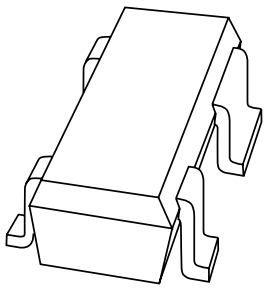
DATA SHEET



BFU540
NPN SiGe wideband transistor

Product specification
Supersedes data of 2002 Jan 28

2003 Jun 12

Philips
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PHILIPS

NPN SiGe wideband transistor BFU540

FEATURES

- Very high power gain
- Very low noise figure
- High transition frequency
- Emitter is thermal lead
- Low feedback capacitance
- 45 GHz SiGe process.

APPLICATIONS

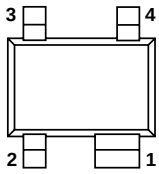
- RF front end
- Wideband applications, e.g. analog and digital cellular telephones, cordless telephones (PHS, DECT, etc.)
- Radar detectors
- Pagers
- Satellite television tuners (SATV)
- High frequency oscillators.

DESCRIPTION

NPN SiGe wideband transistor for low voltage applications in a plastic, 4-pin dual-emitter SOT343R package.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector



Top view MSB842

Marking code: A4.

Fig.1 Simplified outline SOT343R.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–	9	V
V_{CEO}	collector-emitter voltage	open base	–	–	2.3	V
I_C	collector current (DC)		–	40	50	mA
P_{tot}	total power dissipation	$T_s \leq 98$ °C	–	–	115	mW
h_{FE}	DC current gain	I_C = 40 mA; V_{CE} = 2 V; T_j = 25 °C	70	140	210	
G_{max}	maximum power gain	I_C = 40 mA; V_{CE} = 2 V; f = 2 GHz; T_{amb} = 25 °C	–	20	–	dB
NF	noise figure	I_C = 2 mA; V_{CE} = 2 V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	0.9	–	dB

CAUTION

This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling. For further information, refer to Philips specs.: SNW-EQ-608, SNW-FQ-302A and SNW-FQ-302B.

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	–	9	V
V_{CEO}	collector-emitter voltage	open base	–	2.3	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_C	collector current (DC)		–	50	mA
P_{tot}	total power dissipation	$T_s \leq 98$ °C; note 1; see Fig.2	–	115	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C

Note

1. T_s is the temperature at the soldering point of the emitter pins.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	450	K/W

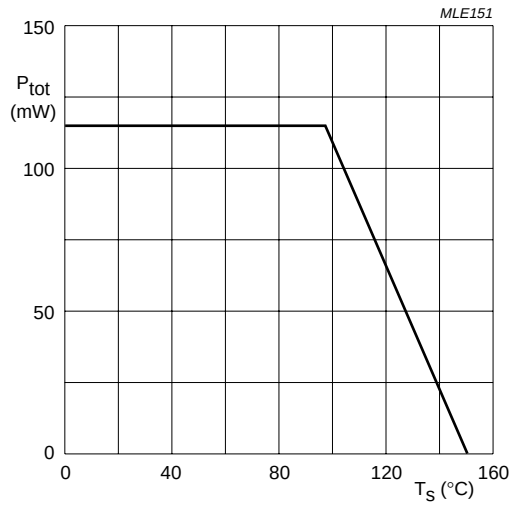


Fig.2 Power derating curve.

