

BFG325/XR

NPN 14 GHz wideband transistor

Rev. 01 — 2 February 2005

Product data sheet

1. Product profile

1.1 General description

NPN silicon planar epitaxial transistor in a 4-pin dual-emitter SOT143R plastic package.

1.2 Features

- High power gain
- Low noise figure
- High transition frequency
- Gold metallization ensures excellent reliability

1.3 Applications

- Intended for Radio Frequency (RF) front end applications in the GHz range, such as:
 - ◆ analog and digital cellular telephones
 - ◆ cordless telephones (Cordless Telephone (CT), Personal Communication Network (PCN), Digital Enhanced Cordless Telecommunications (DECT), etc.)
 - ◆ radar detectors
 - ◆ pagers
 - ◆ Satellite Antenna TeleVision (SATV) tuners
 - ◆ repeater amplifiers in fiber-optic systems

1.4 Quick reference data

Table 1: Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CBO}	collector-base voltage	open emitter	-	-	15	V
V_{CEO}	collector-emitter voltage	open base	-	-	6	V
I_C	collector current (DC)		-	-	35	mA
P_{tot}	total power dissipation	$T_{sp} \leq 90\text{ °C}$	^[1] -	-	210	mW
h_{FE}	DC current gain	$I_C = 15\text{ mA}$; $V_{CE} = 3\text{ V}$; $T_j = 25\text{ °C}$	60	100	200	
C_{CBS}	collector-base capacitance	$V_{CB} = 5\text{ V}$; $f = 1\text{ MHz}$; emitter grounded	-	0.26	0.4	pF
f_T	transition frequency	$I_C = 15\text{ mA}$; $V_{CE} = 3\text{ V}$; $f = 1\text{ GHz}$; $T_{amb} = 25\text{ °C}$	-	14	-	GHz
G_{max}	maximum power gain ^[2]	$I_C = 15\text{ mA}$; $V_{CE} = 3\text{ V}$; $f = 1.8\text{ GHz}$; $T_{amb} = 25\text{ °C}$	-	18.3	-	dB

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Table 1: Quick reference data ...continued

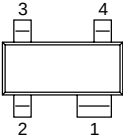
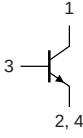
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$ S_{21} ^2$	insertion power gain	$I_C = 15 \text{ mA}$; $V_{CE} = 3 \text{ V}$; $f = 1.8 \text{ GHz}$; $T_{amb} = 25 \text{ }^\circ\text{C}$; $Z_S = Z_L = 50 \text{ } \Omega$	-	14	-	dB
NF	noise figure	$\Gamma_S = \Gamma_{opt}$; $I_C = 3 \text{ mA}$; $V_{CE} = 3 \text{ V}$; $f = 2 \text{ GHz}$	-	1.1	-	dB

[1] T_{sp} is the temperature at the soldering point of the collector pin.

[2] G_{max} is the maximum power gain, if $K > 1$. If $K < 1$ then $G_{max} = MSG$, see [Figure 4](#).

2. Pinning information

Table 2: Pinning

Pin	Description	Simplified outline	Symbol
1	collector		
2	emitter		
3	base		
4	emitter		

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3. Ordering information

Table 3: Ordering information

Type number	Package		
	Name	Description	Version
BFG325/XR	SC-61AA	plastic surface mounted package; reverse pinning; 4 leads	SOT143R

4. Marking

Table 4: Marking codes

Type number	Marking code [1]
BFG325/XR	S2*

[1] * = p: made in Hong Kong.

5. Limiting values

Table 5: Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CBO}	collector-base voltage	open emitter	-	15	V
V_{CEO}	collector-emitter voltage	open base	-	6	V
V_{EBO}	emitter-base voltage	open collector	-	2	V

Table 5: Limiting values ...continued

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
I_C	collector current (DC)		-	35	mA
P_{tot}	total power dissipation	$T_{sp} \leq 90\text{ °C}$	[1] -	210	mW
T_{stg}	storage temperature		-65	+175	°C
T_j	junction temperature		-	175	°C

[1] T_{sp} is the temperature at the soldering point of the collector pin.

