

DATA SHEET

BFR93

NPN 5 GHz wideband transistor

Product specification
Supersedes data of September 1995
File under discrete semiconductors, SC14

1997 Oct 29

NPN 5 GHz wideband transistor

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FEATURES

- Very low intermodulation distortion
- High power gain
- Excellent wideband properties and low noise up to high frequencies due to its very high transition frequency.

APPLICATIONS

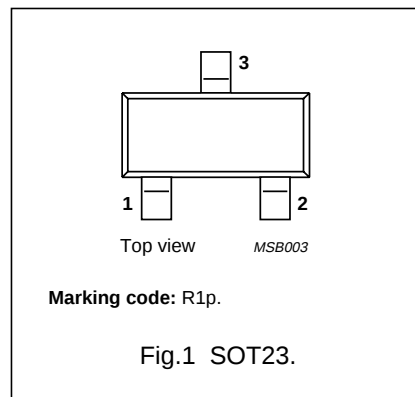
- RF wideband amplifiers and oscillators.

DESCRIPTION

NPN wideband transistor in a plastic SOT23 package.
PNP complement: BFT93.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector



QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	—	15	V
V_{CEO}	collector-emitter voltage	open base	—	12	V
I_C	collector current (DC)		—	35	mA
P_{tot}	total power dissipation	$T_s \leq 95\text{ }^{\circ}\text{C}$	—	300	mW
C_{re}	feedback capacitance	$I_C = 2\text{ mA}$; $V_{CE} = 5\text{ V}$; $f = 1\text{ MHz}$	0.8	—	pF
f_T	transition frequency	$I_C = 30\text{ mA}$; $V_{CE} = 5\text{ V}$; $f = 500\text{ MHz}$; $T_j = 25\text{ }^{\circ}\text{C}$	5	—	GHz
G_{UM}	maximum unilateral power gain	$I_C = 30\text{ mA}$; $V_{CE} = 5\text{ V}$; $f = 500\text{ MHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$	16.5	—	dB
F	noise figure	$I_C = 2\text{ mA}$; $V_{CE} = 5\text{ V}$; $f = 500\text{ MHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$	1.9	—	dB
d_{im}	intermodulation distortion	$I_C = 30\text{ mA}$; $V_{CE} = 5\text{ V}$; $R_L = 75\text{ }\Omega$; $V_O = 300\text{ mV}$; $f_p + f_q - f_r = 493.25\text{ MHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$	−60	—	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	—	15	V
V_{CEO}	collector-emitter voltage	open base	—	12	V
V_{EBO}	emitter-base voltage	open collector	—	2	V
I_C	collector current (DC)		—	35	mA
P_{tot}	total power dissipation	$T_s \leq 95\text{ }^{\circ}\text{C}$; note 1	—	300	mW
T_{stg}	storage temperature		−65	+150	$^{\circ}\text{C}$
T_j	junction temperature		—	175	$^{\circ}\text{C}$

Note

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	$T_s \leq 95\text{ °C}$; note 1	260	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.

