

# DATA SHEET

**BF547W**

**NPN 1 GHz wideband transistor**

Product specification

June 1994

Supersedes data of November 1992

File under Discrete Semiconductors, SC14

**Philips Semiconductors**



**PHILIPS**

## NPN 1 GHz wideband transistor

## BF547W

## FEATURES

- Stable oscillator operation
- High current gain
- Good thermal stability.

## APPLICATIONS

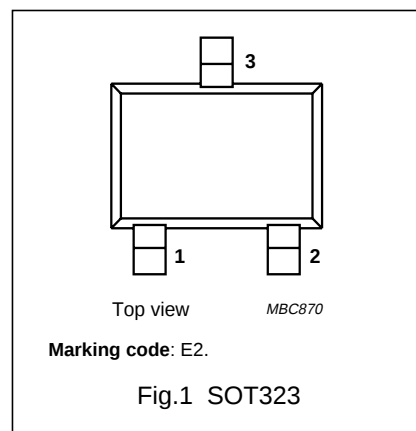
It is primarily intended as a mixer, oscillator and IF amplifier in UHF and VHF tuners.

## DESCRIPTION

Silicon NPN transistor in a plastic SOT323 (S-mini) package. The BF547W uses the same crystal as the SOT23 version, BF547.

## PINNING

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



## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                     | CONDITIONS                                                                                                   | MIN. | TYP. | MAX. | UNIT |
|-----------|-------------------------------|--------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $V_{CBO}$ | collector-base voltage        | open emitter                                                                                                 | —    | —    | 30   | V    |
| $V_{CEO}$ | collector-emitter voltage     | open base                                                                                                    | —    | —    | 20   | V    |
| $I_C$     | collector current (DC)        |                                                                                                              | —    | —    | 50   | mA   |
| $P_{tot}$ | total power dissipation       | up to $T_s = 63\text{ }^{\circ}\text{C}$ ; note 1                                                            | —    | —    | 300  | mW   |
| $h_{FE}$  | DC current gain               | $I_C = 2\text{ mA}$ ; $V_{CE} = 10\text{ V}$                                                                 | 40   | 95   | 250  |      |
| $C_{re}$  | feedback capacitance          | $I_C = 0$ ; $V_{CB} = 10\text{ V}$ ; $f = 1\text{ MHz}$                                                      | —    | 1    | —    | pF   |
| $f_T$     | transition frequency          | $I_C = 15\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 500\text{ MHz}$                                         | 0.8  | 1.2  | 1.6  | GHz  |
| $G_{UM}$  | maximum unilateral power gain | $I_C = 1\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 100\text{ MHz}$ ; $T_{amb} = 25\text{ }^{\circ}\text{C}$ | —    | 20   | —    | dB   |

## 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                                      | —    | 30   | V                  |
| $V_{CEO}$ | collector-emitter voltage | open base                                         | —    | 20   | V                  |
| $V_{EBO}$ | emitter-base voltage      | open collector                                    | —    | 3    | V                  |
| $I_C$     | collector current (DC)    |                                                   | —    | 50   | mA                 |
| $P_{tot}$ | total power dissipation   | up to $T_s = 63\text{ }^{\circ}\text{C}$ ; note 1 | —    | 300  | mW                 |
| $T_{stg}$ | storage temperature       |                                                   | −65  | +150 | $^{\circ}\text{C}$ |
| $T_j$     | junction temperature      |                                                   | —    | +150 | $^{\circ}\text{C}$ |

## Note to the “Quick reference data” and “Limiting values”

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

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## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                          | VALUE | UNIT |
|---------------|-----------------------------------------------------|-------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | up to $T_s = 63\text{ °C}$ ; note 1 | 290   | K/W  |