6. Thermal characteristics

Table 6: Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point	$T_{sp} \leq 90\text{ °C}$	[1] 405	K/W

[1] T_{sp} is the temperature at the soldering point of the collector pin.

7. Characteristics

Table 7: Characteristics $T_j = 25\text{ °C}$; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{CBO}	collector-base cut-off current	$I_E = 0\text{ A}$; $V_{CB} = 5\text{ V}$	-	-	15	nA
h_{FE}	DC current gain	$I_C = 15\text{ mA}$; $V_{CE} = 3\text{ V}$	60	100	200	
C_{CBS}	collector-base capacitance	$V_{CB} = 5\text{ V}$; $f = 1\text{ MHz}$; emitter grounded	-	0.26	0.4	pF
C_{CES}	collector-emitter capacitance	$V_{CE} = 5\text{ V}$; $f = 1\text{ MHz}$; base grounded	-	0.27	-	pF
C_{EBS}	emitter-base capacitance	$V_{EB} = 0.5\text{ V}$; $f = 1\text{ MHz}$; collector grounded	-	0.53	-	pF
f_T	transition frequency	$I_C = 15\text{ mA}$; $V_{CE} = 3\text{ V}$; $f = 1\text{ GHz}$; $T_{amb} = 25\text{ °C}$	-	14	-	GHz
G_{max}	maximum power gain [1]	$I_C = 15\text{ mA}$; $V_{CE} = 3\text{ V}$; $f = 1.8\text{ GHz}$; $T_{amb} = 25\text{ °C}$	-	18.3	-	dB
$ S_{21} ^2$	insertion power gain	$I_C = 15\text{ mA}$; $V_{CE} = 3\text{ V}$; $T_{amb} = 25\text{ °C}$; $Z_S = Z_L = 50\text{ }\Omega$				
		$f = 1.8\text{ GHz}$	-	14	-	dB
		$f = 3\text{ GHz}$	-	10	-	dB
NF	noise figure	$\Gamma_s = \Gamma_{opt}$; $I_C = 3\text{ mA}$; $V_{CE} = 3\text{ V}$; $f = 2\text{ GHz}$	-	1.1	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	$I_C = 15\text{ mA}$; $V_{CE} = 3\text{ V}$; $f = 1.8\text{ GHz}$; $T_{amb} = 25\text{ °C}$; $Z_S = Z_L = 50\text{ }\Omega$	-	8.7	-	dBm
IP3	third order intercept point	$I_C = 15\text{ mA}$; $V_{CE} = 3\text{ V}$; $f = 1.8\text{ GHz}$; $T_{amb} = 25\text{ °C}$; $Z_S = Z_L = 50\text{ }\Omega$	-	19.4	-	dBm

[1] G_{max} is the maximum power gain, if $K > 1$. If $K < 1$ then $G_{max} = MSG$, see [Figure 4](#).

$$K \text{ is the Rollet stability factor: } K = \frac{1 + |Ds|^2 - |s_{11}|^2 - |s_{22}|^2}{2 \times |s_{21}| \times |s_{12}|} \text{ where } Ds = s_{11} \times s_{22} - s_{12} \times s_{21}.$$

MSG = maximum stable gain.