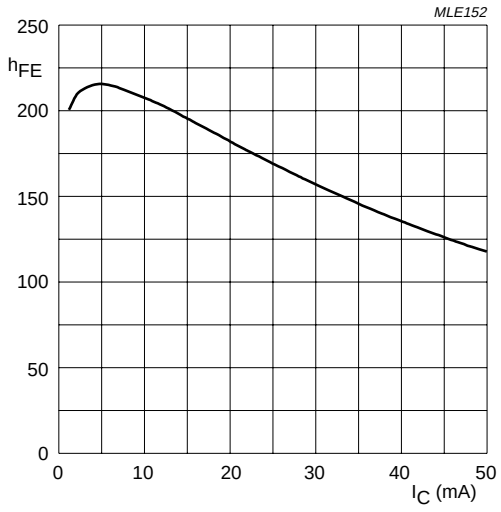
CHARACTERISTICS

T_j = 25 °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 2.5 μA; I_E = 0	9	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 1 mA; I_B = 0	2.3	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 2.5 μA; I_C = 0	2.5	–	–	V
I_{CBO}	collector-base leakage current	I_E = 0; V_{CB} = 4.5 V	–	–	15	nA
h_{FE}	DC current gain	I_C = 40 mA; V_{CE} = 2 V	70	140	210	
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 2 V; f = 1 MHz	–	520	–	fF
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 2 V; f = 1 MHz	–	105	–	fF
G_{max}	maximum power gain; note 1	I_C = 40 mA; V_{CE} = 2 V; f = 2 GHz; T_{amb} = 25 °C	–	20	–	dB
NF	noise figure	I_C = 2 mA; V_{CE} = 2 V; f = 2 GHz; $\Gamma_S = \Gamma_{opt}$	–	0.9	–	dB
P_{L1}	output power at 1 dB gain compression	I_C = 20 mA; V_{CE} = 2 V; f = 2 GHz; $Z_S = Z_{S\,opt}$; $Z_L = Z_{L\,opt}$; note 2	–	11	–	dBm
ITO	third order intercept point	I_C = 40 mA; V_{CE} = 2 V; f = 2 GHz; $Z_S = Z_{S\,opt}$; $Z_L = Z_{L\,opt}$; note 2	–	21	–	dBm

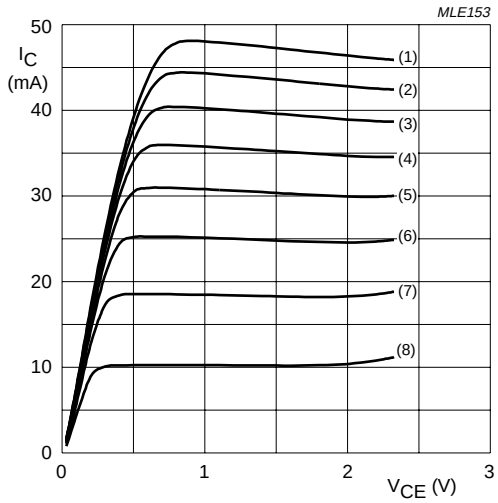
Notes

1. G_{max} is the maximum power gain, if K > 1. If K < 1 then G_{max} = MSG.
2. Z_S and Z_L are optimized for gain.



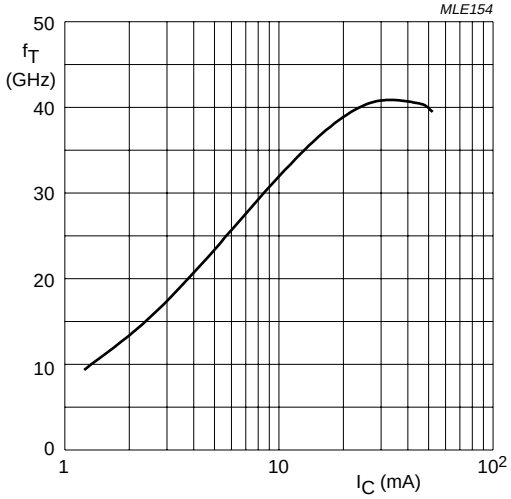
V_{CE} = 2 V; T_j = 25 °C.