## Note

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

## CHARACTERISTICS

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

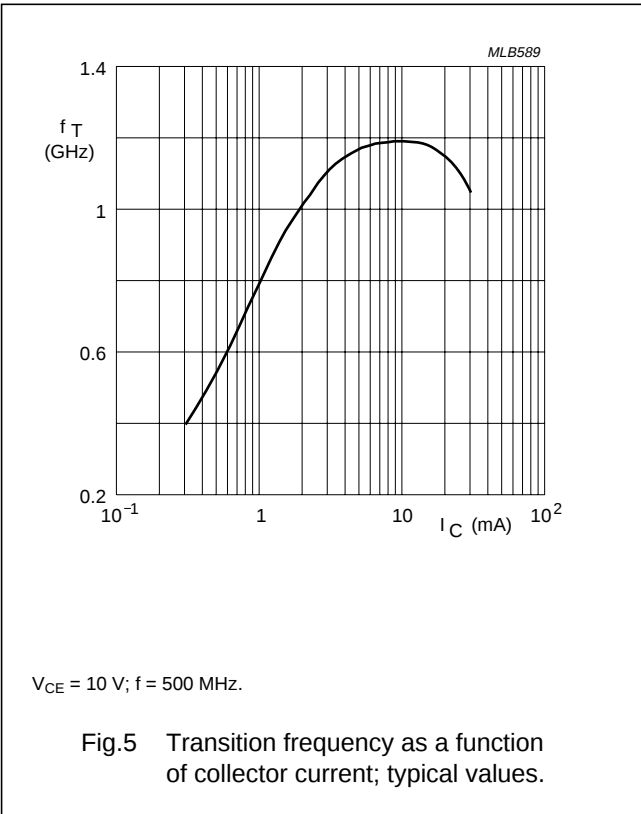
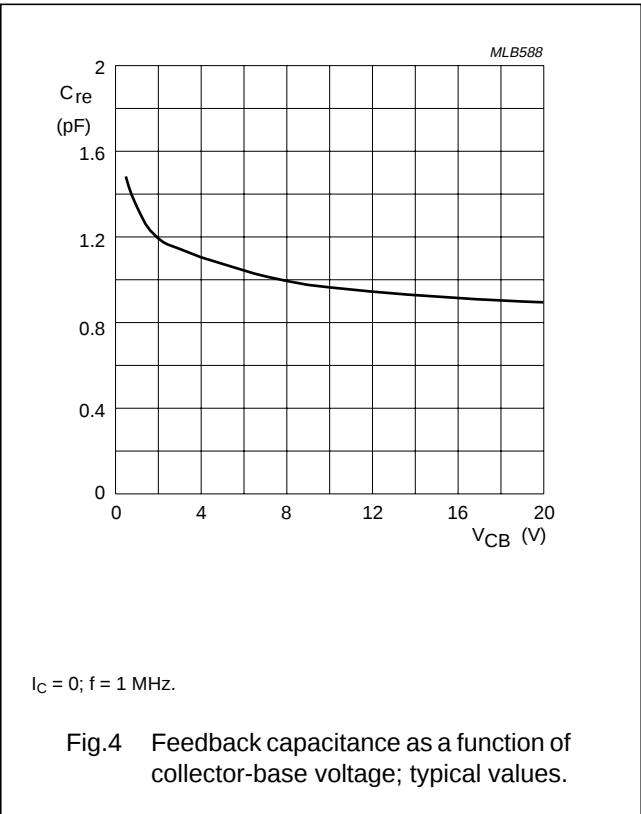
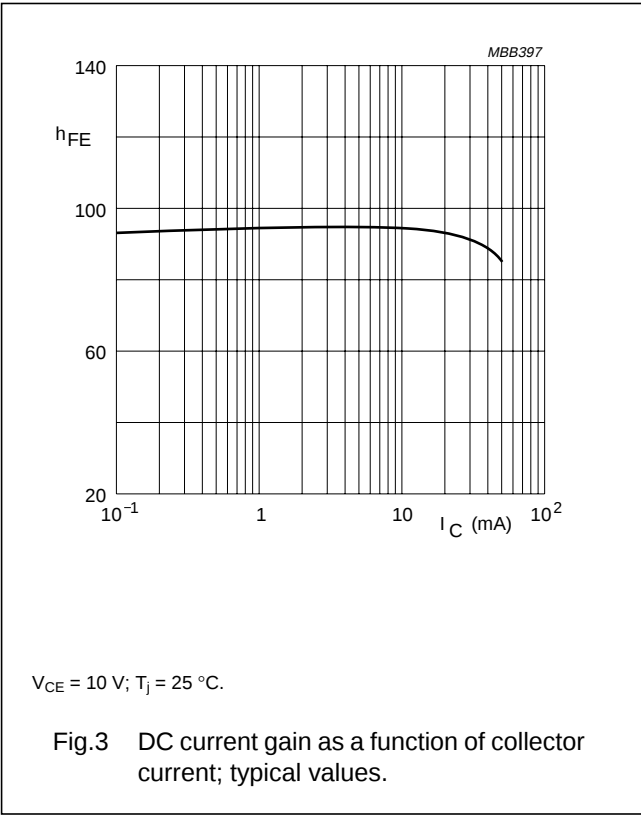
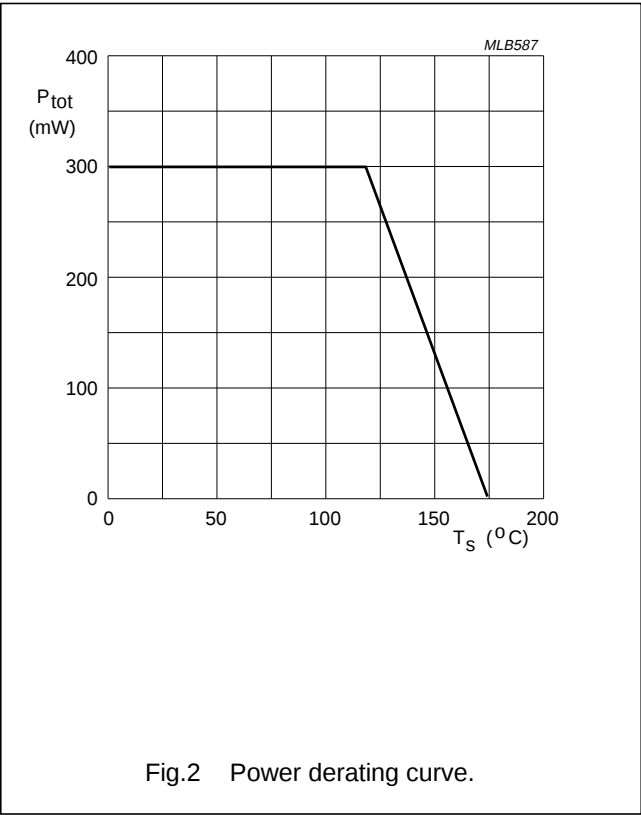
| SYMBOL        | PARAMETER                                | CONDITIONS                                                                                          | MIN. | TYP. | MAX. | UNIT |
|---------------|------------------------------------------|-----------------------------------------------------------------------------------------------------|------|------|------|------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage         | $I_C = 0.01\text{ mA}$ ; $I_E = 0$                                                                  | –    | –    | 30   | V    |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage      | $I_C = 10\text{ mA}$ ; $I_B = 0$                                                                    | –    | –    | 20   | V    |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage           | $I_E = 0.01\text{ mA}$ ; $I_C = 0$                                                                  | –    | –    | 3    | V    |
| $I_{CBO}$     | collector cut-off current                | $I_E = 0$ ; $V_{CB} = 10\text{ V}$                                                                  | –    | –    | 100  | nA   |
| $h_{FE}$      | DC current gain                          | $I_C = 2\text{ mA}$ ; $V_{CE} = 10\text{ V}$                                                        | 40   | 95   | 250  |      |
| $C_{re}$      | feedback capacitance                     | $I_C = 0$ ; $V_{CB} = 10\text{ V}$ ; $f = 1\text{ MHz}$                                             | –    | 1    | –    | pF   |
| $f_T$         | transition frequency                     | $I_C = 15\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ;<br>$f = 500\text{ MHz}$                             | 0.8  | 1.2  | 1.6  | GHz  |
| $G_{UM}$      | maximum unilateral power gain;<br>note 1 | $I_C = 1\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ;<br>$f = 100\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$ ; | –    | 20   | –    | dB   |