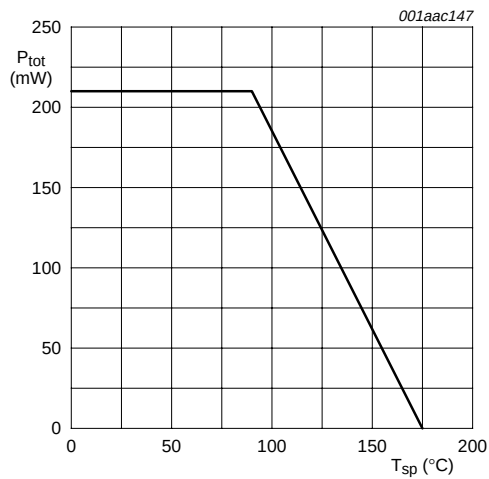


Fig 1. Power derating curve

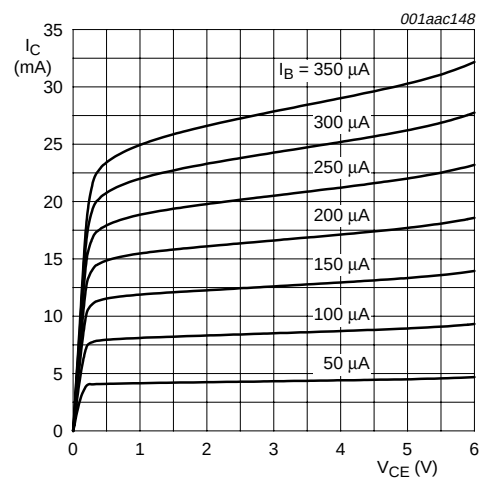
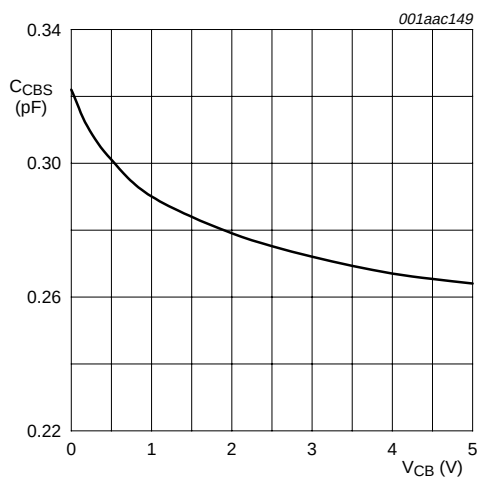
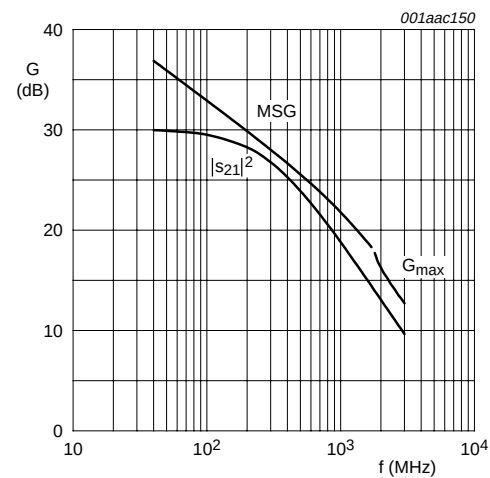


Fig 2. Collector current as a function of collector-emitter voltage; typical values



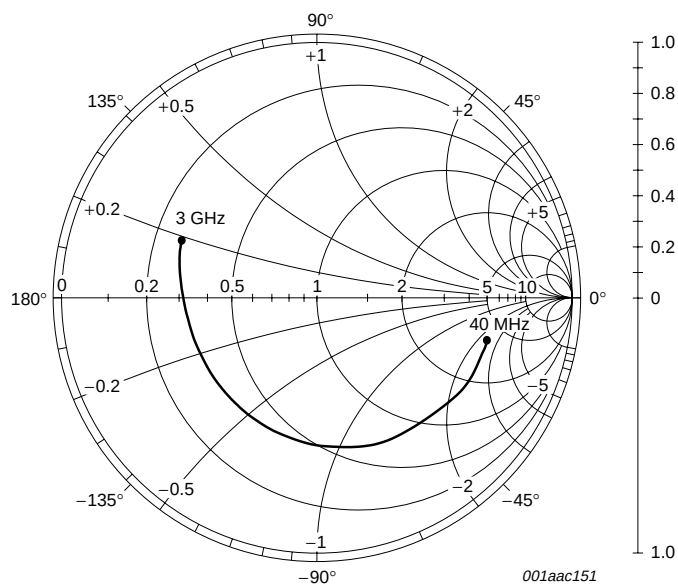
$I_C = 0$ mA; $f = 1$ MHz.