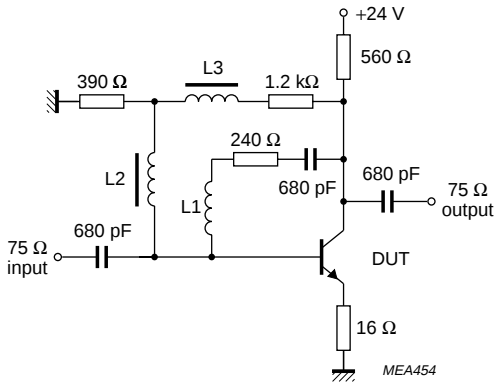
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 10\text{ V}$	–	–	50	nA
h_{FE}	DC current gain	$I_C = 30\text{ mA}$; $V_{CE} = 5\text{ V}$	40	90	–	
C_c	collector capacitance	$I_E = I_e = 0$; $V_{CB} = 10\text{ V}$; $f = 1\text{ MHz}$	–	0.7	–	pF
C_e	emitter capacitance	$I_C = I_c = 0$; $V_{EB} = 0.5\text{ V}$; $f = 1\text{ MHz}$	–	1.8	–	pF
C_{re}	feedback capacitance	$I_C = 2\text{ mA}$; $V_{CE} = 5\text{ V}$; $f = 1\text{ MHz}$; $T_{amb} = 25\text{ °C}$	–	0.8	–	pF
f_T	transition frequency	$I_C = 30\text{ mA}$; $V_{CE} = 5\text{ V}$; $f = 500\text{ MHz}$	–	5	–	GHz
G_{UM}	maximum unilateral power gain (note 1)	$I_C = 30\text{ mA}$; $V_{CE} = 5\text{ V}$; $f = 500\text{ MHz}$; $T_{amb} = 25\text{ °C}$	–	16.5	–	dB
F	noise figure (note 2)	$I_C = 2\text{ mA}$; $V_{CE} = 5\text{ V}$; $f = 500\text{ MHz}$; $Z_S = \text{opt.}$; $T_{amb} = 25\text{ °C}$	–	1.9	–	dB
d_{im}	intermodulation distortion	note 3	–	–60	–	dB

Notes

- G_{UM} is the maximum unilateral power gain, assuming S_{12} is zero and $G_{UM} = 10 \log \left(\frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)} \right)$ dB
- Die mounted in a SOT37 package (BFR91).
- $I_C = 30\text{ mA}$; $V_{CE} = 5\text{ V}$; $R_L = 75\text{ }\Omega$; $VSWR < 2$; $T_{amb} = 25\text{ °C}$;
 $V_p = V_O = 300\text{ mV}$ at $f_p = 495.25\text{ MHz}$;
 $V_q = V_O - 6\text{ dB}$ at $f_q = 503.25\text{ MHz}$;
 $V_r = V_O - 6\text{ dB}$ at $f_r = 505.25\text{ MHz}$;
measured at $f_p + f_q - f_r = 493.25\text{ MHz}$.

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L2 = L3 = 5 μH Ferroxcube choke, catalogue number 3122 108 20150.
L1 = 4 turns 0.35 mm copper wire; winding pitch 1 mm; internal diameter 4 mm.

Fig.2 Intermodulation distortion test circuit.

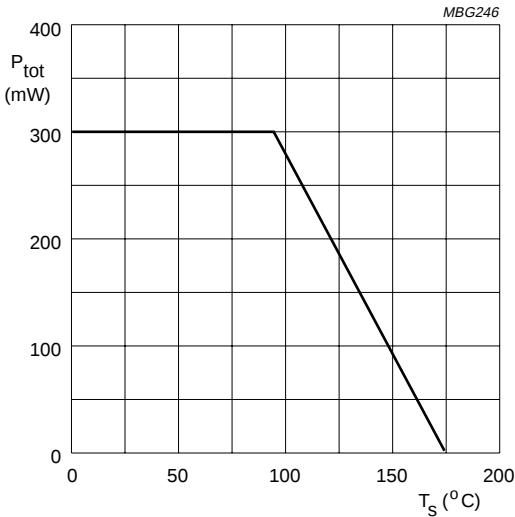
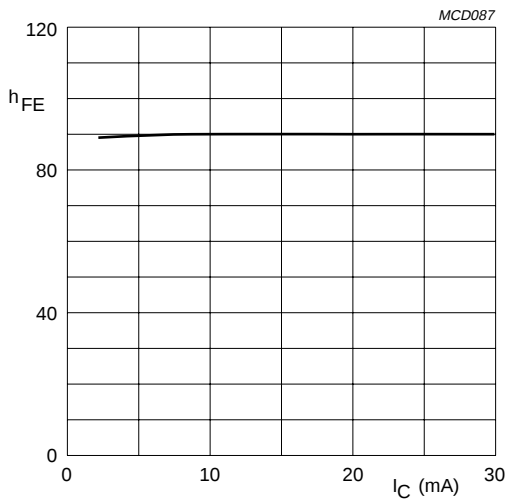
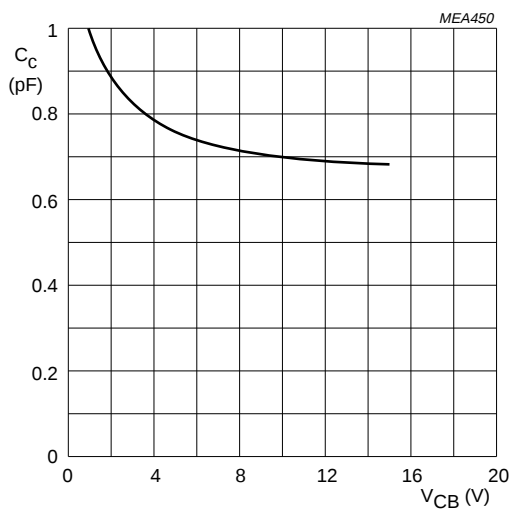