## Note

- $G_{UM}$  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.

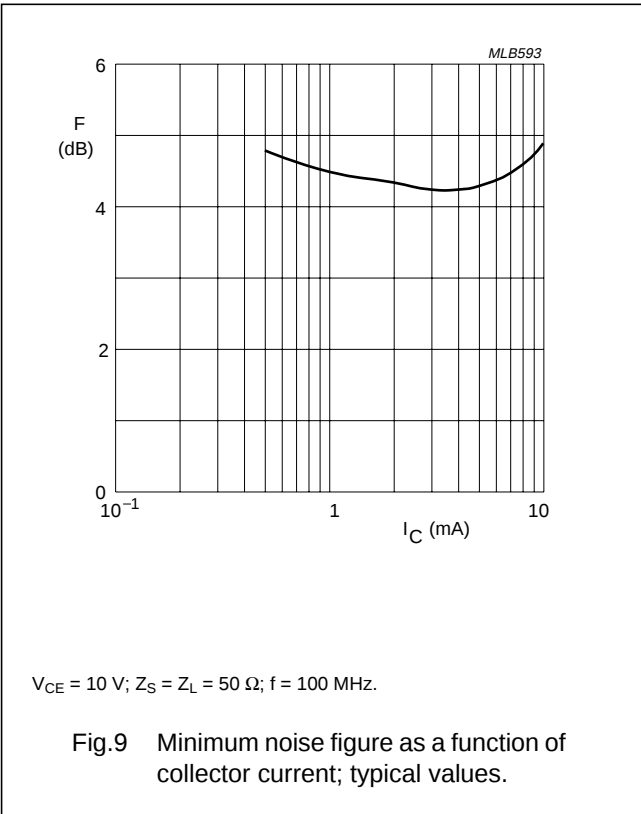
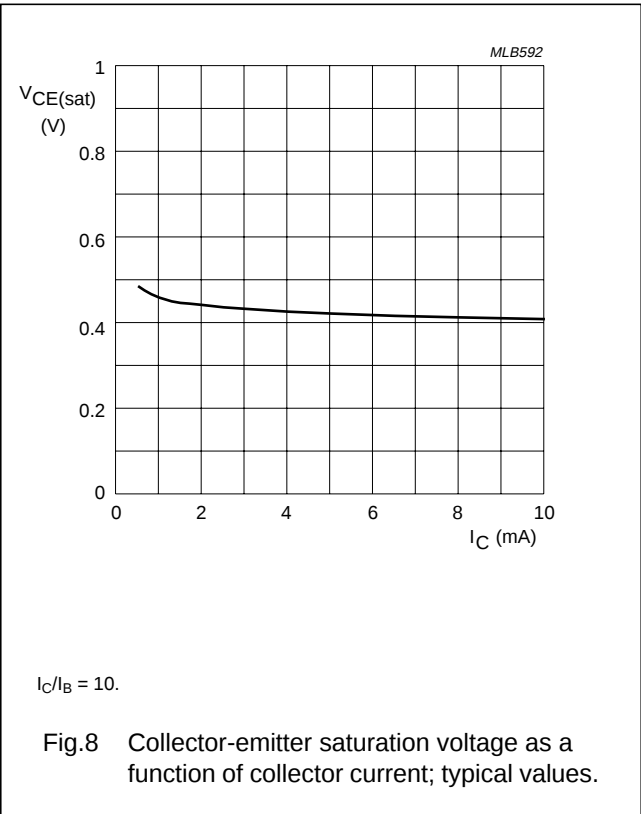
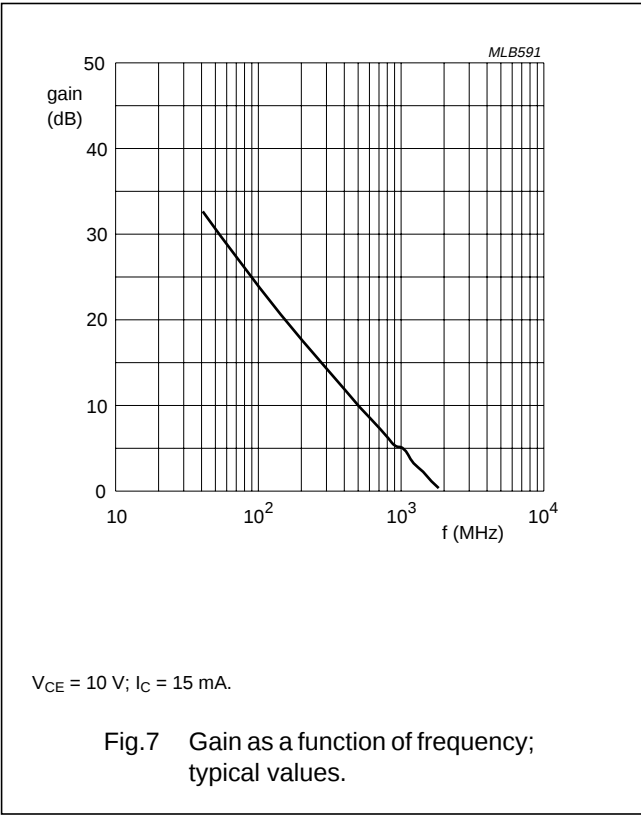
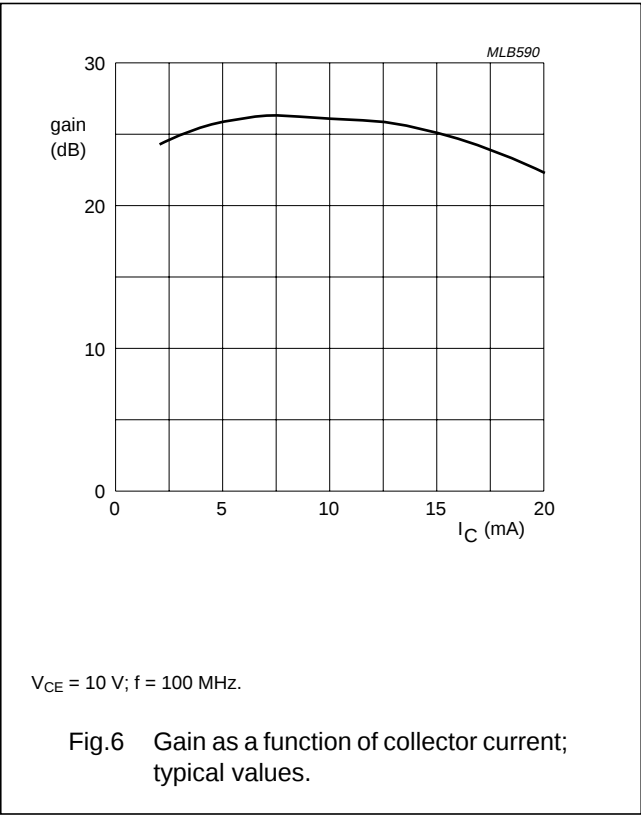