Fig 3. Collector-base capacitance as a function of collector-base voltage; typical values



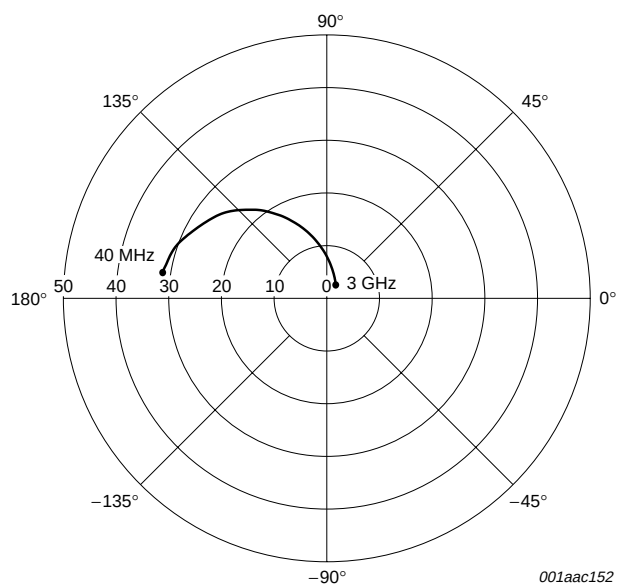
$I_C = 15$ mA; $V_{CE} = 3$ V.

Fig 4. Gain as a function of frequency; typical values



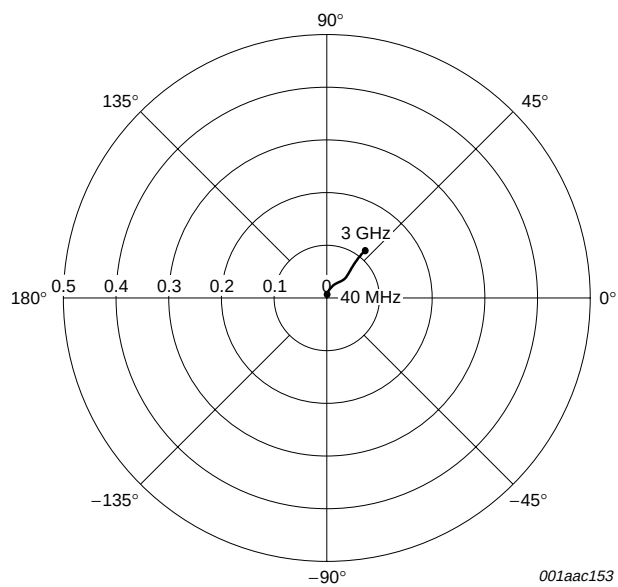
$V_{CE} = 3\text{ V}$; $I_C = 15\text{ mA}$; $Z_0 = 50\ \Omega$.

Fig 5. Common emitter input reflection coefficient (s_{11}); typical values



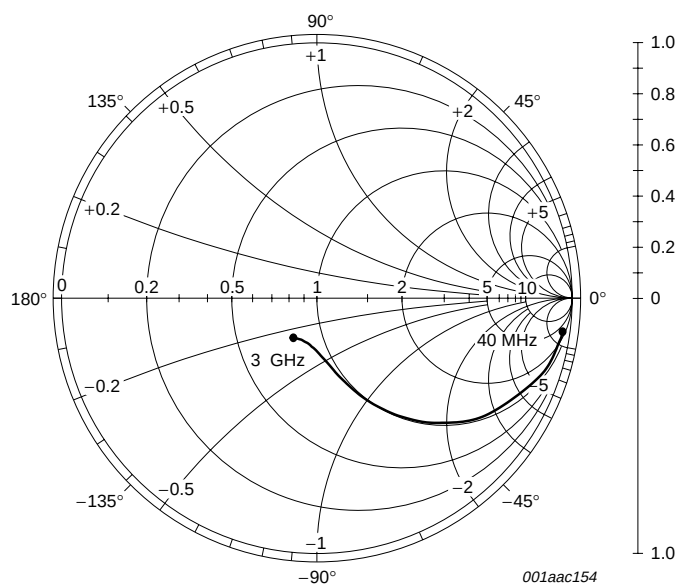
$V_{CE} = 3\text{ V}$; $I_C = 15\text{ mA}$.

