

# DATA SHEET

**BFG135**

NPN 7GHz wideband transistor

Product specification

1995 Sep 13



## NPN 7GHz wideband transistor

## BFG135

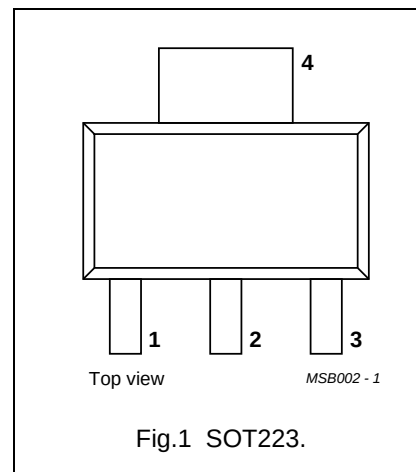
## DESCRIPTION

NPN silicon planar epitaxial transistor in a plastic SOT223 envelope, intended for wideband amplifier applications. The small emitter structures, with integrated emitter-ballasting resistors, ensure high output voltage capabilities at a low distortion level.

The distribution of the active areas across the surface of the device gives an excellent temperature profile.

## PINNING

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



## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                     | CONDITIONS                                                                                                                                                          | MIN. | TYP. | MAX. | UNIT |
|-----------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $V_{CBO}$ | collector-base voltage        | open emitter                                                                                                                                                        | —    | —    | 25   | V    |
| $V_{CEO}$ | collector-emitter voltage     | open base                                                                                                                                                           | —    | —    | 15   | V    |
| $I_C$     | DC collector current          |                                                                                                                                                                     | —    | —    | 150  | mA   |
| $P_{tot}$ | total power dissipation       | up to $T_s = 145\text{ °C}$ (note 1)                                                                                                                                | —    | —    | 1    | W    |
| $h_{FE}$  | DC current gain               | $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $T_j = 25\text{ °C}$                                                                                               | 80   | 130  | —    |      |
| $f_T$     | transition frequency          | $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 1\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$                                                                      | —    | 7    | —    | GHz  |
| $G_{UM}$  | maximum unilateral power gain | $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 500\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$                                                                    | —    | 16   | —    | dB   |
|           |                               | $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 800\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$                                                                    | —    | 12   | —    | dB   |
| $V_o$     | output voltage                | $d_{im} = -60\text{ dB}$ ; $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $R_L = 75\text{ }\Omega$ ; $T_{amb} = 25\text{ °C}$ ; $f_{(p+q-r)} = 793.25\text{ MHz}$ | —    | 850  | —    | mV   |

## LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                           | MIN. | MAX. | UNIT |
|-----------|---------------------------|--------------------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                         | —    | 25   | V    |
| $V_{CEO}$ | collector-emitter voltage | open base                            | —    | 15   | V    |
| $V_{EBO}$ | emitter-base voltage      | open collector                       | —    | 2    | V    |
| $I_C$     | DC collector current      |                                      | —    | 150  | mA   |
| $P_{tot}$ | total power dissipation   | up to $T_s = 145\text{ °C}$ (note 1) | —    | 1    | W    |
| $T_{stg}$ | storage temperature       |                                      | −65  | 150  | °C   |
| $T_j$     | junction temperature      |                                      | —    | 175  | °C   |

## Note

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

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## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                           | THERMAL RESISTANCE |
|---------------|-----------------------------------------------------|--------------------------------------|--------------------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | up to $T_s = 145\text{ °C}$ (note 1) | 30 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               | $I_E = 0$ ; $V_{CB} = 10\text{ V}$                                                                                                                                                 | –    | –    | 1    | $\mu\text{A}$ |
| $h_{FE}$  | DC current gain                         | $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$                                                                                                                                     | 80   | 130  | –    |               |
| $C_c$     | collector capacitance                   | $I_E = I_e = 0$ ; $V_{CB} = 10\text{ V}$ ; $f = 1\text{ MHz}$                                                                                                                      | –    | 2    | –    | pF            |
| $C_e$     | emitter capacitance                     | $I_C = I_c = 0$ ; $V_{EB} = 0.5\text{ V}$ ; $f = 1\text{ MHz}$                                                                                                                     | –    | 7    | –    | pF            |
| $C_{re}$  | feedback capacitance                    | $I_C = 0$ ; $V_{CE} = 10\text{ V}$ ; $f = 1\text{ MHz}$                                                                                                                            | –    | 1.2  | –    | pF            |
| $f_T$     | transition frequency                    | $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 1\text{ GHz}$ ; $T_{amb} = 25\text{ °C}$                                                                                     | –    | 7    | –    | GHz           |
| $G_{UM}$  | maximum unilateral power gain           | $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 500\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$                                                                                   | –    | 16   | –    | dB            |
|           |                                         | $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 800\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$                                                                                   | –    | 12   | –    | dB            |
| $V_o$     | output voltage                          | note 1                                                                                                                                                                             | –    | 900  | –    | mV            |
|           |                                         | note 2                                                                                                                                                                             | –    | 850  | –    | mV            |
| $d_2$     | second order intermodulation distortion | $I_C = 90\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $V_O = 50\text{ dBmV}$ ; $T_{amb} = 25\text{ °C}$ ; $f_{(p+q)} = 450\text{ MHz}$ ; $f_p = 50\text{ MHz}$ ; $f_q = 400\text{ MHz}$  | –    | –58  | –    | dB            |
|           |                                         | $I_C = 90\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $V_O = 50\text{ dBmV}$ ; $T_{amb} = 25\text{ °C}$ ; $f_{(p+q)} = 810\text{ MHz}$ ; $f_p = 250\text{ MHz}$ ; $f_q = 560\text{ MHz}$ | –    | –53  | –    | dB            |

## Notes

- $d_{im} = -60\text{ dB}$  (DIN 45004B);  $I_C = 100\text{ mA}$ ;  $V_{CE} = 10\text{ V}$ ;  $R_L = 75\text{ }\Omega$ ;  $T_{amb} = 25\text{ °C}$ ;  $V_p = V_o$  at  $d_{im} = -60\text{ dB}$ ;  $f_p = 445.25\text{ MHz}$ ;  $V_q = V_o - 6\text{ dB}$ ;  $f_q = 453.25\text{ MHz}$ ;  $V_r = V_o - 6\text{ dB}$ ;  $f_r = 455.25\text{ MHz}$ ; measured at  $f_{(p+q-r)} = 443.25\text{ MHz}$ .
- $d_{im} = -60\text{ dB}$  (DIN 45004B);  $I_C = 100\text{ mA}$ ;  $V_{CE} = 10\text{ V}$ ;  $R_L = 75\text{ }\Omega$ ;  $T_{amb} = 25\text{ °C}$ ;  $V_p = V_o$  at  $d_{im} = -60\text{ dB}$ ;  $f_p = 795.25\text{ MHz}$ ;  $V_q = V_o - 6\text{ dB}$ ;  $f_q = 803.25\text{ MHz}$ ;  $V_r = V_o - 6\text{ dB}$ ;  $f_r = 805.25\text{ MHz}$ ; measured at  $f_{(p+q-r)} = 793.25\text{ MHz}$ .

