# UHF wideband transistor PBR941

## FEATURES

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

## APPLICATIONS

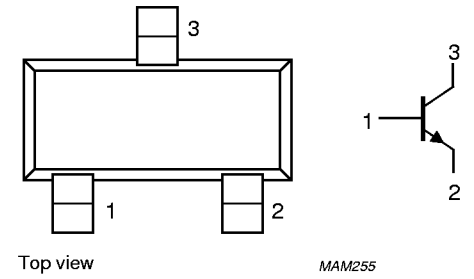
- Communication and instrumentation systems.

## DESCRIPTION

Silicon NPN transistor in a surface mount 3-pin SOT23 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 - SOT23

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




**Marking code**: V0.

Fig.1 Simplified outline and symbol.

## QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|
| $C_{re}$ | feedback capacitance | $I_C$ = 0; $V_{CB}$ = 6 V; f = 1 MHz | 0.3 | – | pF |
| $f_T$ | transition frequency | $I_C$ = 15 mA; $V_{CE}$ = 6 V; $f_m$ = 1 GHz | 8 | – | GHz |
| $G_{UM}$ | maximum unilateral power gain | $I_C$ = 15 mA; $V_{CE}$ = 6 V; f = 1 GHz; $T_{amb}$ = 25 °C | 15 | – | dB |
| F | noise figure | $\Gamma_S = \Gamma_{opt}$; $I_C$ = 5 mA; $V_{CE}$ = 6 V; f = 1 GHz | 1.4 | – | dB |
| $P_{tot}$ | total power dissipation | $T_s$ = 60 °C; note 1 | – | 360 | mW |
| $R_{th\ j\text{-}s}$ | thermal resistance from junction to soldering point | $P_{tot}$ = 360 mW | – | 320 | K/W |

**Note**

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

## 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 |
| $I_C$ | collector current (DC) | | – | 50 | mA |
| $I_{C(AV)}$ | average collector current | | – | 50 | mA |
| $P_{tot}$ | total power dissipation | $T_s$ = 60 °C; note 1 | – | 360 | 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 pin.

## THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---|---|---|---|---|
| $R_{th\ j\text{-}s}$ | thermal resistance from junction to soldering point; note 1 | $P_{tot}$ = 360 mW; $T_s$ = 60 °C; note 1 | 320 | K/W |

**Note**

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

## CHARACTERISTICS

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

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| **DC characteristics** | | | | | | |
| $V_{(BR)CBO}$ | collector-base breakdown voltage | $I_C$ = 100 μA; $I_E$ = 0 | 20 | – | – | V |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage | $I_C$ = 100 μA; $I_B$ = 0 | 10 | – | – | V |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage | $I_E$ = 10 μA; $I_C$ = 0 | 1.5 | – | – | V |
| $I_{CBO}$ | collector-base leakage current | $V_{CB}$ = 10 V; $I_E$ = 0 | – | – | 100 | nA |
| $I_{EBO}$ | emitter-base leakage current | $V_{EB}$ = 1 V; $I_C$ = 0 | – | – | 100 | nA |
| $h_{FE}$ | DC current gain | $I_C$ = 5 mA; $V_{CE}$ = 6 V | 50 | 100 | 200 | |
| | | $I_C$ = 15 mA; $V_{CE}$ = 6 V | – | 100 | – | |
| **AC characteristics** | | | | | | |
| $C_{re}$ | feedback capacitance | $I_C$ = 0; $V_{CB}$ = 6 V; f = 1 MHz | – | 0.3 | – | pF |
| $f_T$ | transition frequency | $I_C$ = 15 mA; $V_{CE}$ = 6 V; f = 1 GHz | – | 8 | – | GHz |
| $G_{UM}$ | maximum unilateral power gain; note 1 | $I_C$ = 15 mA; $V_{CE}$ = 6 V; $T_{amb}$ = 25 °C; f = 1 GHz | – | 15 | – | dB |
| | | $I_C$ = 15 mA; $V_{CE}$ = 6 V; $T_{amb}$ = 25 °C; f = 2 GHz | – | 9.5 | – | dB |
| F | noise figure | $\Gamma_S = \Gamma_{opt}$; $I_C$ = 5 mA; $V_{CE}$ = 6 V; f = 1 GHz | – | 1.4 | – | dB |
| | | $\Gamma_S = \Gamma_{opt}$; $I_C$ = 5 mA; $V_{CE}$ = 6 V; f = 2 GHz | – | 2 | – | 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