Fig 6. Common emitter forward transmission coefficient (s_{21}); typical values



$V_{CE} = 3 \text{ V}; I_C = 15 \text{ mA}.$

Fig 7. Common emitter reverse transmission coefficient (s_{12}); typical values



$V_{CE} = 3 \text{ V}; I_C = 15 \text{ mA}; Z_0 = 50 \Omega.$

Fig 8. Common emitter output reflection coefficient (s_{22}); typical values



8. Application information

Table 8: SPICE parameters of the BFG325 DIE

Sequence	Parameter	Value	Unit
1	IS	26.6	aA
2	BF	200	-
3	NF	1	-
4	VAF	40	V
5	IKF	105	mA
6	ISE	2.3	fA
7	NE	2.114	-
8	BR	10	-
9	NR	1	-
10	VAR	2.5	V
11	IKR	10	A
12	ISC	0	aA
13	NC	1.5	-
14	RB	3.6	Ω
15	RE	1.5	Ω
16	RC	2.6	Ω
17	CJE	185.6	fF
18	VJE	890	mV
19	MJE	0.294	-
20	CJC	77.06	fF
21	VJC	601	mV
22	MJC	0.159	-
23	XCJC	1	-
24	FC	0.7	-
25	TF	8.1	ps
26	XTF	10	-
27	VTF	1000	V
28	ITF	150	mA
29	PTF	0	deg
30	TR	0	ns
31	KF	0	-
32	AF	1	-
33	TNOM	25	$^{\circ}\text{C}$
34	EG	1.014	eV
35	XTB	0	-
36	XTI	8	-
37	Q1.AREA	2.5	-

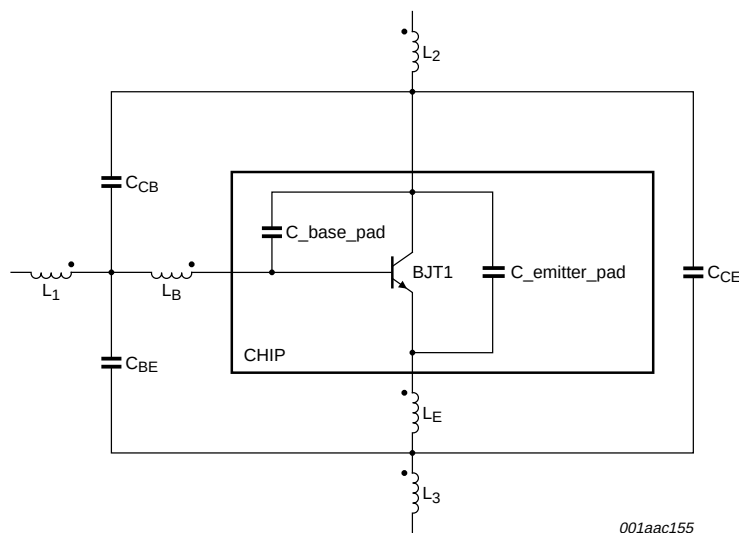


Fig 9. Package equivalent circuit of SOT143R

Table 9: List of components; see Figure 9

Designation	Value	Unit
C_{CB}	17	fF
C_{BE}	84	fF
C_{CE}	191	fF
C_{base_pad}	67	fF
$C_{emitter_pad}$	142	fF
L_B	0.95	nH
L_E	0.40	nH
L_1	0.12	nH
L_2	0.21	nH
L_3	0.06	nH