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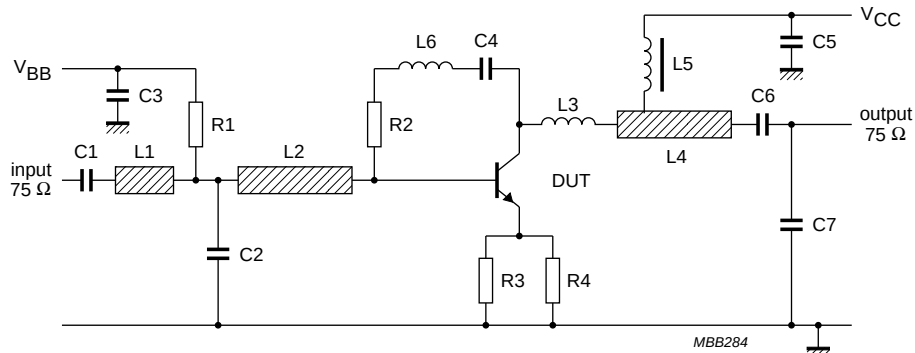


Fig.2 Intermodulation distortion and second order intermodulation distortion test circuit.

## List of components (see test circuit)

| DESIGNATION    | DESCRIPTION                       | VALUE        | UNIT       | DIMENSIONS                            | CATALOGUE NO.  |
|----------------|-----------------------------------|--------------|------------|---------------------------------------|----------------|
| C1, C3, C5, C6 | multilayer ceramic capacitor      | 10           | nF         |                                       | 2222 590 08627 |
| C2, C7         | multilayer ceramic capacitor      | 1            | pF         |                                       | 2222 851 12108 |
| C4 (note 1)    | miniature ceramic plate capacitor | 10           | nF         |                                       | 2222 629 08103 |
| L1             | microstripline                    | 75           | $\Omega$   | length 7 mm;<br>width 2.5 mm          |                |
| L2             | microstripline                    | 75           | $\Omega$   | length 22mm;<br>width 2.5 mm          |                |
| L3 (note 1)    | 1.5 turns 0.4 mm copper wire      |              |            | int. dia. 3 mm;<br>winding pitch 1 mm |                |
| L4             | microstripline                    | 75           | $\Omega$   | length 19 mm;<br>width 2.5 mm         |                |
| L5             | Ferroxcube choke                  | 5            | $\mu$ H    |                                       | 3122 108 20153 |
| L6 (note 1)    | 0.4 mm copper wire                | $\approx 25$ | nH         | length 30 mm                          |                |
| R1             | metal film resistor               | 10           | k $\Omega$ |                                       | 2322 180 73103 |
| R2 (note 1)    | metal film resistor               | 200          | $\Omega$   |                                       | 2322 180 73201 |
| R3, R4         | metal film resistor               | 27           | $\Omega$   |                                       | 2322 180 73279 |

## Note

- Components C4, L3, L6 and R2 are mounted on the underside of the PCB.

The circuit is constructed on a double copper-clad printed circuit board with PTFE dielectric ( $\epsilon_r = 2.2$ ); thickness  $\frac{1}{16}$  inch; thickness of copper sheet  $\frac{1}{32}$  inch.