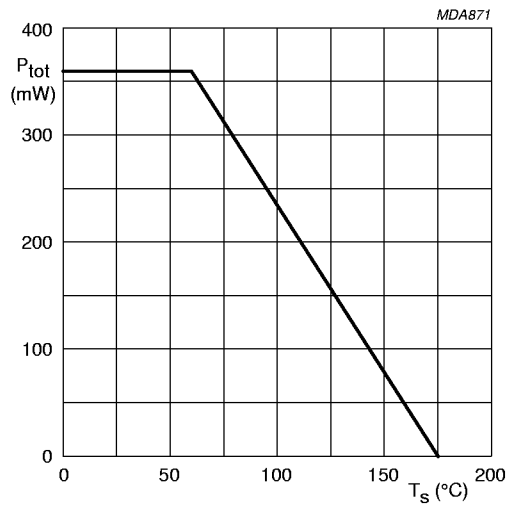
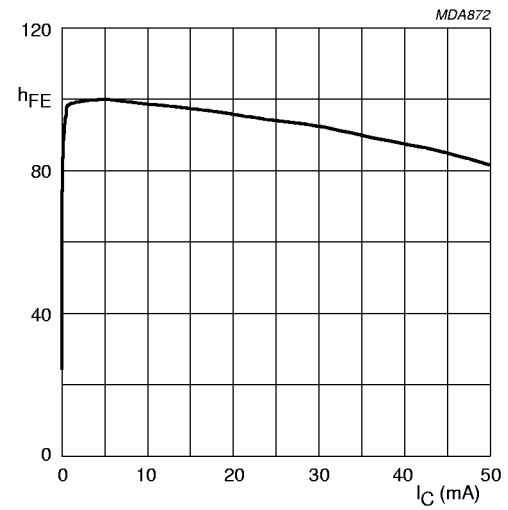
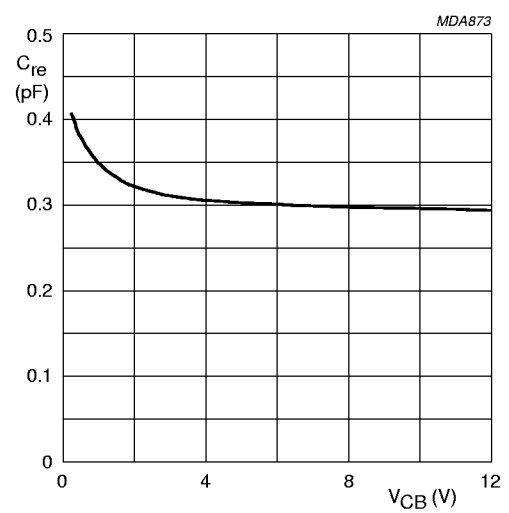



Fig.2 Power derating as a function of soldering point temperature.



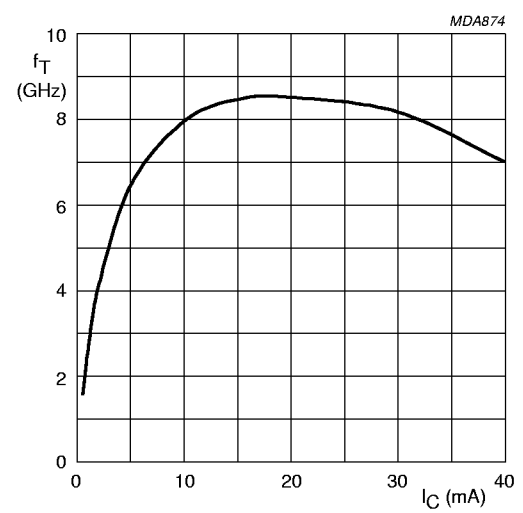

$V_{CE}$ = 6 V.