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



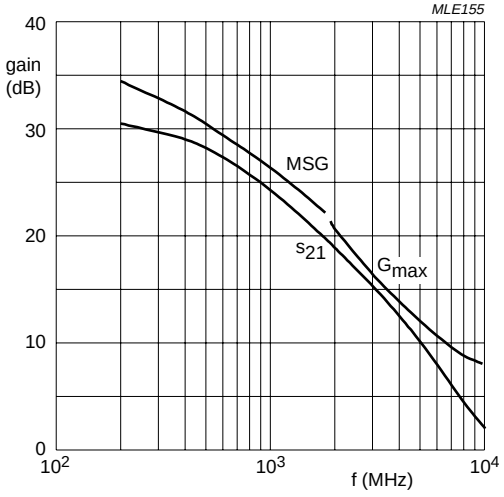
(1) I_B = 400 µA.
(2) I_B = 350 µA.
(3) I_B = 300 µA.
(4) I_B = 250 µA.
(5) I_B = 200 µA.
(6) I_B = 150 µA.
(7) I_B = 100 µA.
(8) I_B = 50 µA.

Fig.4 Output characteristics; typical values.



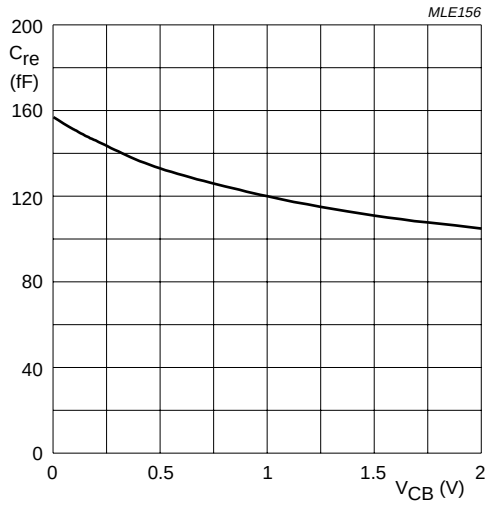
V_{CB} = 1 V; f = 2 GHz; T_{amb} = 25 °C.

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



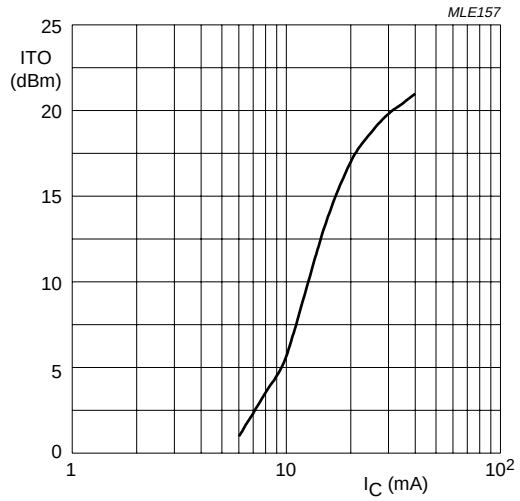
I_C = 40 mA; V_{CE} = 2 V; T_{amb} = 25 °C.

Fig.6 Gain as a function of frequency; typical values.



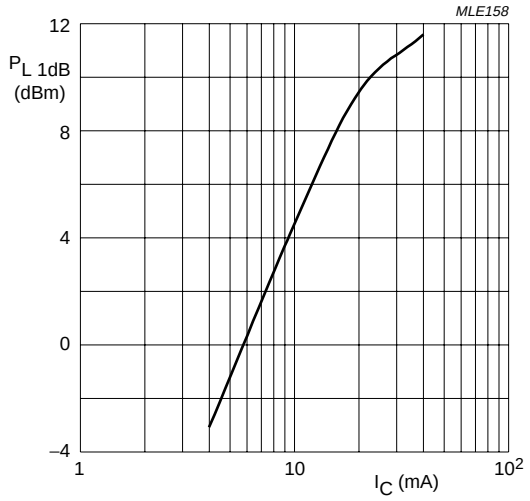
I_C = 0; f = 1 MHz; T_{amb} = 25 °C.

Fig.7 Feedback capacitance as a function of collector-base voltage; typical values.