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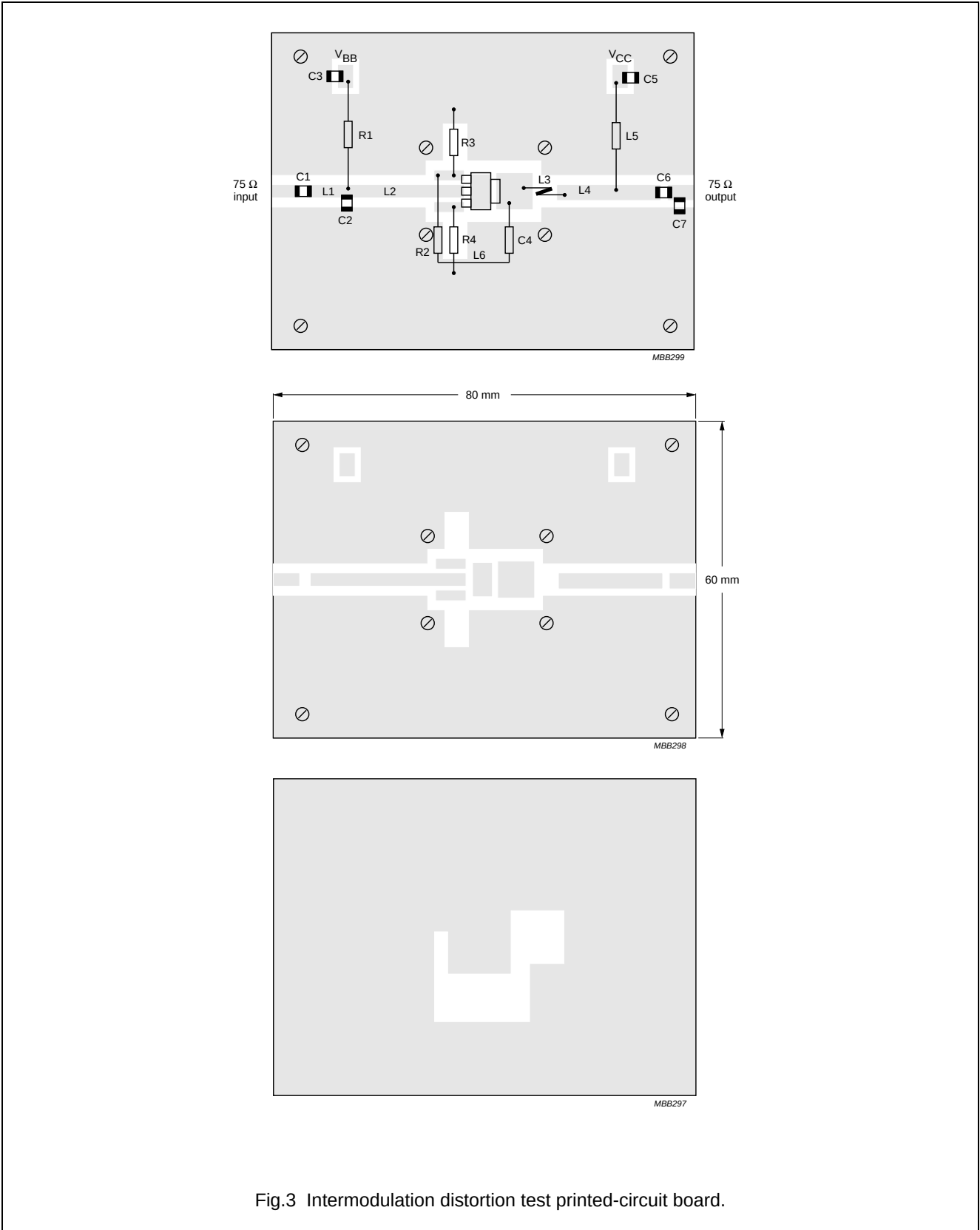
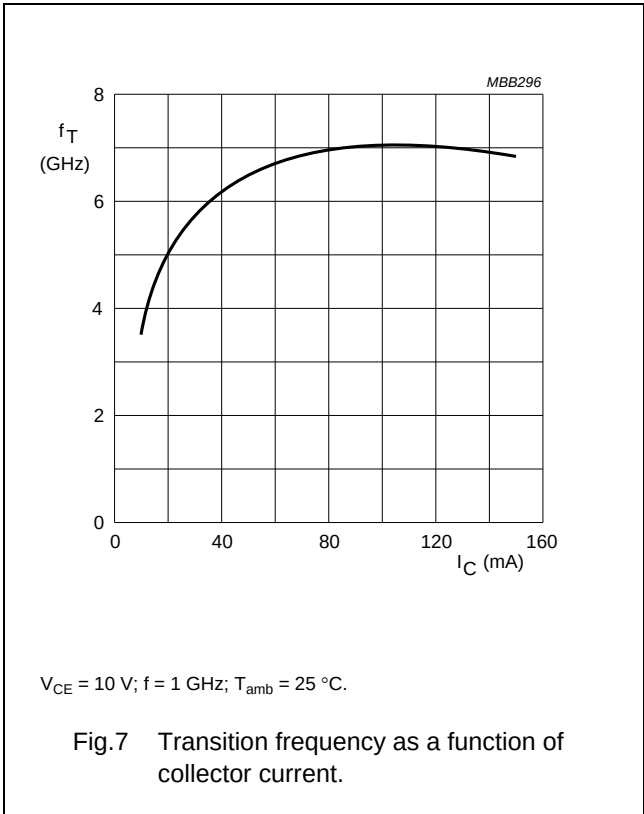
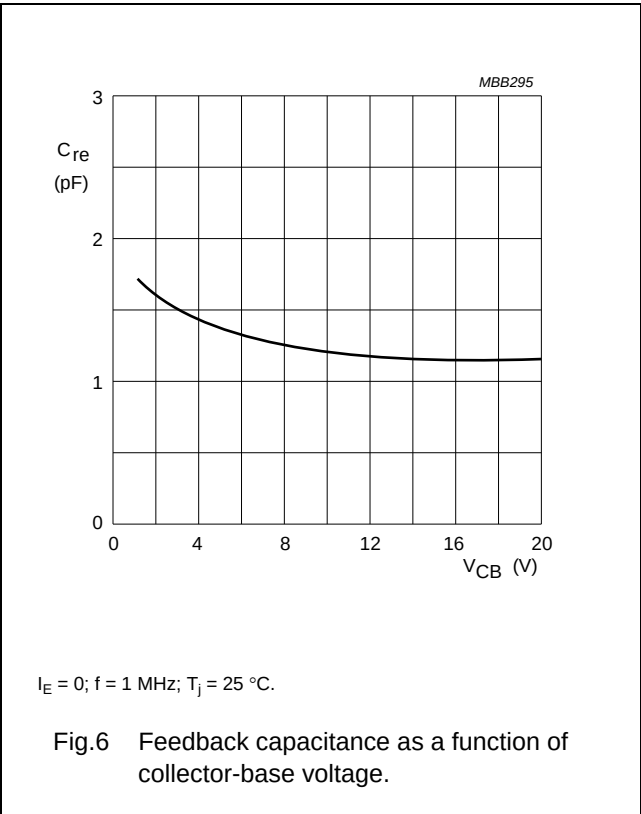
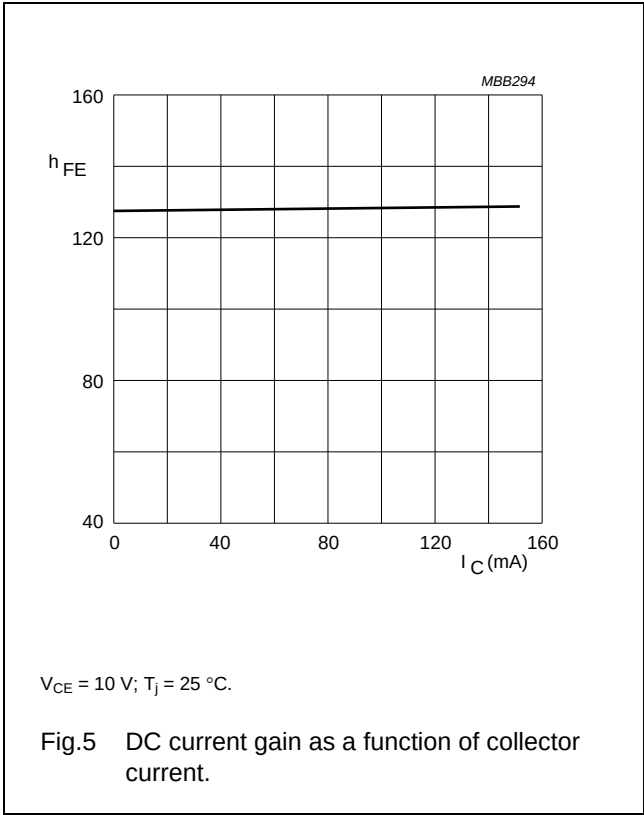
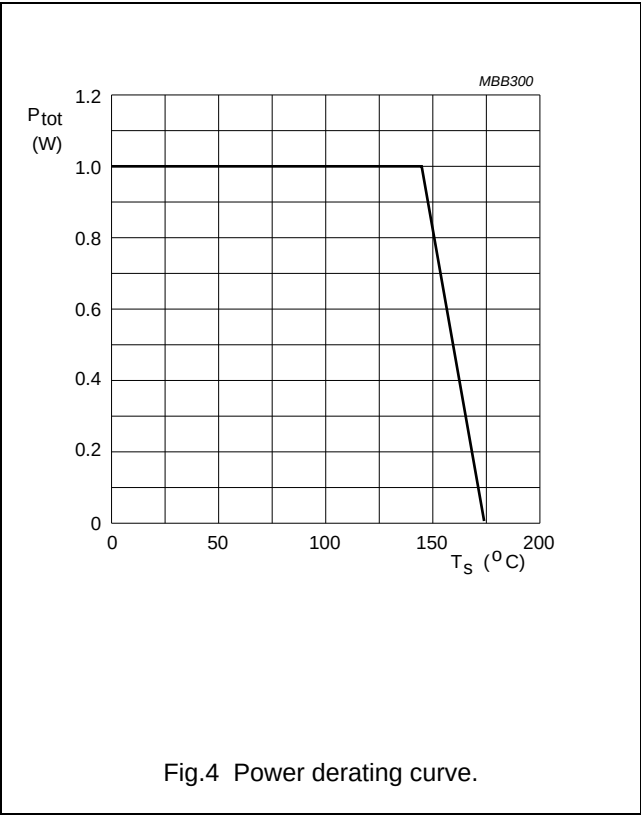


Fig.3 Intermodulation distortion test printed-circuit board.

