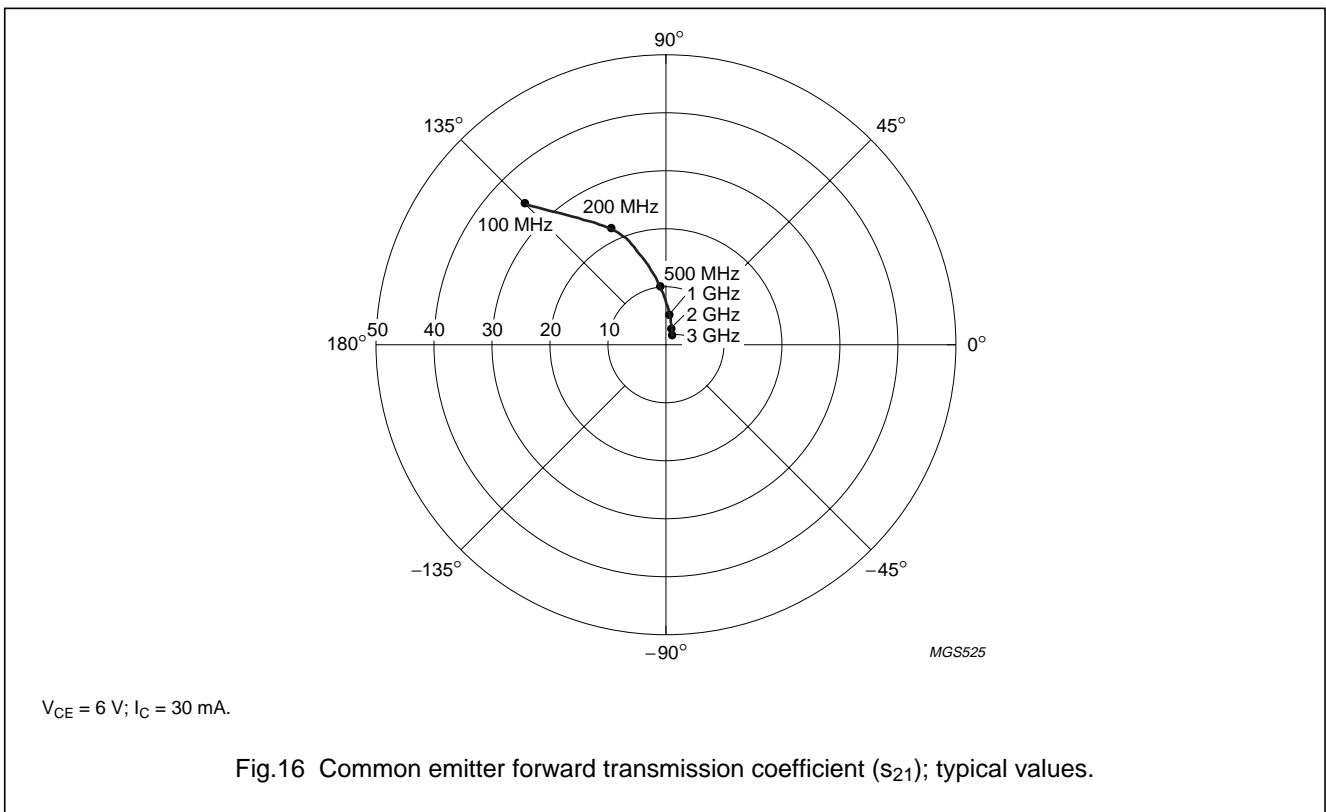
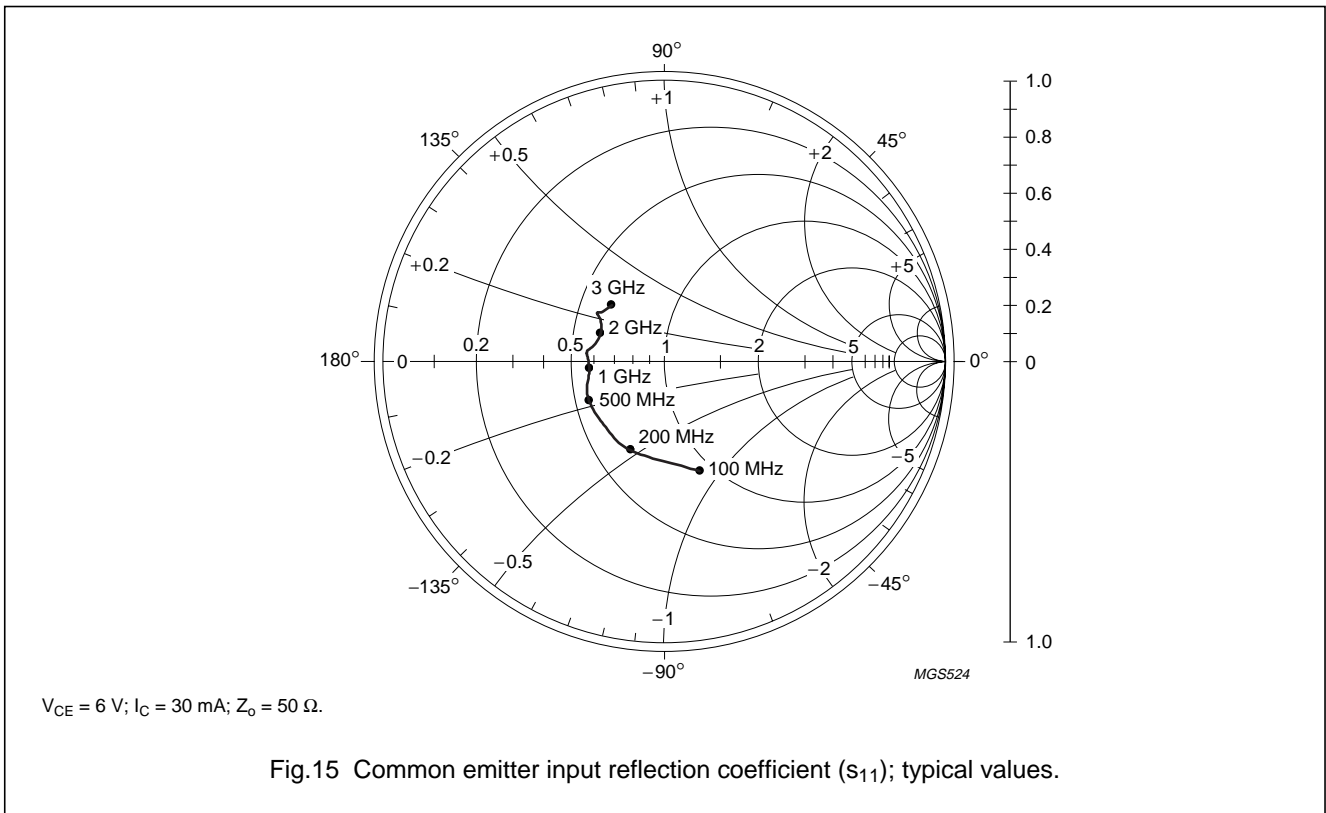
Fig.14 Package equivalent circuit SOT323.