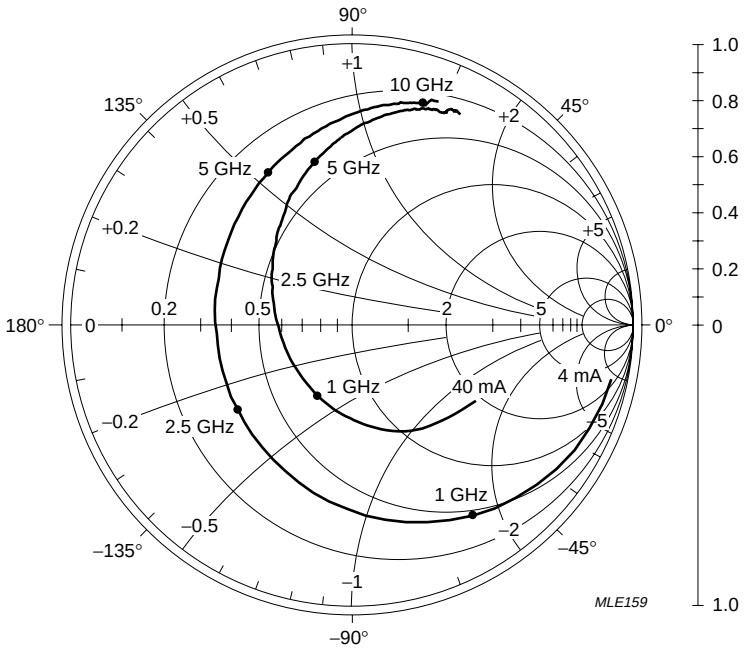
V_{CE} = 2 V; f = 2 GHz.

Fig.8 Third order intercept point as a function of collector current.



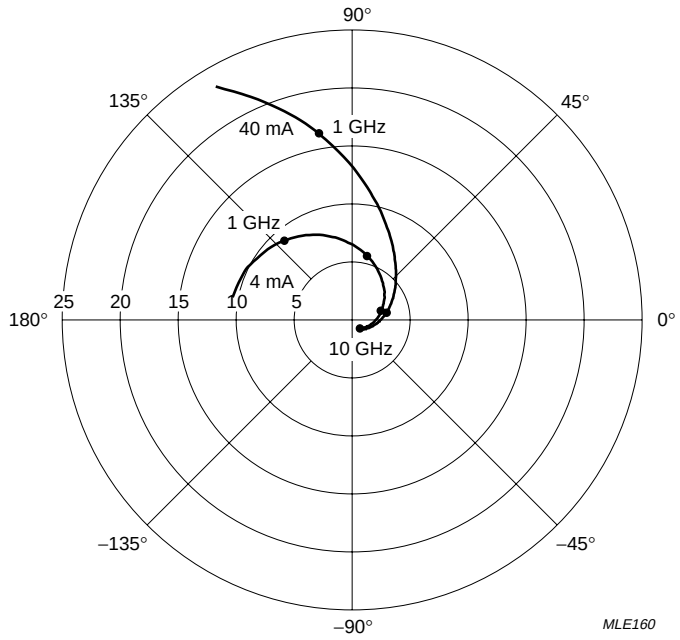
V_{CE} = 2 V; f = 2 GHz; source and load tuned for optimum gain.

Fig.9 Output power at 1 dB gain compression as a function of collector current.