Fig.3 DC current gain as a function of collector current; typical values.



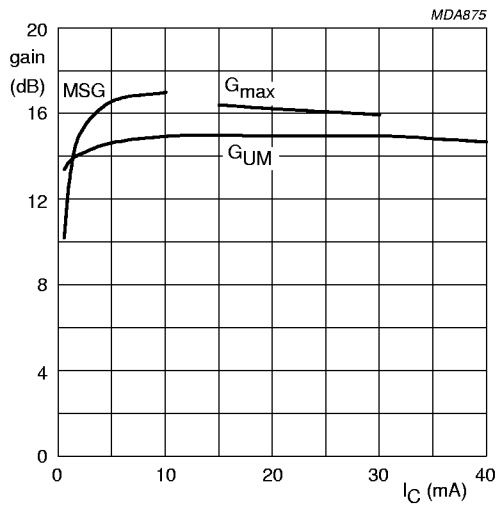

$I_C$ = 0; f = 1 MHz.

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



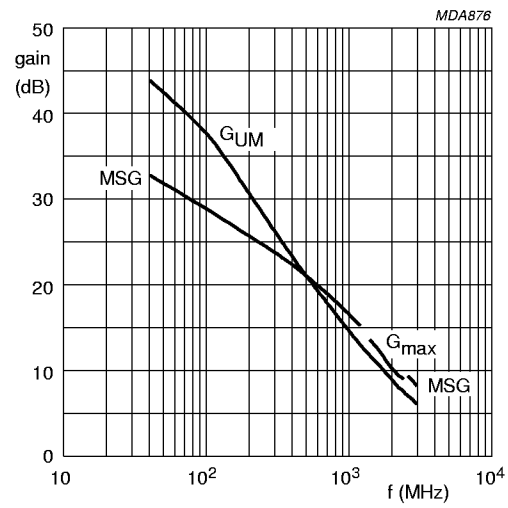

$V_{CE}$ = 6 V; f = 1 GHz; $T_{amb}$ = 25 °C.

Fig.5 Transition frequency as a function of collector current; typical values.



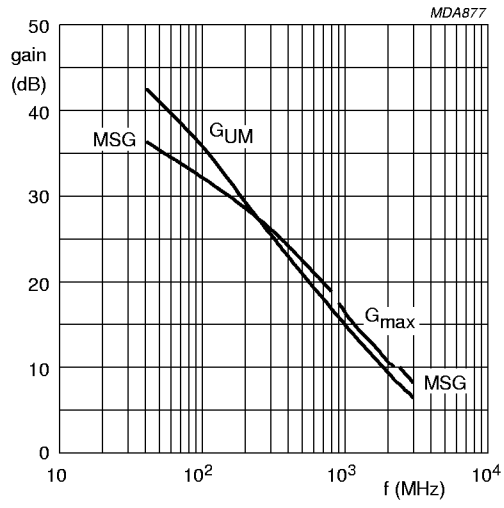

$f = 1$ GHz; $V_{CE} = 6$ V.

Fig.6 Gain as a function of collector current; typical values.



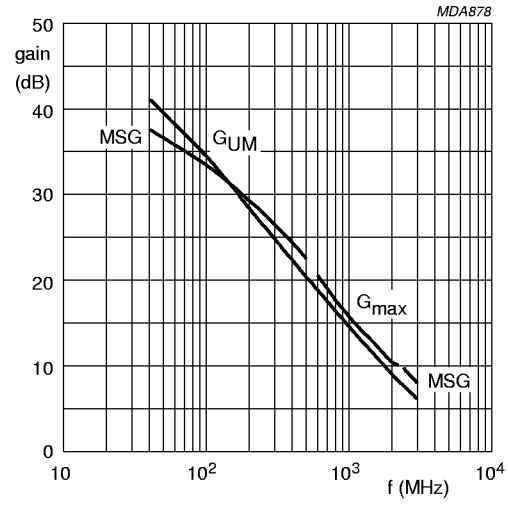

$I_C = 5$ mA; $V_{CE} = 6$ V.

Fig.7 Gain as a function of frequency; typical values.