Fig.3 Power derating curve.



V_{CE} = 5 V; T_J = 25 °C.

Fig.4 DC current gain as a function of collector current; typical values.

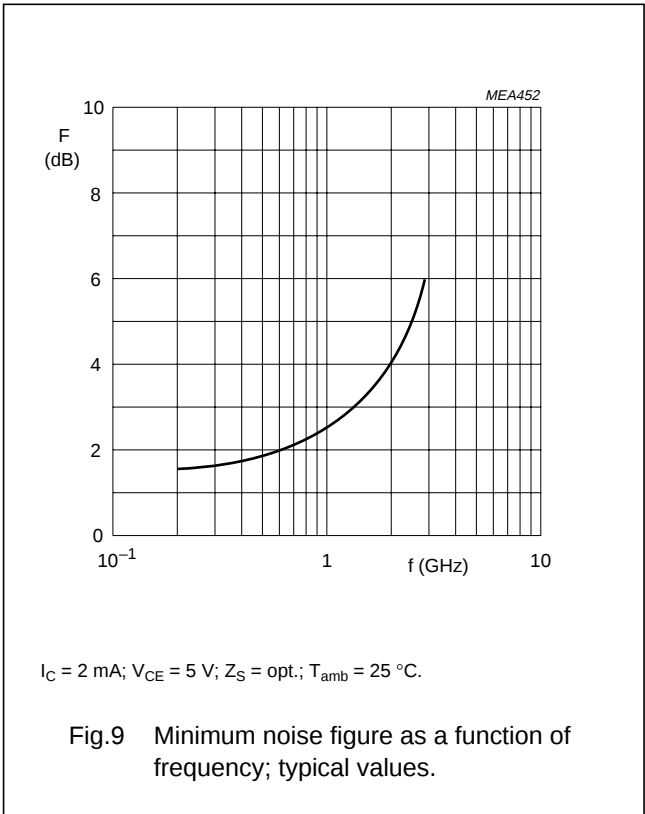