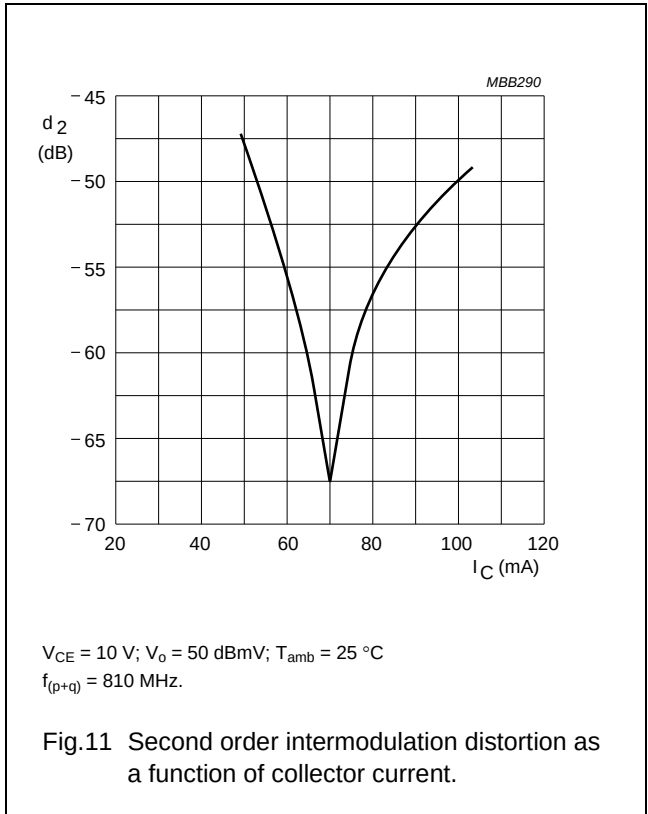
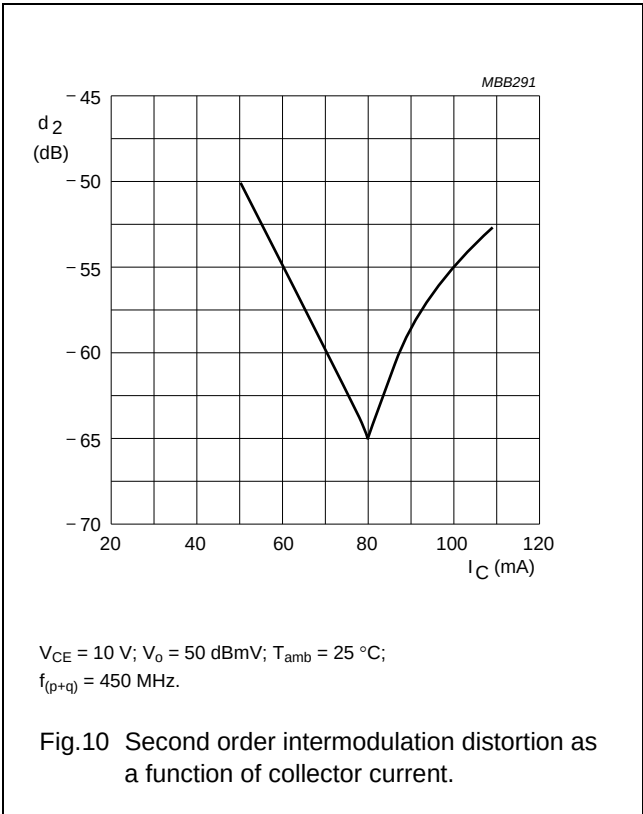
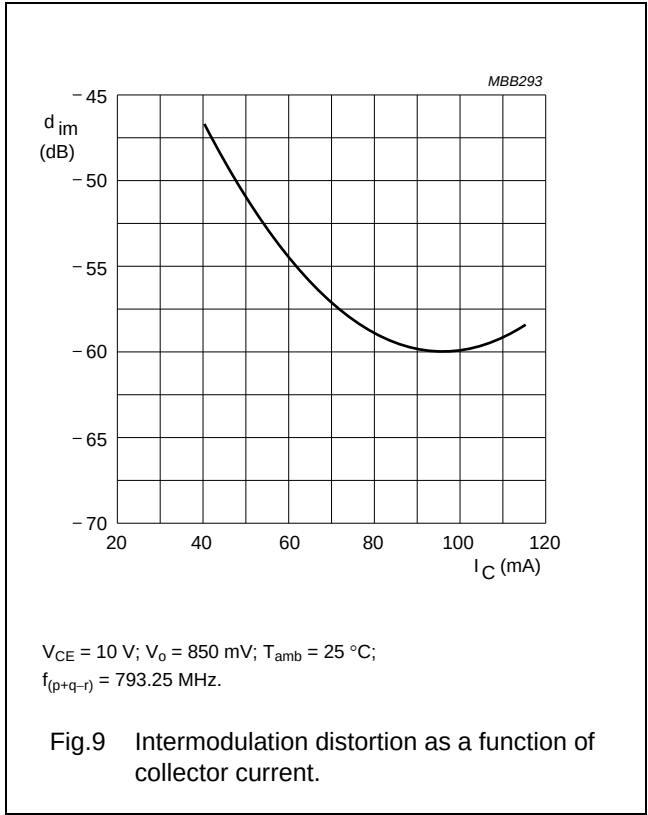
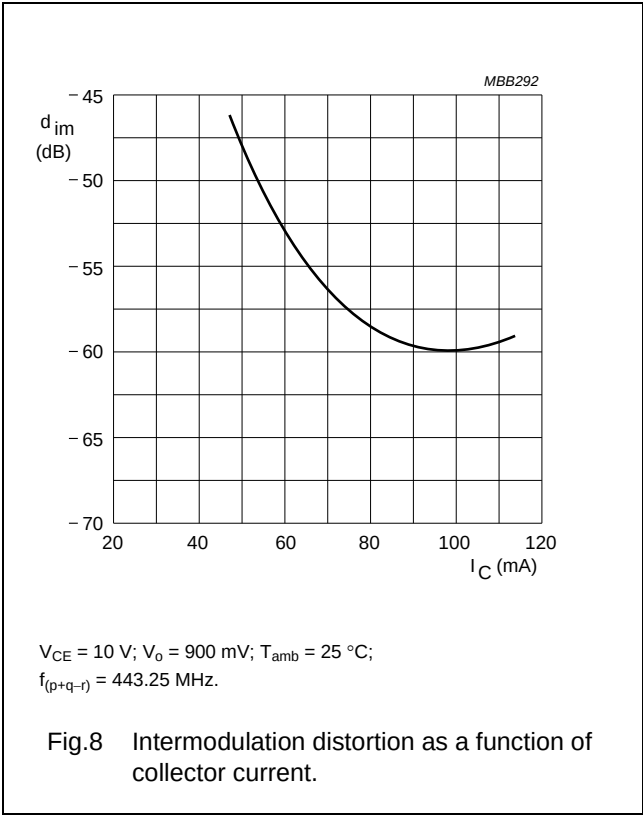
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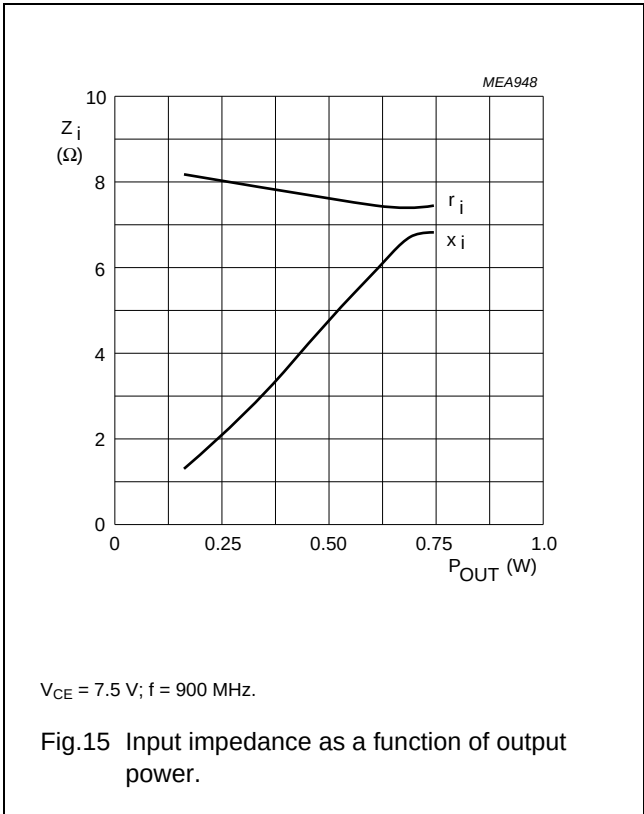
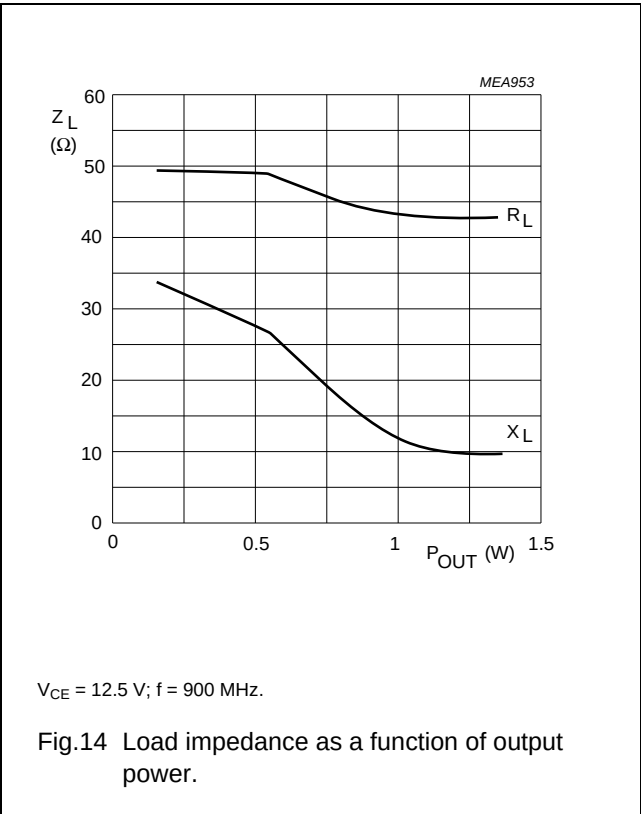
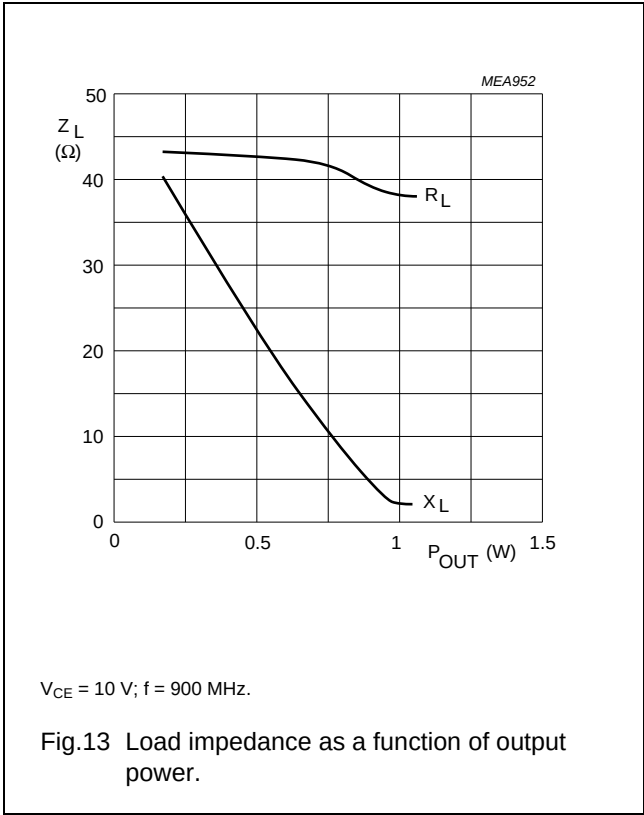
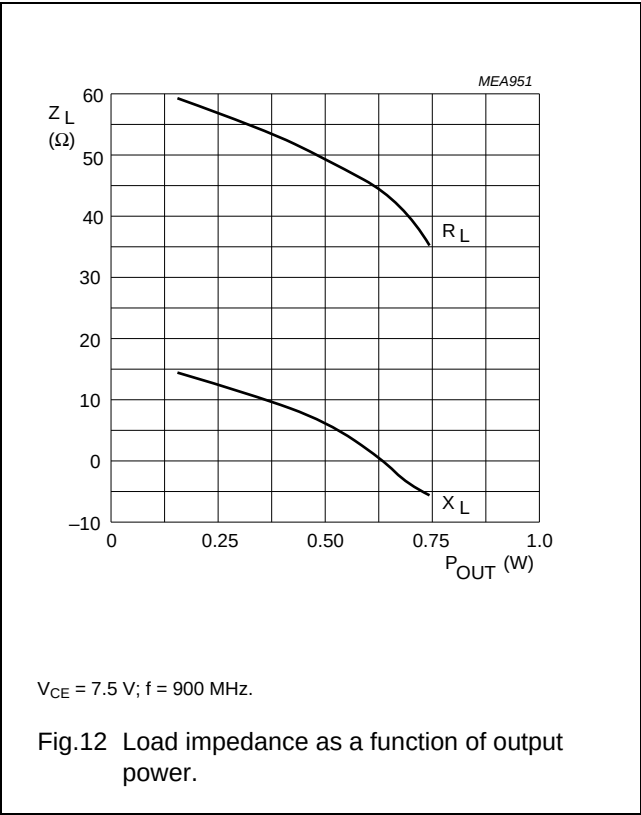