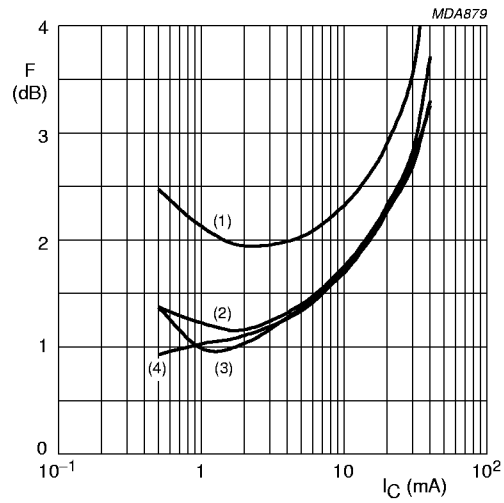

$I_C = 15$ mA; $V_{CE} = 6$ V.

Fig.8 Gain as a function of frequency; typical values.




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

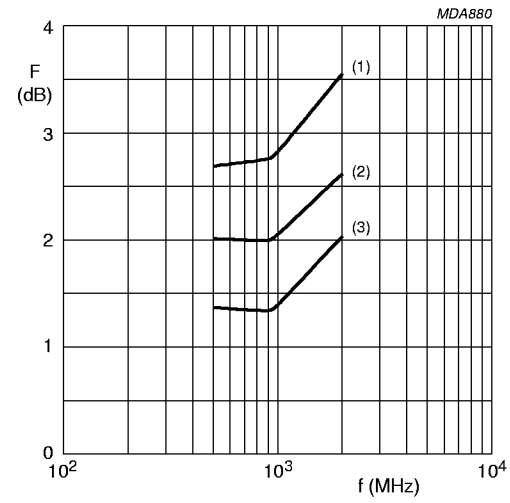
Fig.9 Gain as a function of frequency; typical values.




$V_{CE}$ = 6 V.

(1) f = 2000 MHz.
(2) f = 1000 MHz.
(3) f = 500 MHz.
(4) f = 900 MHz.

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




$V_{CE}$ = 6 V.

(1) $I_C$ = 30 mA.
(2) $I_C$ = 15 mA.
(3) $I_C$ = 5 mA.

Fig.11 Minimum noise figure as a function of frequency, typical values.