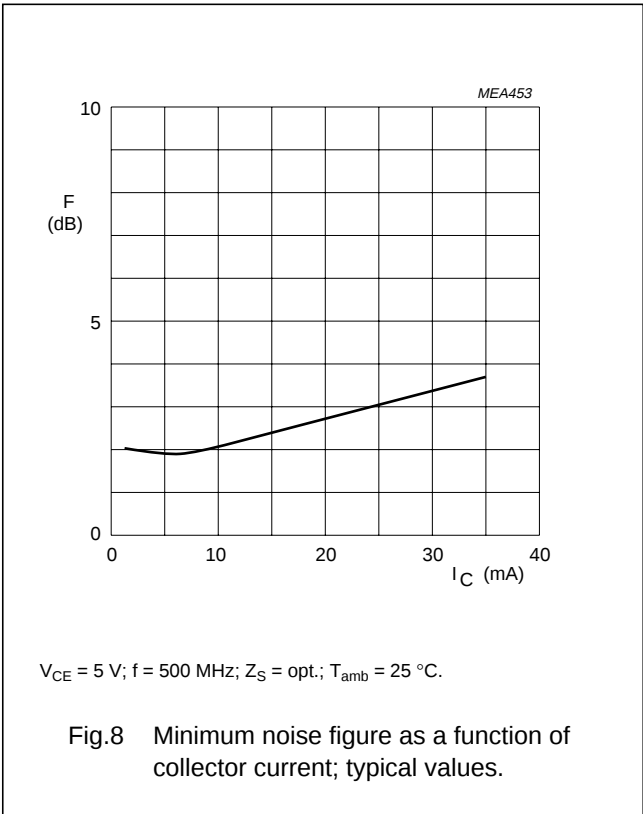
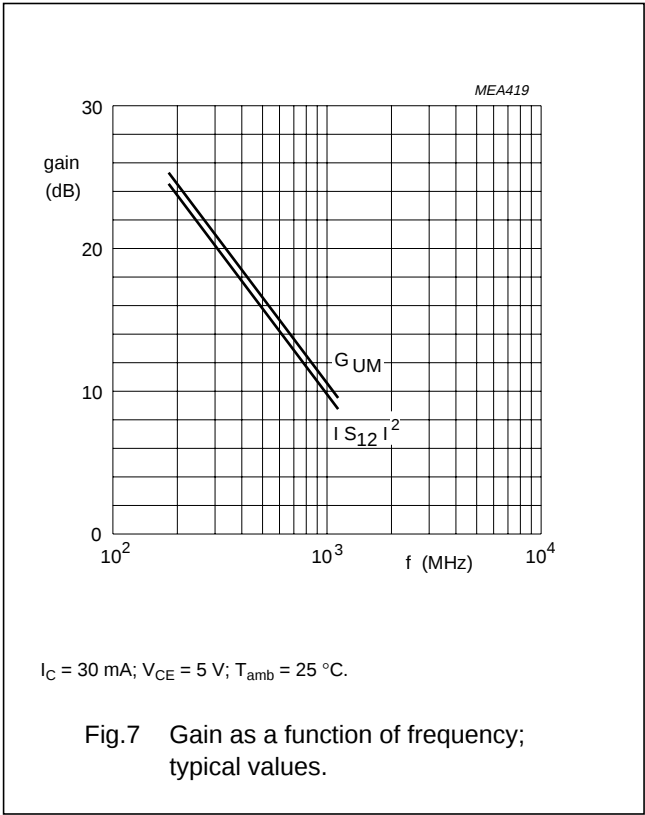
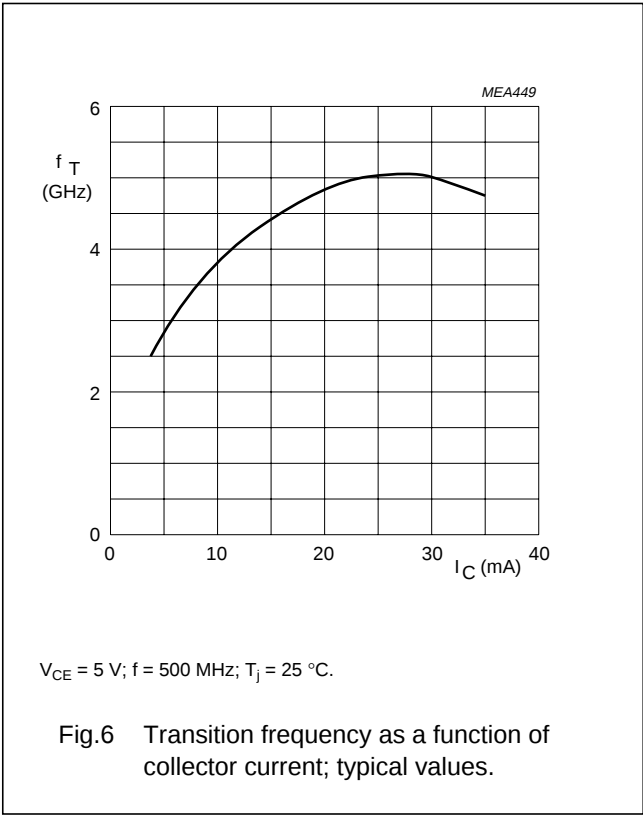


I_E = I_B = 0; f = 1 MHz; T_J = 25 °C.