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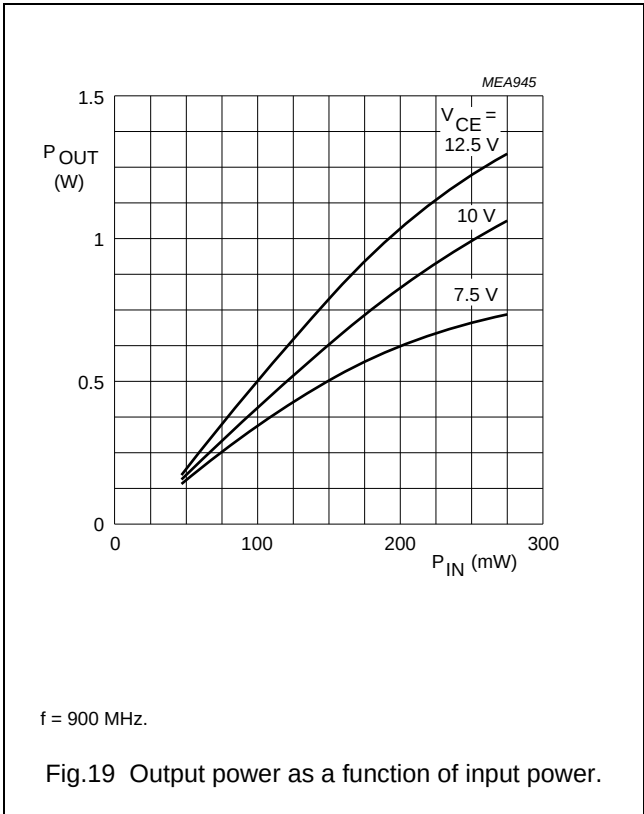
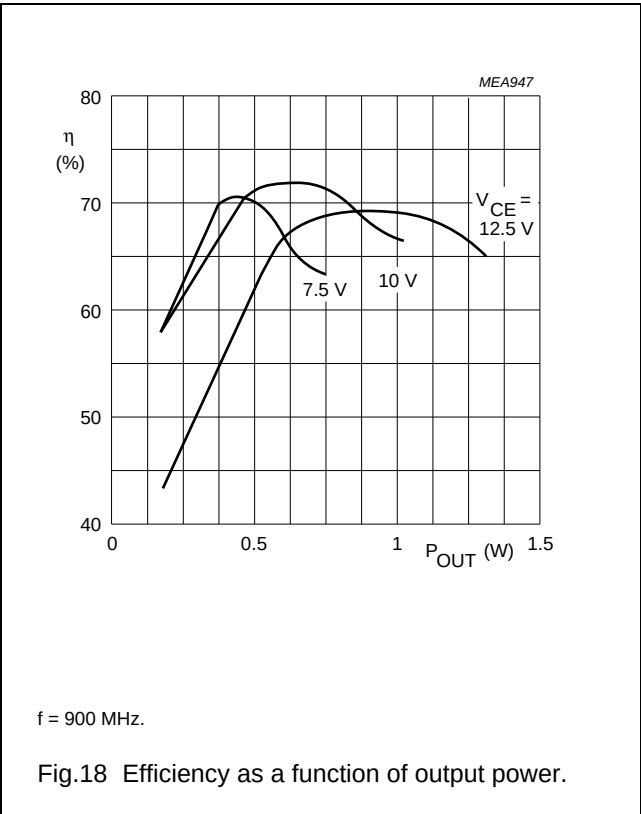
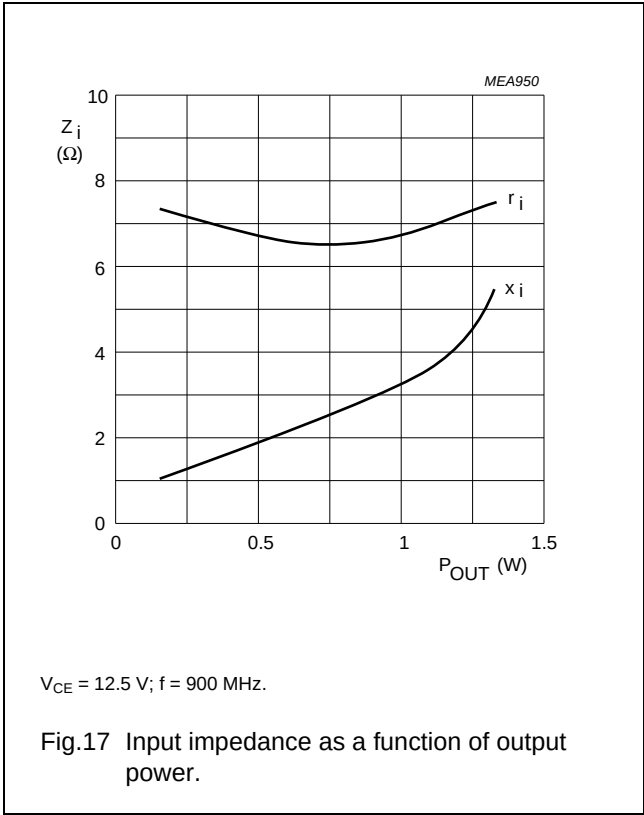
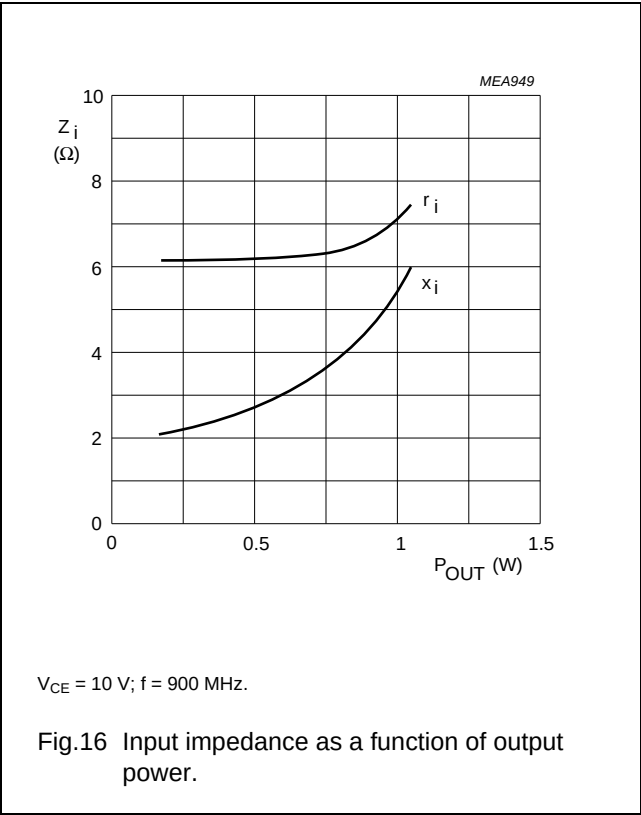
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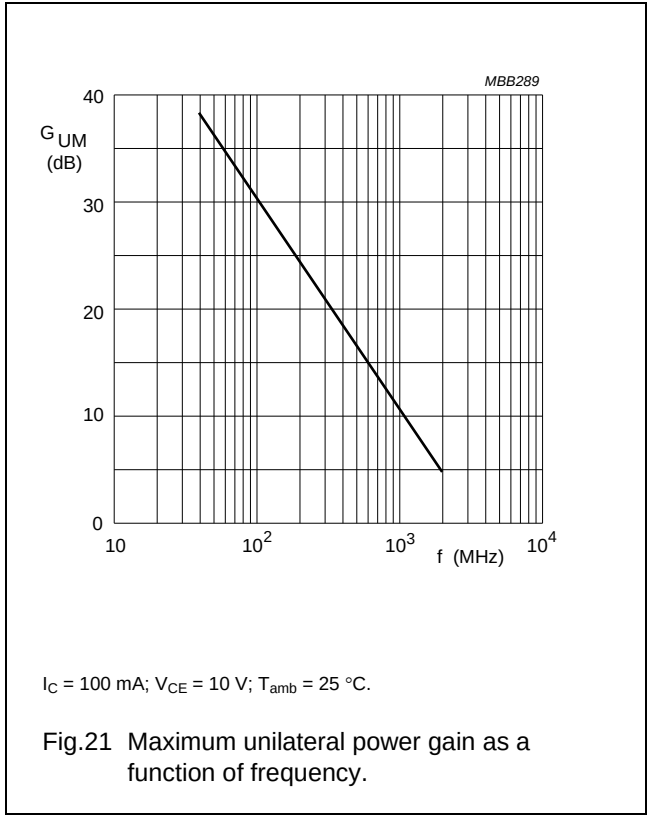
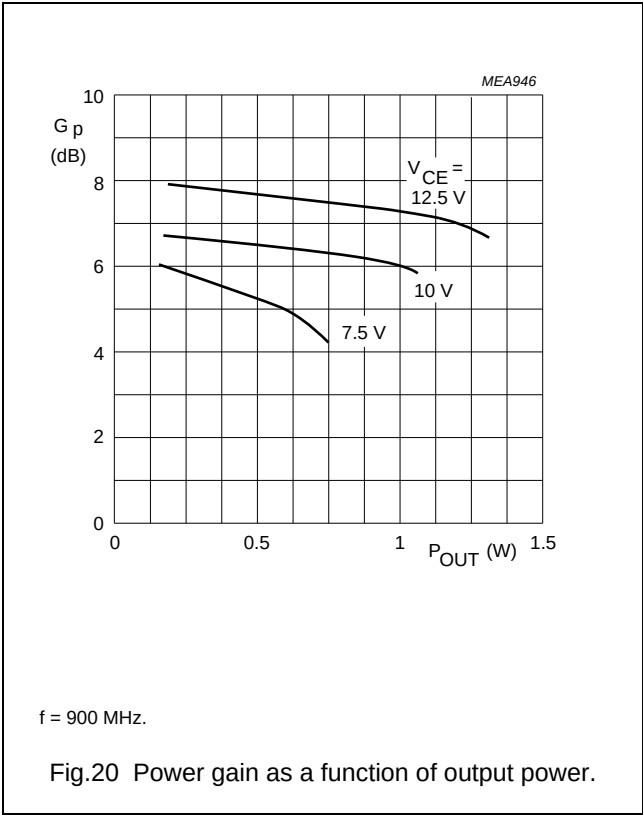