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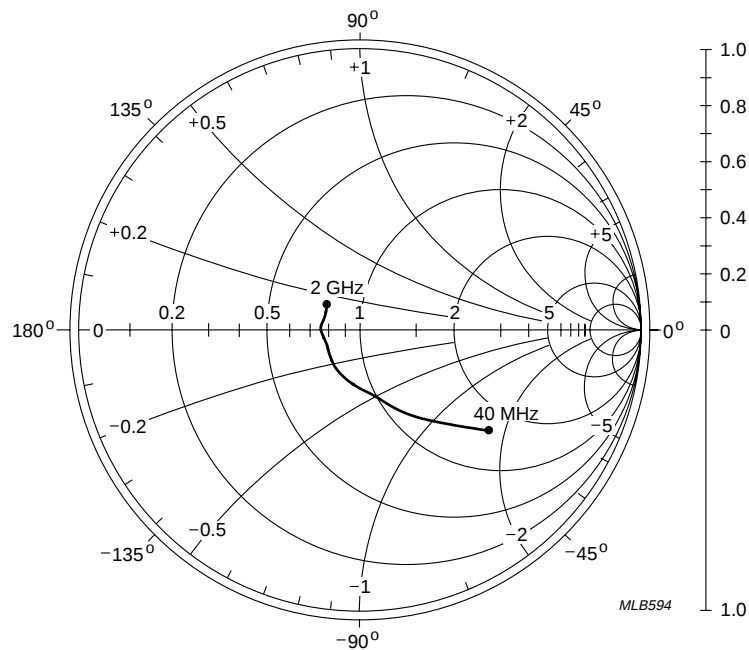
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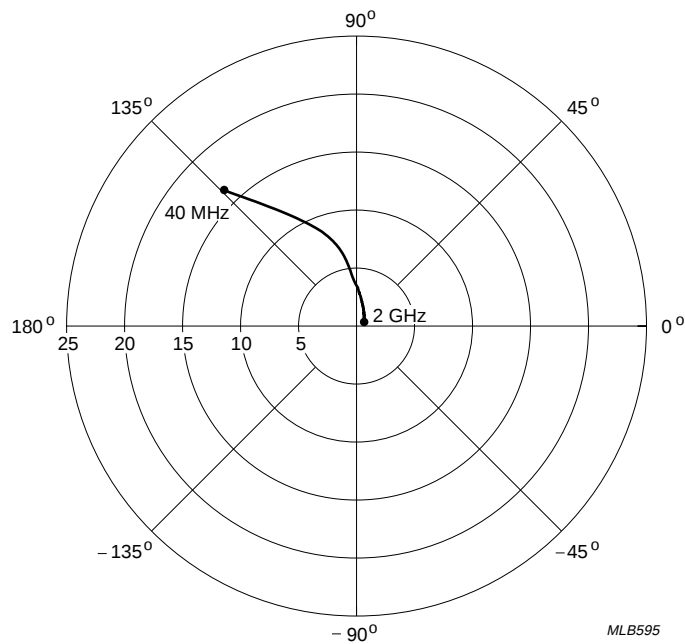
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$V_{CE} = 10\text{ V}$ ;  $I_C = 15\text{ mA}$ ;  $Z_0 = 50\ \Omega$ .