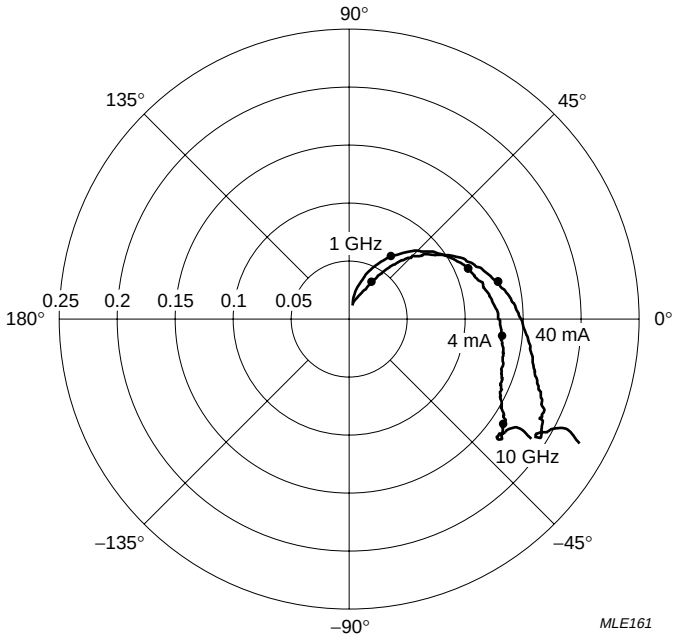
I_C = 4 mA and 40 mA; V_{CE} = 2 V; Z_o = 50 Ω.

Fig.10 Common emitter input reflection coefficient (s_{11}).



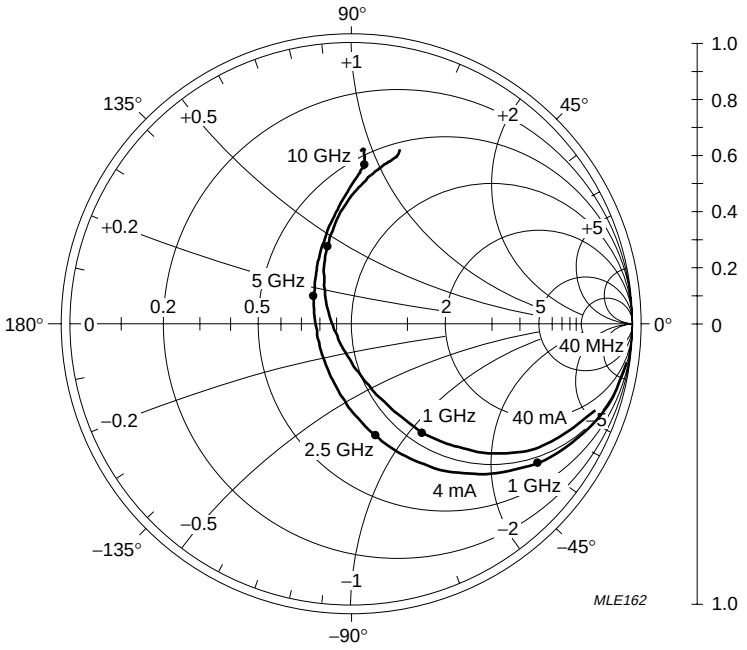
I_C = 4 mA and 40 mA; V_{CE} = 2 V; Z_o = 50 Ω.

Fig.11 Common emitter forward transmission coefficient (s_{21}).



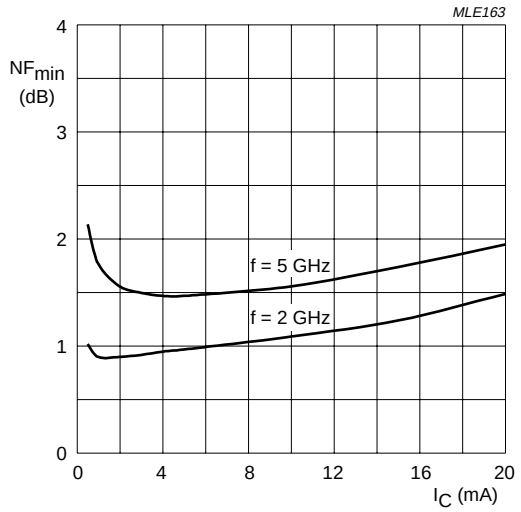
I_C = 4 mA and 40 mA; V_{CE} = 2 V; Z_o = 50 Ω.

Fig.12 Common emitter reverse transmission coefficient (s_{12}).