Fig.5 Collector capacitance as a function of collector-base voltage; typical values.

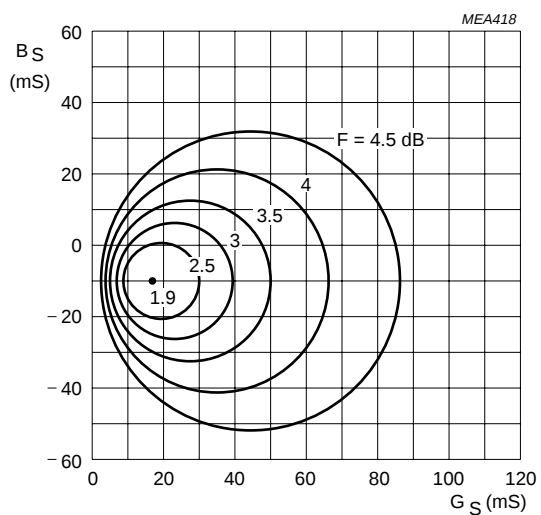
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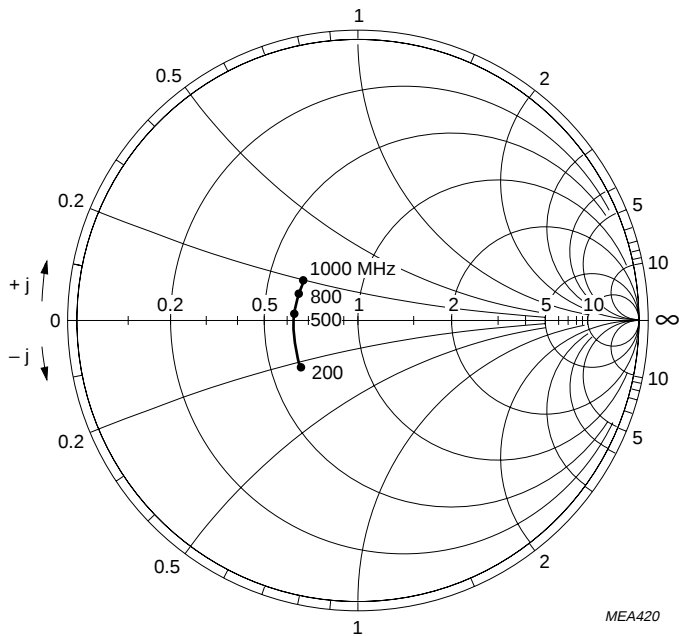


$I_C = 2$ mA; $V_{CE} = 5$ V; $f = 500$ MHz; $T_{amb} = 25$ °C.

Fig.10 Circles of constant noise figure;
typical values.

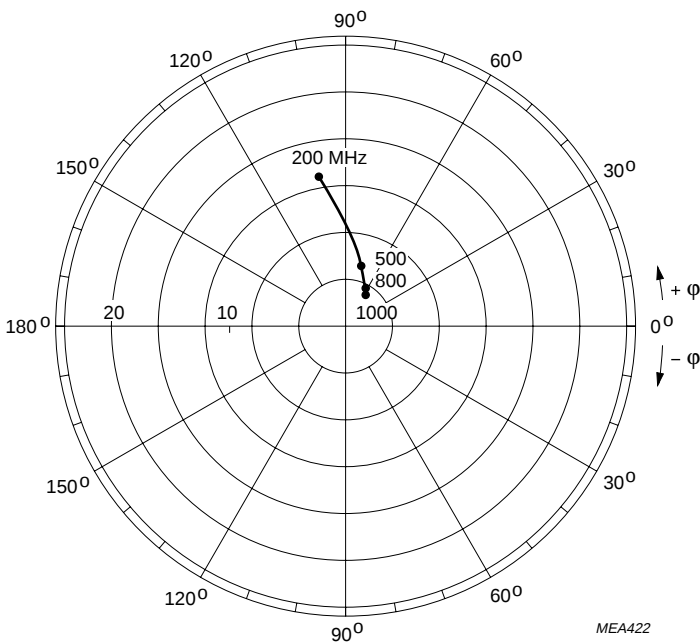
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$I_C = 30\text{ mA}$; $V_{CE} = 5\text{ V}$; $Z_0 = 50\text{ }\Omega$; $T_{amb} = 25\text{ }^\circ\text{C}$.