Fig.10 Common emitter input reflection coefficient ( $s_{11}$ ); typical values.

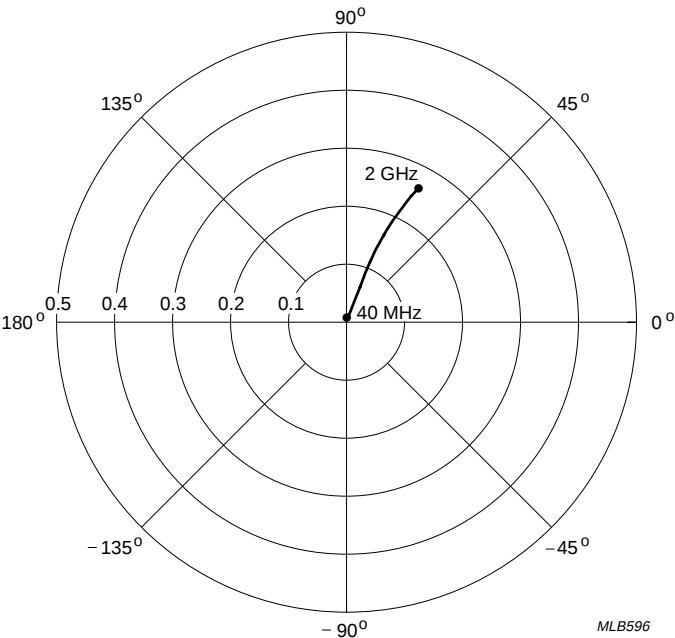


$V_{CE} = 10\text{ V}$ ;  $I_C = 15\text{ mA}$ .

Fig.11 Common emitter forward transmission coefficient ( $s_{21}$ ); typical values.

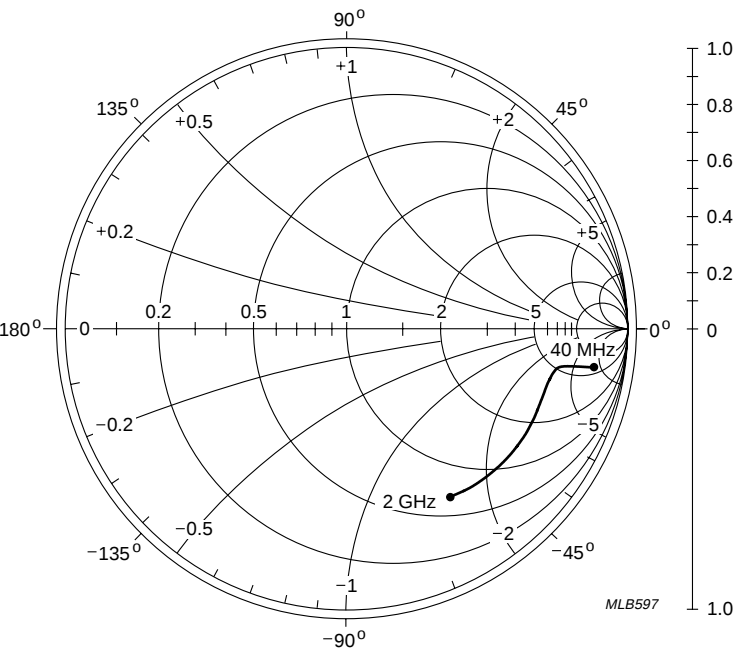
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$V_{CE} = 10\text{ V}$ ;  $I_C = 15\text{ mA}$ .