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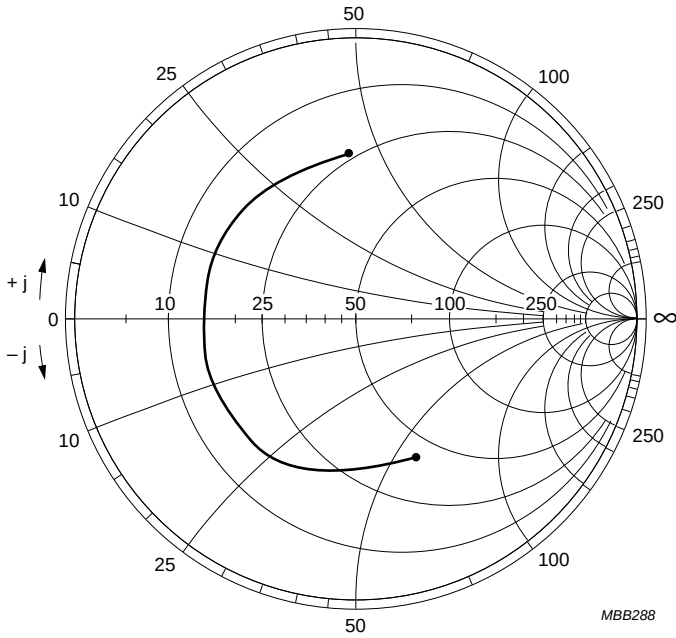
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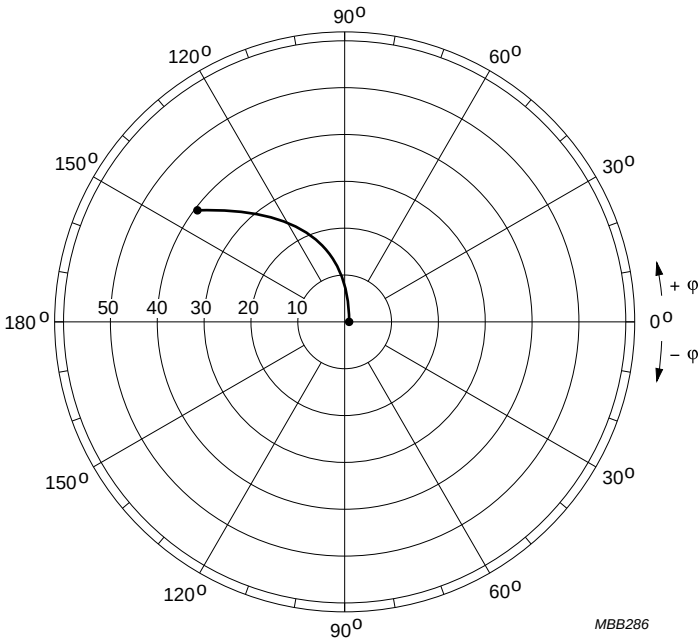
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$I_C = 100\text{ mA}$ ;  $V_{CE} = 10\text{ V}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $Z_0 = 50\text{ }\Omega$ .