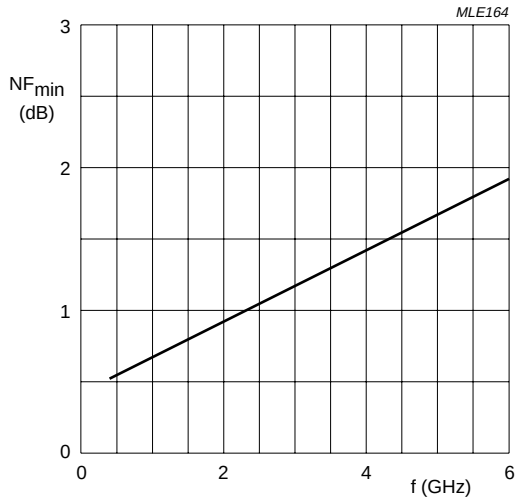
I_C = 4 mA and 40 mA; V_{CE} = 2 V; Z_o = 50 Ω.

Fig.13 Common emitter output reflection coefficient (s_{22}).



V_{CE} = 2 V; T_{amb} = 25 °C.

Fig.14 Minimum noise figure as a function of collector current.



I_C = 2 mA; V_{CE} = 2 V; T_{amb} = 25 °C.

Fig.15 Minimum noise figure as a function of frequency.

Noise data: V_{CE} = 2 V; I_C = 4 mA; T_{amb} = 25 °C; typical values

f (GHz)	F_{min} (dB)	Γ_{opt}		r_n (Ω)
		(mag)	(deg)	
2	1.0	0.39	55.9	0.20
3	1.2	0.23	86.8	0.15
4	1.4	0.11	142.5	0.13
5	1.6	0.14	–121.0	0.16
6	1.7	0.28	–74.2	0.27
7	1.9	0.41	–52.1	0.43
8	2.1	0.47	–32.6	0.66
9	2.3	0.54	–14.1	0.91
10	2.6	0.62	3.7	1.22
11	2.8	0.63	22.7	1.44
12	3.0	0.61	36.8	1.65

SPICE parameters for the BFU540 die

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	1.5	aA
2	BF	271.5	–
3	NF	1.061	–
4	VAF	25	V
5	IKF	68	mA
6	ISE	1060	fA
7	NE	2.9	–
8	BR	50	–
9	NR	1.01	–
10	VAR	1	MV
11	IKR	6.4	mA
12	ISC	1.2	fA
13	NC	1.21	–
14	RB	8.75	Ω
15(1)	IRB	–	–
16	RBM	5	Ω
17	RE	0.9	mΩ
18	RC	9.25	Ω
19	XTB	–2.2	–
20	EG	1.014	eV
21	XTI	3	–
22	CJE	222	fF
23	VJE	918	mV
24	MJE	0.27	–
25	TF	2.1	ps
26	XTF	10	–
27	VTF	1.5	V
28	ITF	0.92	A
29	PTF	30	deg
30	CJC	147	fF
31	VJC	587	mV
32	MJC	0.246	–
33	XCJC	0.44	–
34	TR	20	ps
35	CJS	51	fF
36	VJS	441	mV
37	MJS	0.313	–
38	FC	0.7	–