List of components (see Fig.14)

| DESIGNATION     | VALUE | UNIT |
|-----------------|-------|------|
| C <sub>be</sub> | 2     | fF   |
| C <sub>cb</sub> | 100   | fF   |
| C <sub>ce</sub> | 100   | fF   |
| L1              | 0.34  | nH   |
| L2              | 0.10  | nH   |
| L3              | 0.34  | nH   |
| L <sub>B</sub>  | 0.60  | nH   |
| L <sub>E</sub>  | 0.60  | nH   |

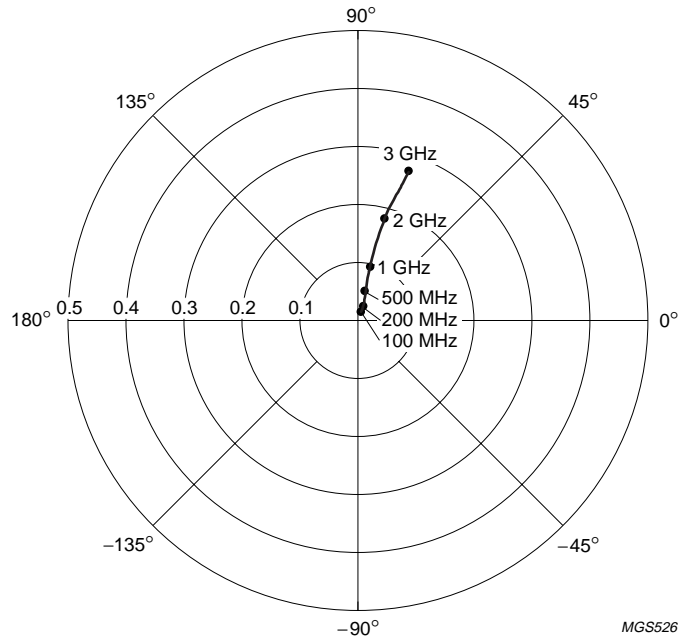
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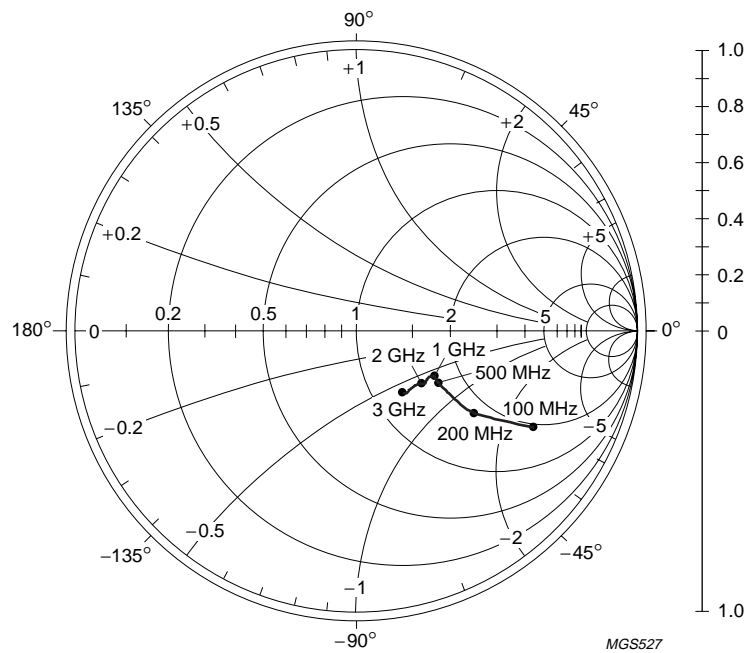
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$V_{CE} = 6\text{ V}; I_C = 30\text{ mA}$ .