Fig.22 Common emitter input reflection coefficient ( $S_{11}$ ).

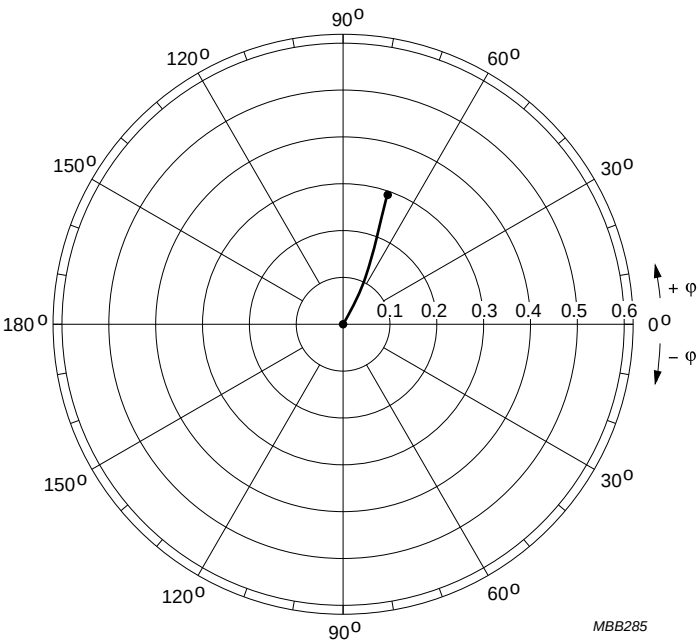


$I_C = 100\text{ mA}$ ;  $V_{CE} = 10\text{ V}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

Fig.23 Common emitter forward transmission coefficient ( $S_{21}$ ).