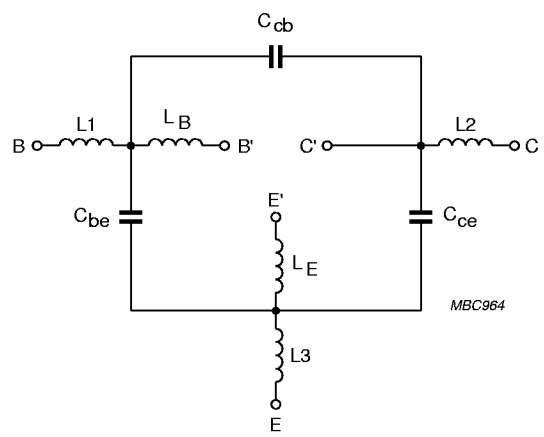
## APPLICATION INFORMATION

### SPICE parameters for the PBR941 die

| SEQUENCE No. | PARAMETER | VALUE | UNIT |
|---|---|---|---|
| 1 | IS | 0.466 | fA |
| 2 | BF | 150.4 | – |
| 3 | NF | 1.000 | – |
| 4 | VAF | 53.06 | V |
| 5 | IKF | 180.0 | mA |
| 6 | ISE | 57.30 | fA |
| 7 | NE | 2.000 | – |
| 8 | BR | 27.68 | – |
| 9 | NR | 1.000 | – |
| 10 | VAR | 1.976 | V |
| 11 | IKR | 9.943 | mA |
| 12 | ISC | 1.420 | aA |
| 13 | NC | 1.000 | – |
| 14 | RB | 12.14 | Ω |
| 15 | IRB | 0.000 | μA |
| 16 | RBM | 4.957 | Ω |
| 17 | RE | 0.597 | Ω |
| 18 | RC | 1.988 | Ω |
| 19(1) | XTB | 0.000 | – |
| 20(1) | EG | 1.110 | eV |
| 21(1) | XTI | 3.000 | – |
| 22 | CJE | 0.568 | pF |
| 23 | VJE | 600.0 | mV |
| 24 | MJE | 0.412 | – |
| 25 | TF | 2.037 | ps |
| 26 | XTF | 30.90 | – |
| 27 | VTF | 3.148 | V |
| 28 | ITF | 131.8 | mA |
| 29 | PTF | 0.000 | deg |
| 30 | CJC | 205.8 | fF |
| 31 | VJC | 296.2 | mV |
| 32 | MJC | 0.118 | – |
| 33 | XCJC | 0.104 | – |
| 34 | TR | 0.000 | ps |
| 35(1) | CJS | 0.000 | F |
| 36(1) | VJS | 700.0 | mV |
| 37(1) | MJS | 0.000 | – |
| 38 | FC | 0.943 | – |
| 39(2) | $C_{bpb}$ | 83.00 | fF |
| 40(2) | $C_{bpe}$ | 84.00 | fF |
| 41 | AF | 1.000 | – |
| 42 | KF | $4 \times 10^{-16}$ | – |

**Notes**

1. These parameters have not been extracted, the default values are shown.
2. $C_{bpb}$, $C_{bpe}$; base-bondpad and emitter-bondpad capacitance to collector.

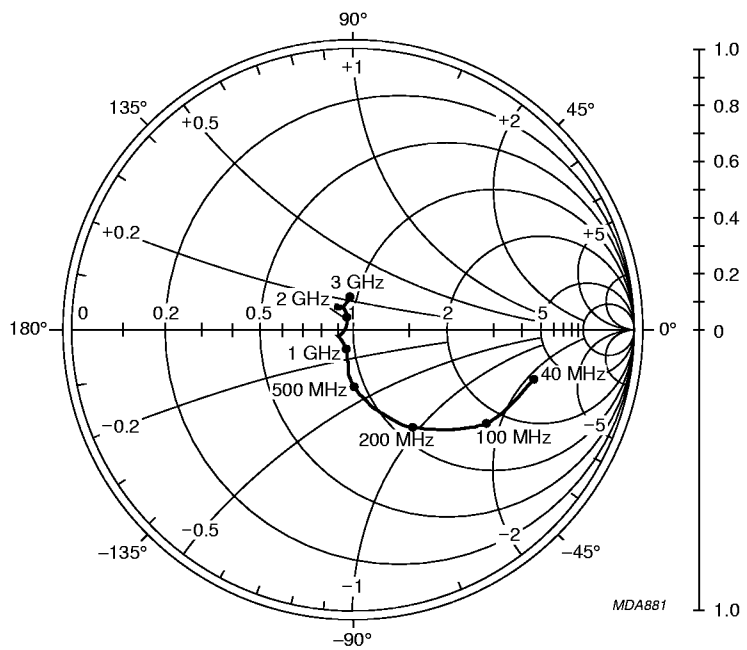



$QL_B = 50$; $QL_E = 50$; $QL_{B,E}(f) = QL_{B,E}\sqrt{(f/f_c)}$;
$f_c$ = scaling frequency = 1 GHz.

Fig.12 Package equivalent circuit SOT23.

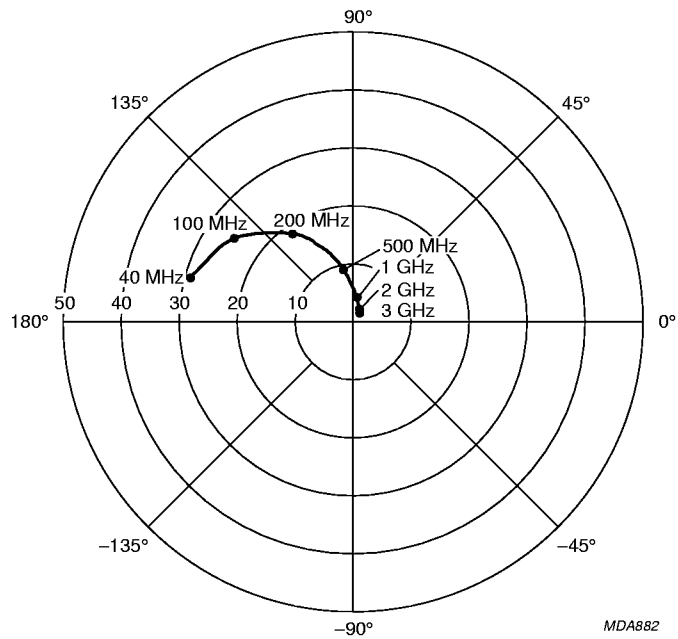
**List of components** (see Fig.12)