9. Package outline

Plastic surface mounted package; reverse pinning; 4 leads

SOT143R

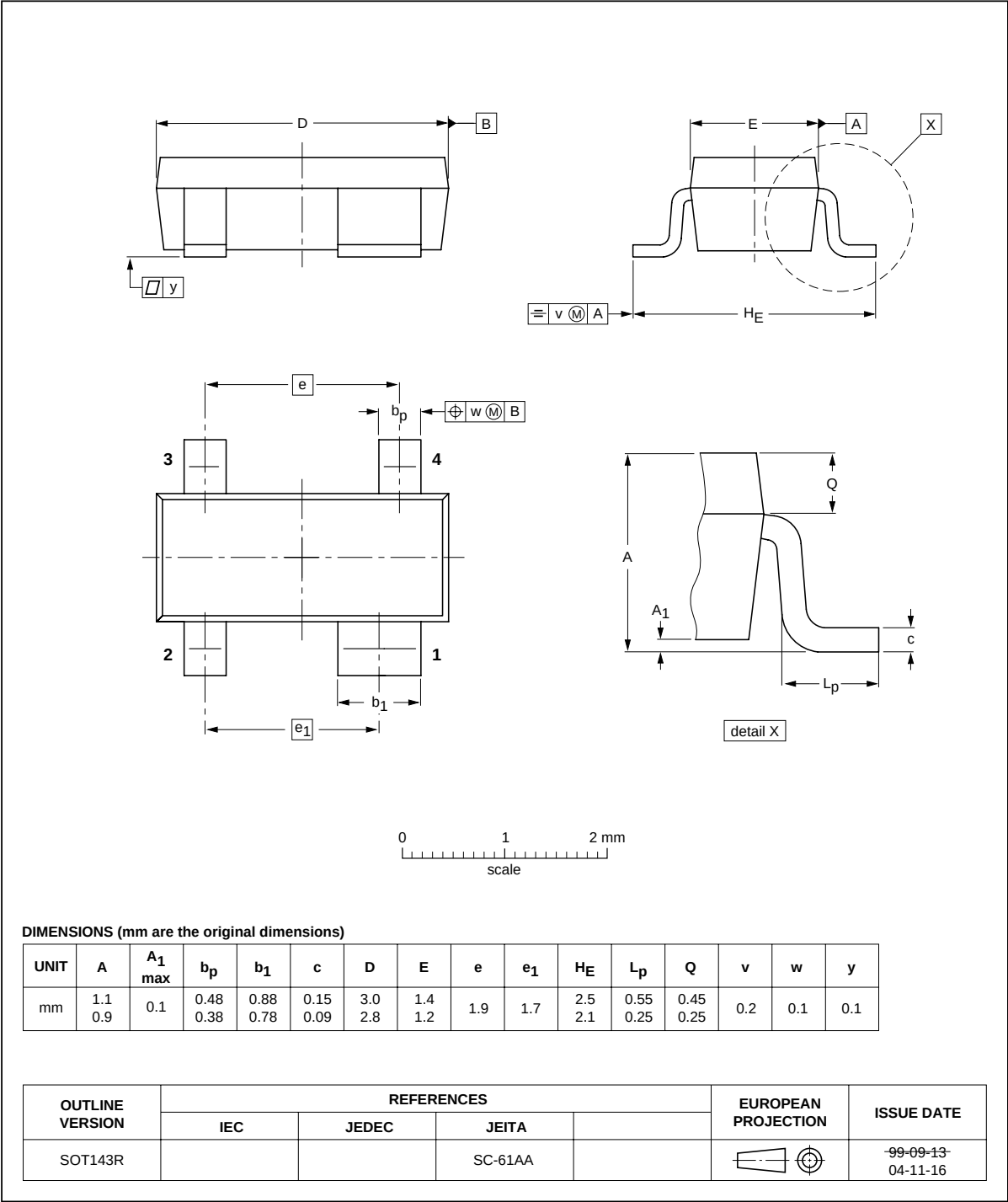


Fig 10. Package outline SOT143R (SC-61AA)



10. Revision history

Table 10: Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
BFG325_XR_1	20050202	Product data sheet	-	9397 750 14247	-

11. Data sheet status

Level	Data sheet status ^[1]	Product status ^{[2] [3]}	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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