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



$V_{CE} = 10\text{ V}$ ;  $I_C = 15\text{ mA}$ ;  $Z_0 = 50\text{ }\Omega$ .

Fig.13 Common emitter output reflection coefficient ( $s_{22}$ ); typical values.

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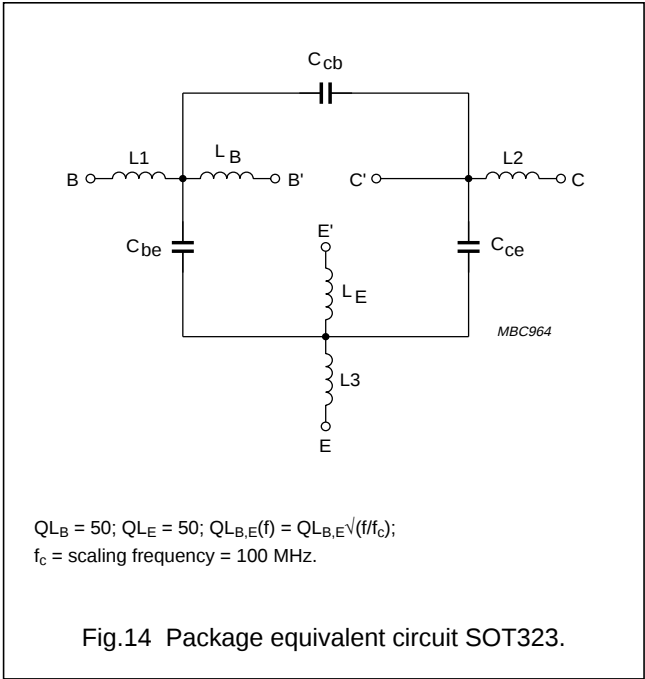
SPICE parameters for the BF547W crystal

| SEQUENCE No.      | PARAMETER | VALUE | UNIT |
|-------------------|-----------|-------|------|
| 1                 | IS        | 289.1 | aA   |
| 2                 | BF        | 94.29 | –    |
| 3                 | NF        | 0.989 | –    |
| 4                 | VAF       | 90.00 | V    |
| 5                 | IKF       | 158.6 | mA   |
| 6                 | ISE       | 426.6 | aA   |
| 7                 | NE        | 1.491 | –    |
| 8                 | BR        | 12.32 | –    |
| 9                 | NR        | 0.989 | –    |
| 10                | VAR       | 19.39 | V    |
| 11                | IKR       | 24.75 | mA   |
| 12                | ISC       | 249.7 | pA   |
| 13                | NC        | 1.200 | –    |
| 14                | RB        | 50.00 | Ω    |
| 15                | IRB       | 1.000 | μA   |
| 16                | RBM       | 50.00 | Ω    |
| 17                | RE        | 0.500 | Ω    |
| 18                | RC        | 1.309 | 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       | 1.071 | pF   |
| 23                | VJE       | 727.3 | mV   |
| 24                | MJE       | 0.332 | –    |
| 25                | TF        | 92.98 | ps   |
| 26                | XTF       | 43.89 | –    |
| 27                | VTF       | 1.813 | V    |
| 28                | ITF       | 143.9 | mA   |
| 29                | PTF       | 0.000 | deg  |
| 30                | CJC       | 1.167 | pF   |
| 31                | VJC       | 489.0 | mV   |
| 32                | MJC       | 0.253 | –    |
| 33                | XCJC      | 0.150 | –    |
| 34                | TR        | 50.00 | ns   |
| 35 <sup>(1)</sup> | CJS       | 0.000 | F    |

| SEQUENCE No.      | PARAMETER | VALUE | UNIT |
|-------------------|-----------|-------|------|
| 36 <sup>(1)</sup> | VJS       | 750.0 | mV   |
| 37 <sup>(1)</sup> | MJS       | 0.000 | –    |
| 38                | FC        | 0.950 | –    |