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

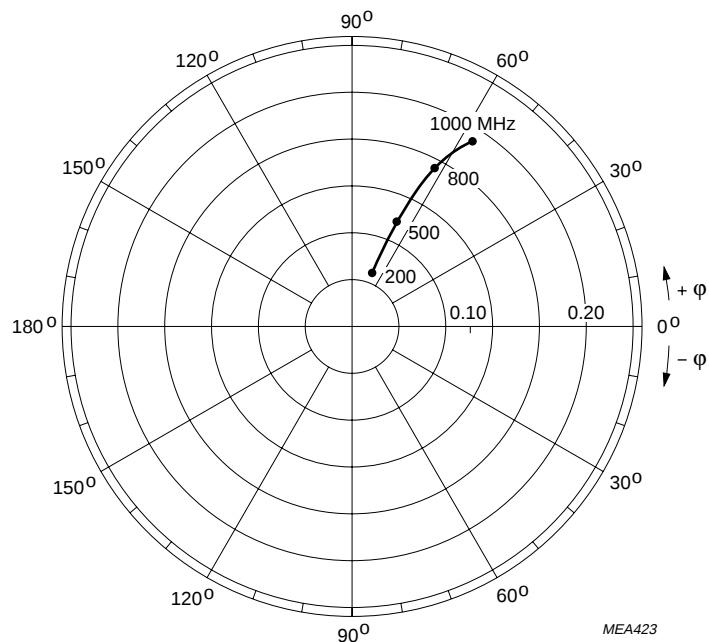


$I_C = 30\text{ mA}$; $V_{CE} = 5\text{ V}$; $T_{amb} = 25\text{ }^\circ\text{C}$.

Fig.12 Common emitter forward transmission coefficient (S_{21}); typical values.

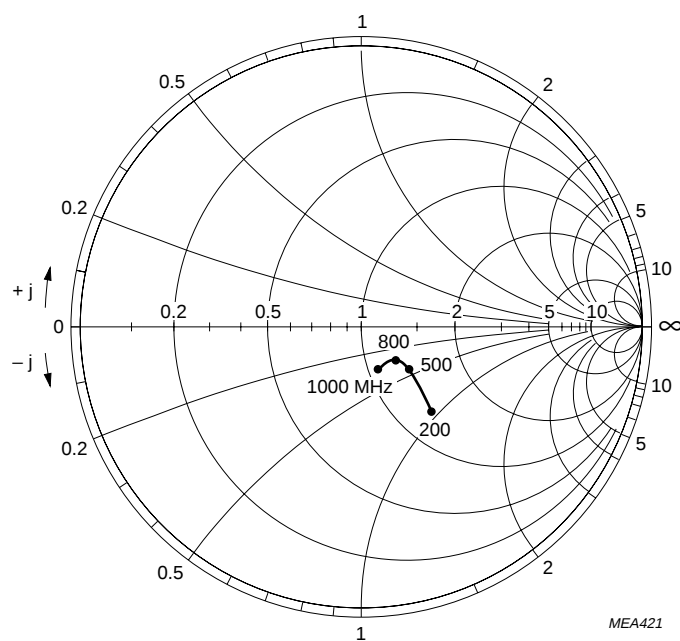
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$I_C = 30 \text{ mA}$; $V_{CE} = 5 \text{ V}$; $T_{amb} = 25^\circ \text{C}$.

Fig.13 Common emitter reverse transmission coefficient (S_{12}); typical values.



$I_C = 30 \text{ mA}$; $V_{CE} = 5 \text{ V}$; $Z_0 = 50 \Omega$; $T_{amb} = 25^\circ \text{C}$.