MGS526

Fig.17 Common emitter reverse transmission coefficient ( $s_{12}$ ); typical values.



$V_{CE} = 6\text{ V}; I_C = 30\text{ mA}; Z_0 = 50\ \Omega$ .

MGS527

Fig.18 Common emitter output reflection coefficient ( $s_{22}$ ); typical values.

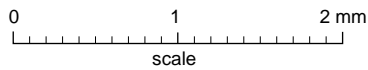
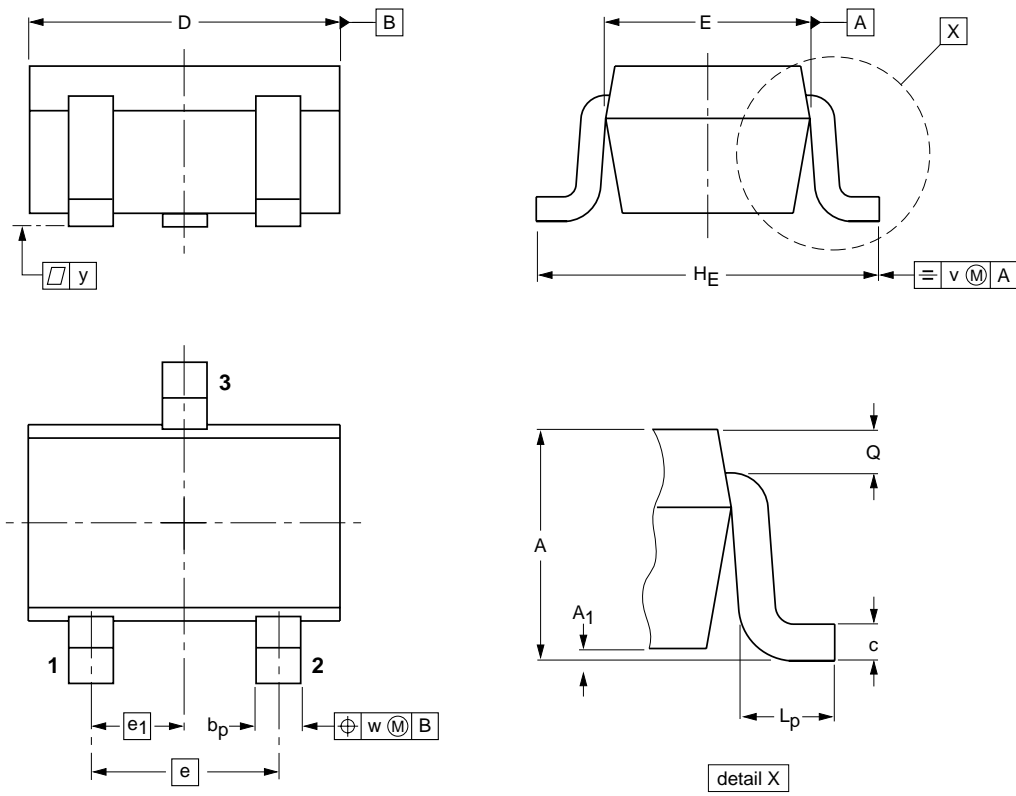
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PACKAGE OUTLINE

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

## UHF wideband transistor

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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.   |   |

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**NOTES**

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**NOTES**

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