| DESIGNATION | VALUE | UNIT |
|---|---|---|
| $C_{be}$ | 7 | fF |
| $C_{cb}$ | 80 | fF |
| $C_{ce}$ | 80 | fF |
| L1 | 0.35 | nH |
| L2 | 0.17 | nH |
| L3 | 0.35 | nH |
| $L_B$ | 0.40 | nH |
| $L_E$ | 0.83 | nH |



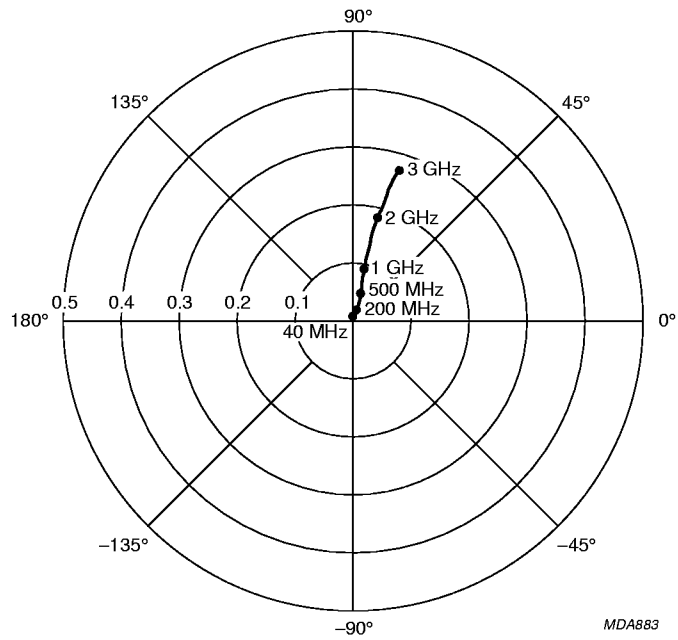

$V_{CE}$ = 6 V; $I_C$ = 15 mA; $Z_o$ = 50 Ω.

Fig.13 Common emitter input reflection coefficient ($S_{11}$); typical values.



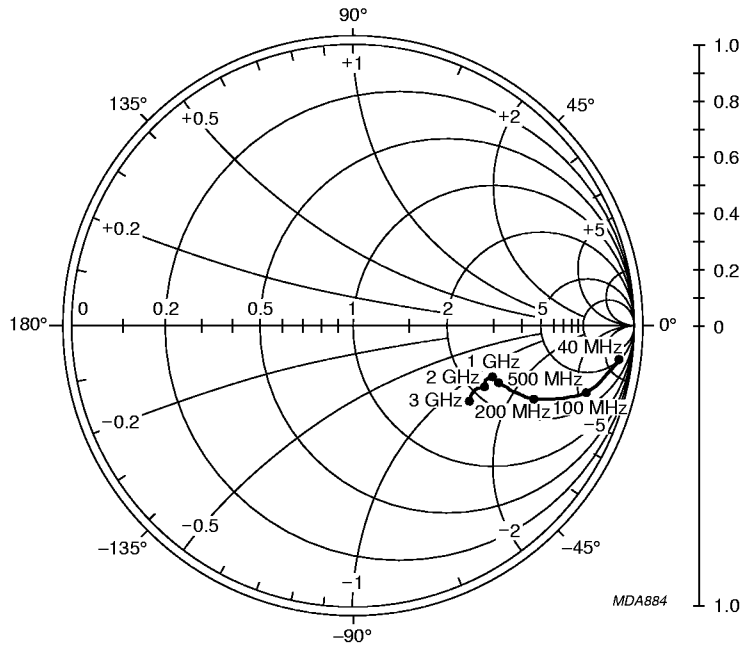

$V_{CE}$ = 6 V; $I_C$ = 15 mA.