Fig.14 Common emitter output reflection coefficient (S_{22}); typical values.

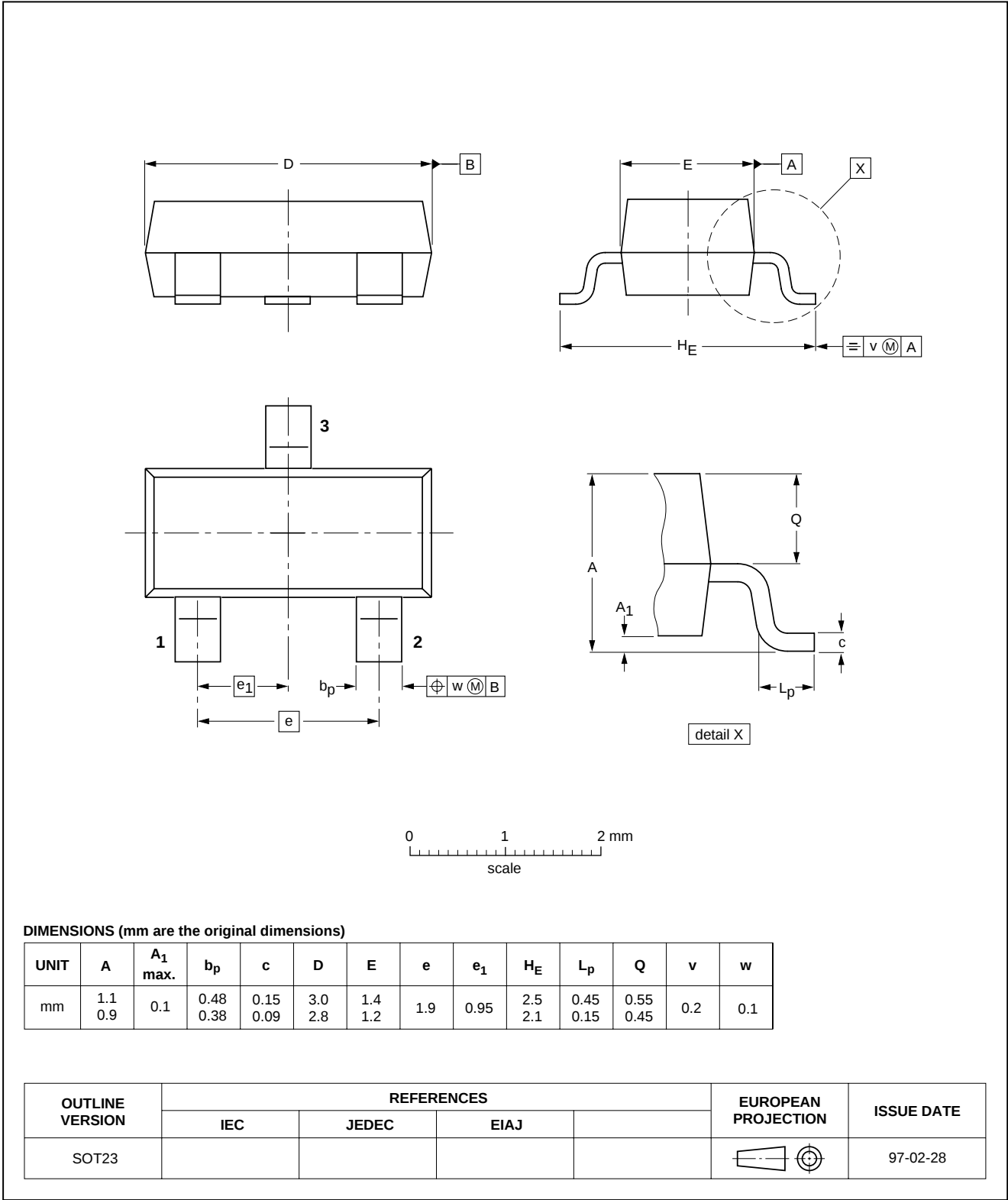
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PACKAGE OUTLINE

Plastic surface mounted package; 3 leads

SOT23



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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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