Note

1. These parameters have not been extracted, the default values are shown.



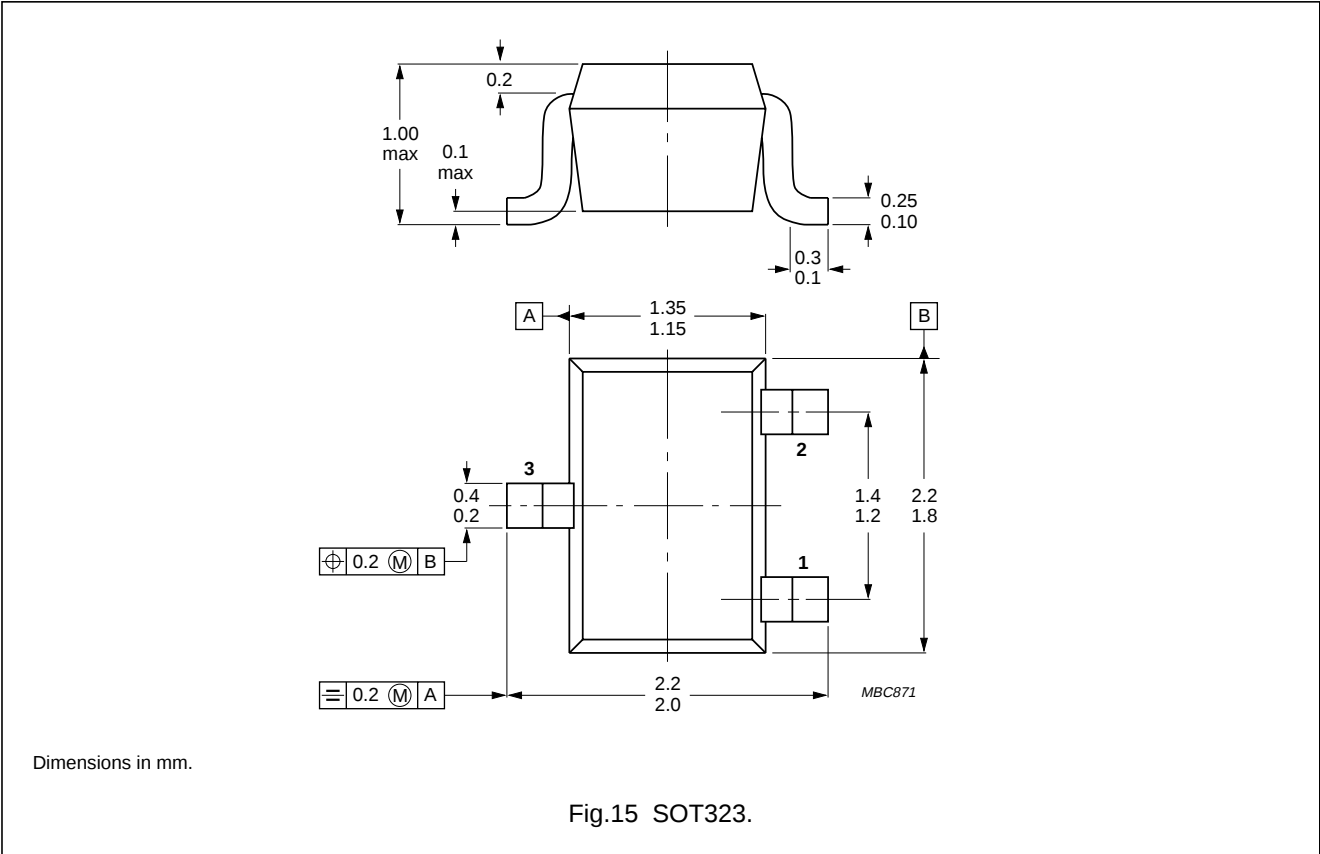
List of components (see Fig.14).

| 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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PACKAGE OUTLINE



DEFINITIONS

| Data sheet status                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 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.                                |
| Limiting values                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                       |
| 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. |                                                                                       |
| Application information                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                       |
| 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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