Fig.14 Common emitter forward transmission coefficient ($S_{21}$); typical values.



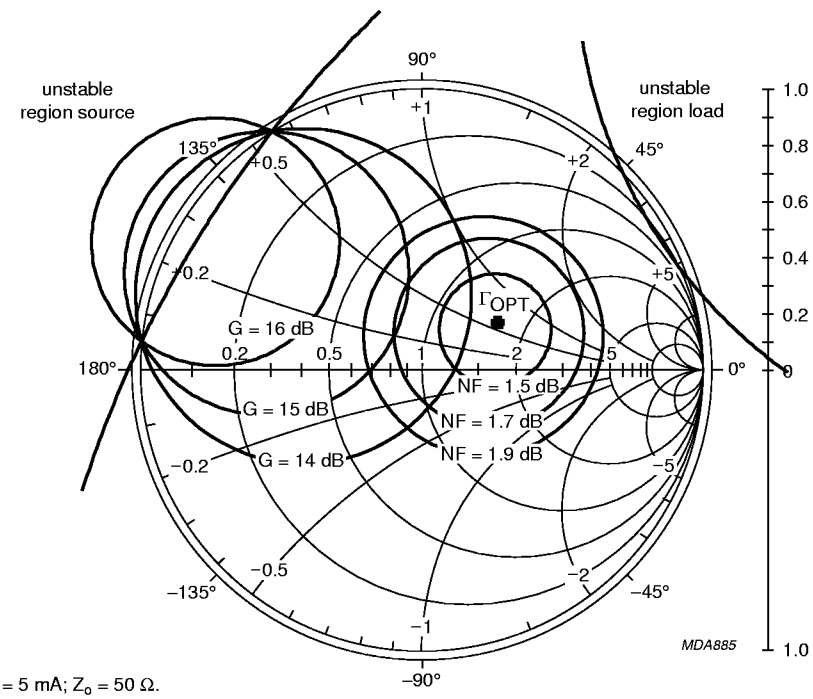

$V_{CE}$ = 6 V; $I_C$ = 15 mA.

Fig.15 Common emitter reverse transmission coefficient ($S_{12}$); typical values.



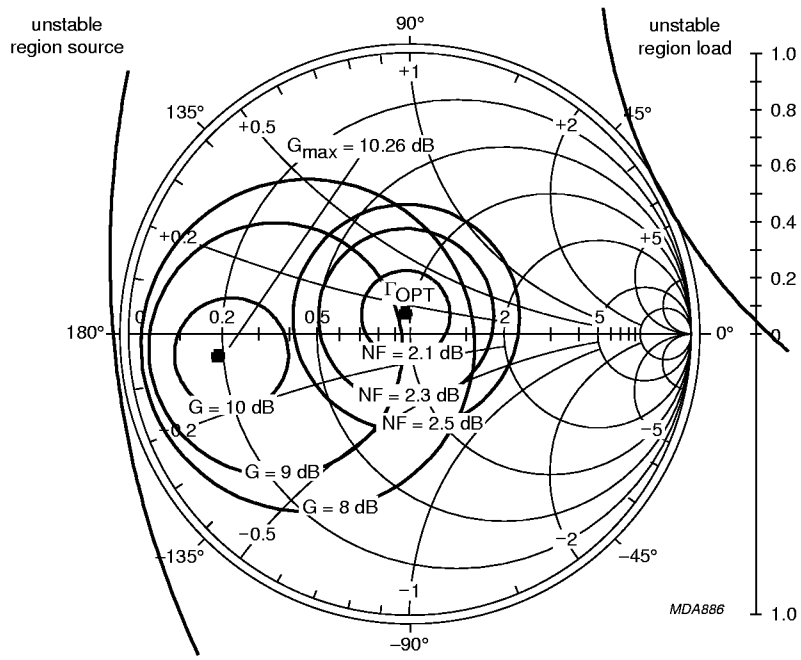

$V_{CE}$ = 6 V; $I_C$ = 15 mA; $Z_o$ = 50 Ω.