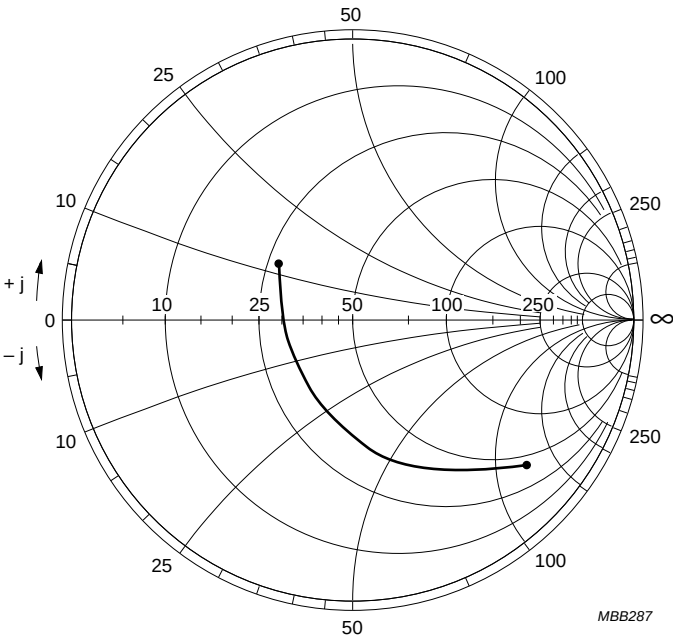
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$I_C = 100\text{ mA}$ ;  $V_{CE} = 10\text{ V}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

Fig.24 Common emitter reverse transmission coefficient ( $S_{12}$ ).



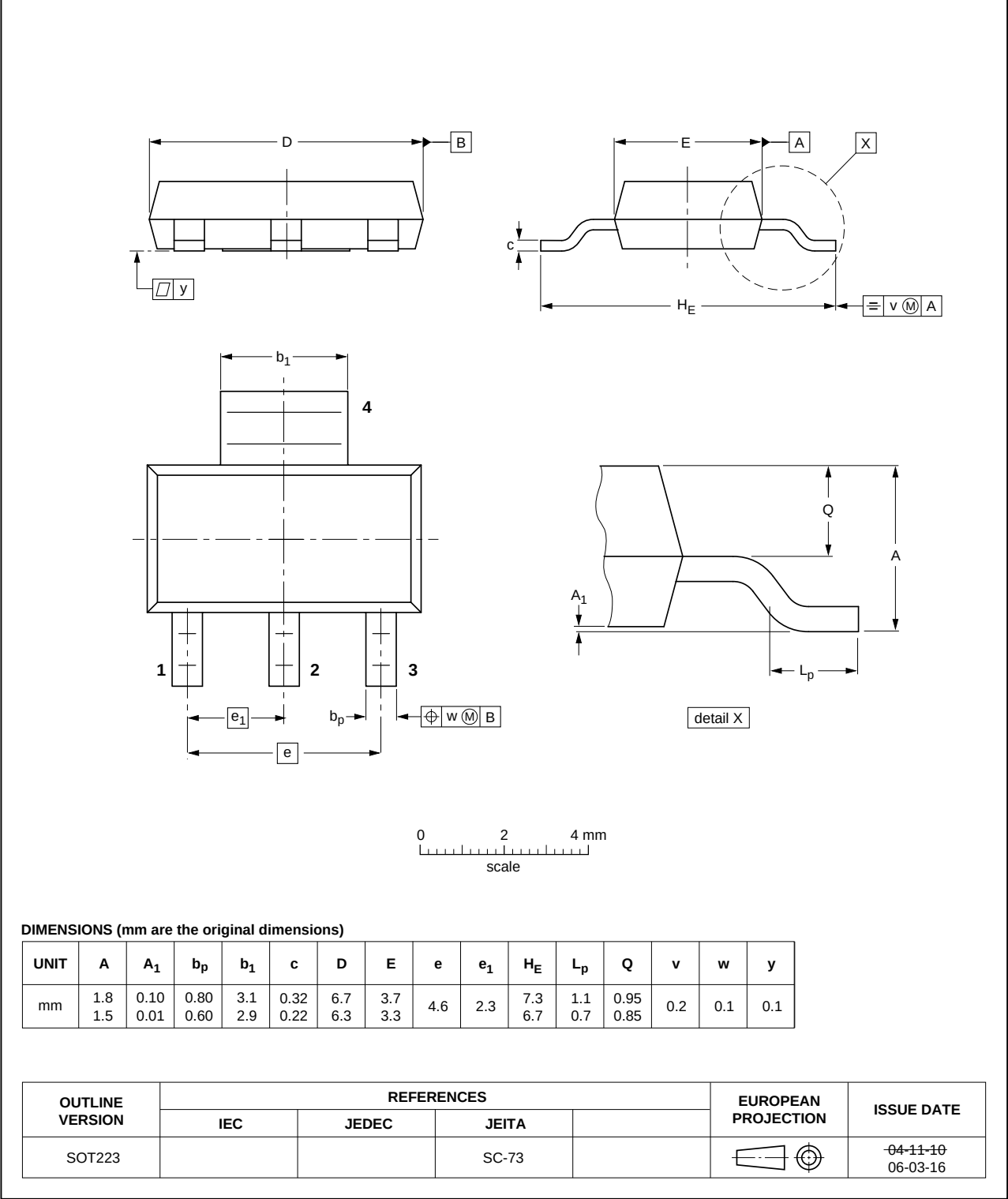
$I_C = 100\text{ mA}$ ;  $V_{CE} = 10\text{ V}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $Z_0 = 50\text{ }\Omega$ .

Fig.25 Common emitter output reflection coefficient ( $S_{22}$ ).

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PACKAGE OUTLINE

Plastic surface-mounted package with increased heatsink; 4 leads
 SOT223



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## DATA SHEET STATUS

| DOCUMENT STATUS <sup>(1)</sup> | PRODUCT STATUS <sup>(2)</sup> | DEFINITION                                                                            |
|--------------------------------|-------------------------------|---------------------------------------------------------------------------------------|
| Objective data sheet           | Development                   | This document contains data from the objective specification for product development. |
| Preliminary data sheet         | Qualification                 | This document contains data from the preliminary specification.                       |
| Product data sheet             | Production                    | This document contains the product specification.                                     |

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