Note

1. Not used.

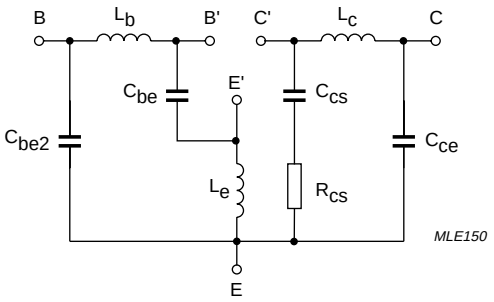


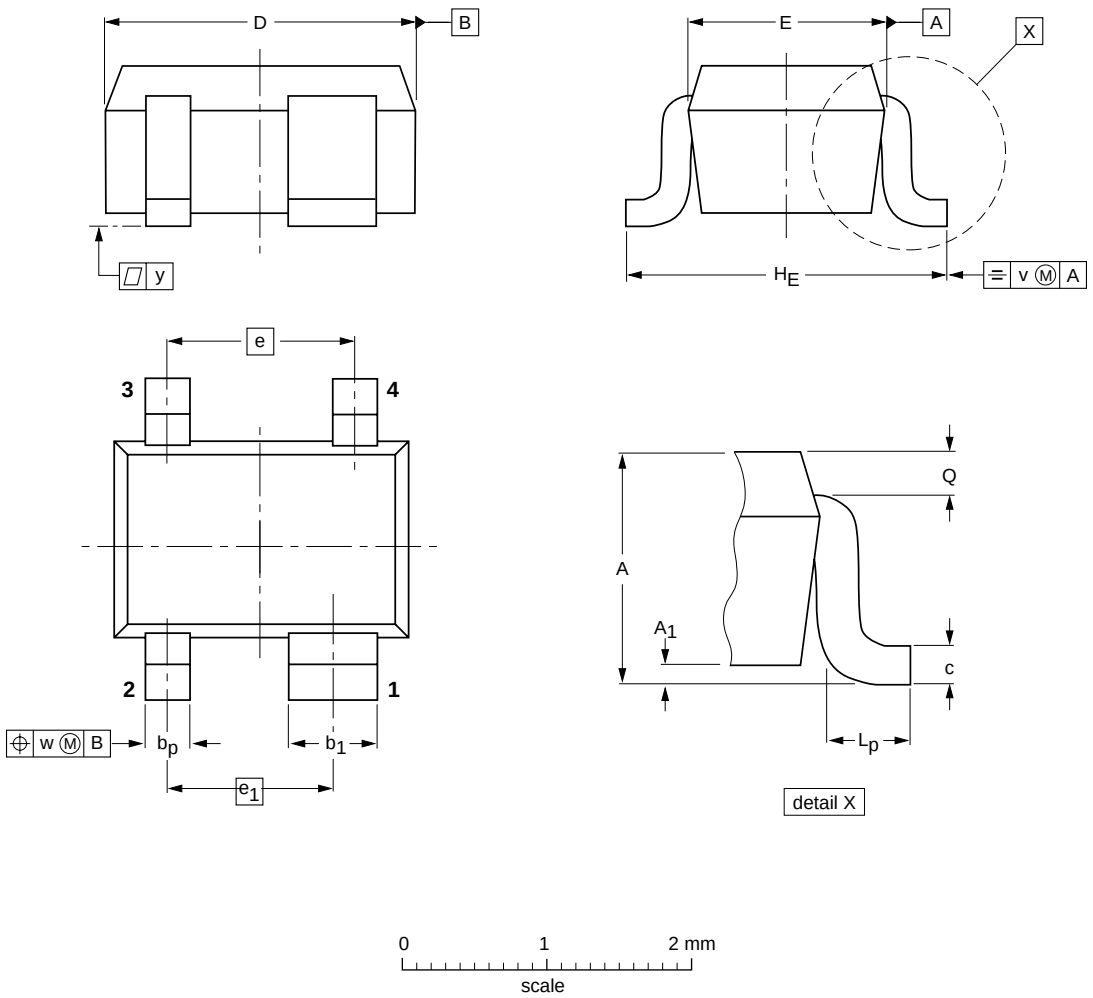
Fig.16 Package equivalent circuit SOT343R2.

List of components (see Fig.16)

DESIGNATION	VALUE	UNIT
L_b	1.18	nH
L_c	1.04	nH
L_e	0.32	nH
C_{be1}	146	fF
C_{be2}	55	fF
C_{ce}	56	fF
C_{cs}	100	fF
R_{cs}	170	Ω

PACKAGE OUTLINE

Plastic surface mounted package; reverse pinning; 4 leads **SOT343R**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	b_1	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.4 0.3	0.7 0.5	0.25 0.10	2.2 1.8	1.35 1.15	1.3	1.15	2.2 2.0	0.45 0.15	0.23 0.13	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT343R						97-05-21

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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Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). 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.

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