Fig.16 Common emitter output reflection coefficient ($S_{22}$); typical values.




f = 1 GHz; $V_{CE}$ = 6 V; $I_C$ = 5 mA; $Z_o$ = 50 Ω.

Fig.17 Common emitter available gain circles; typical values.

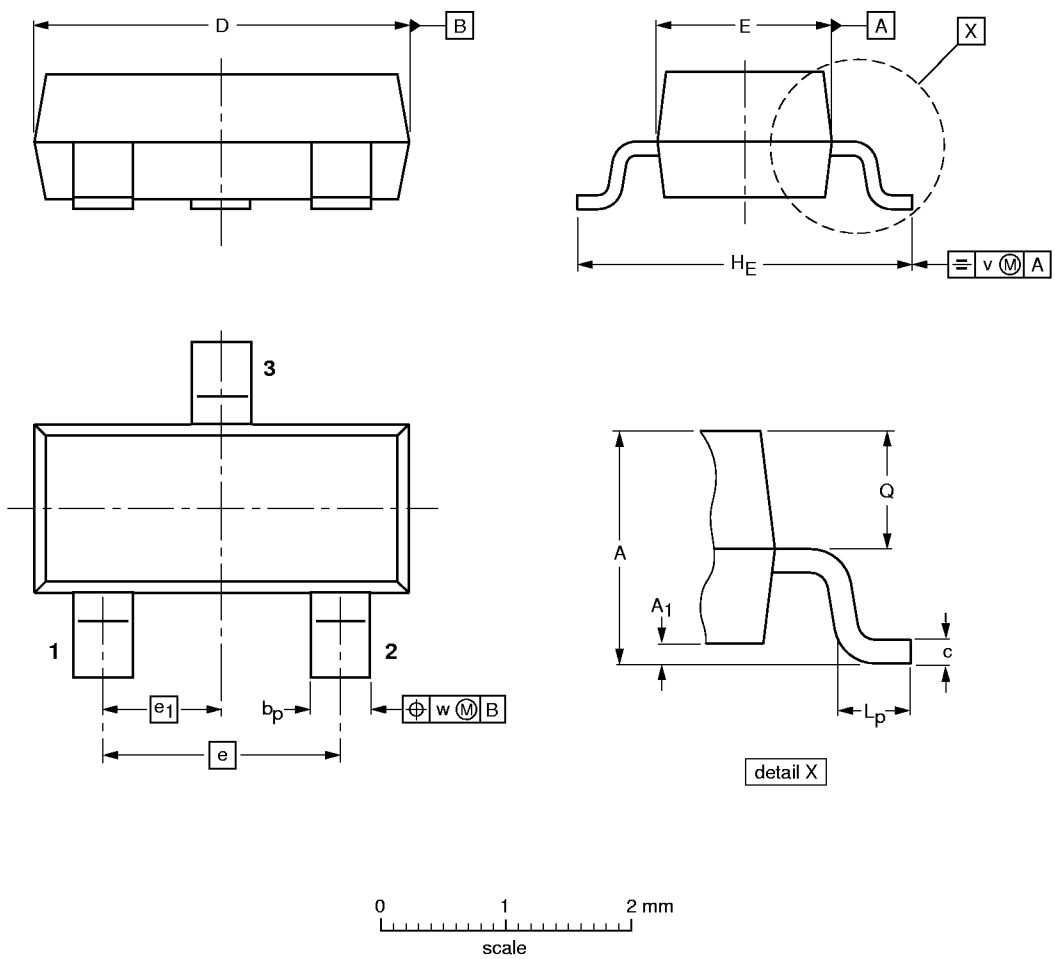



f = 2 GHz; $V_{CE}$ = 6 V; $I_C$ = 5 mA; $Z_o$ = 50 Ω.

Fig.18 Common emitter available gain circles; typical values.

## 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 | EIAJ | | | |
| SOT23 | | | | | | 97-02-28 |