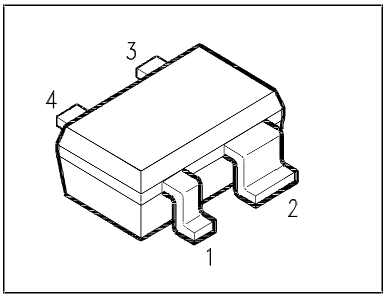
NPN Silicon RF Transistor



- For Medium Power Amplifiers
- Compression Point P_{-1dB} = +19 dBm at 1.8 GHz
  Maximum Available Gain G_{ma} = 14 dB at 1.8 GHz
  Noise Figure F = 1.25 dB at 1.8 GHz
- Transition Frequency f_T = 24 GHz
- Gold metalization for high reliability
- **SIEGET®25-Line**
  Siemens **G**rounded **E**mitter **T**ransistor-
  25 GHz f_T-**Line**

ESD: **E**lectro**s**tatic **d**ischarge sensitive device,
observe handling precautions!

Type	Marking	Ordering Code (8-mm taped)	Pin Configuration 1	2	3	4	Package 1)
BFP450	ANs	Q62702-F1590	B	E	C	E	SOT343

Maximum Ratings

Parameter	Symbol		Unit
Collector-emitter voltage	V_{CEO}	4.5	V
Collector-base voltage	V_{CBO}	15	V
Emitter-base voltage	V_{EBO}	1.5	V
Collector current	I_C	100	mA
Base current	I_B	10	mA
Total power dissipation, Ts ≤ 90°C 2)3)	P_{tot}	450	mW
Junction temperature	T_j	150	°C
Ambient temperature range	T_A	-65...+150°C	°C
Storage temperature range	T_{stg}	-65...+150°C	°C

Thermal Resistance

Junction-soldering point 2)	$R_{th\ JS}$	130	K/W

1) For detailed information see chapter Package page 9

2) T_S is measured on the emitter lead at the soldering point to the pcb.

3) P_{tot} due to Maximum Ratings.
At typical Ts ≤ 78°C: P_{tot} = 550 mW due to thermical characteristics.

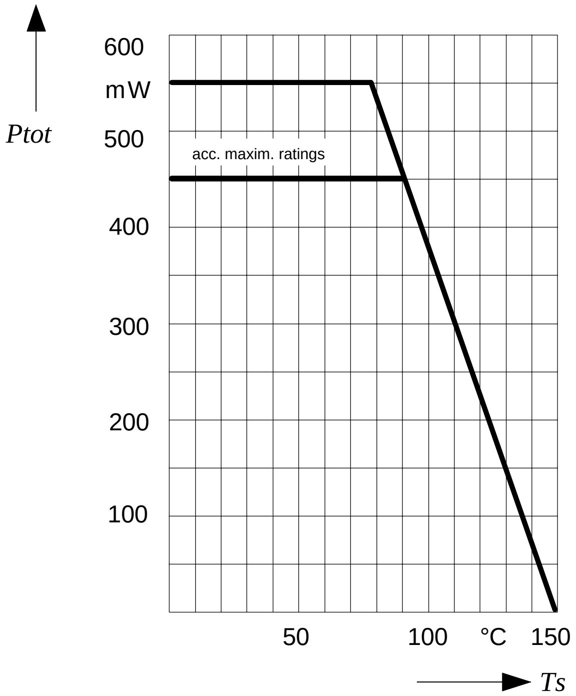
Electrical Characteristics

at T_A = 25 °C, unless otherwise specified.

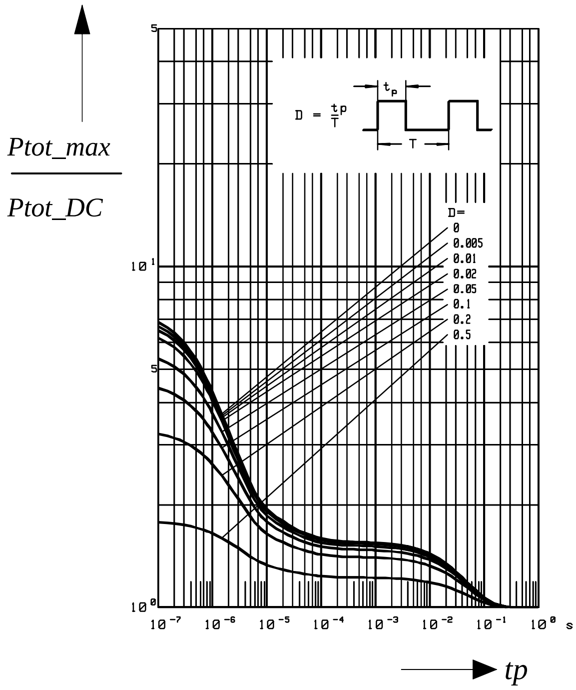
Parameter	Symbol	Value			Unit
		min.	typ.	max.	
DC Characteristics					
Collector-emitter breakdown voltage I_C = 1 mA	$V_{(BR)CEO}$	4.5	5	6.5	V
Collector-cutoff current V_{CB} = 5 V, I_E = 0	I_{CBO}	-	-	600	nA
Emitter base cuttoff current V_{EB} = 1.5 V, I_C = 0	I_{EBO}	-	-	100	µA
DC current gain I_C = 50 mA, V_{CE} = 4 V	h_{FE}	50	80	150	
AC Characteristics					
Transition frequency I_C = 90 mA, V_{CE} = 3 V, f = 1 GHz I_C = 90 mA, V_{CE} = 3 V, f = 2 GHz	f_T	 - 15	 24 17	 - -	GHz
Collector-base capacitance V_{CB} = 2 V, V_{BE} = v_{be} = 0, f = 1 MHz	C_{cb}	-	0.48	0.75	pF
Collector-emitter capacitance V_{CE} = 2 V, V_{BE} = v_{be} = 0, f = 1 MHz	C_{ce}	-	1.33	-	pF
Emitter-base capacitance V_{EB} = 0.5 V, V_{CB} = v_{cb} = 0, f = 1 MHz	C_{eb}	-	1.75	-	pF
Noise figure I_C = 10 mA, V_{CE} = 2 V, f = 1.8 GHz, Z_S = Z_{Sopt}	F	-	1.25	1.6	dB
Power gain I_C = 50 mA, V_{CE} = 2 V, f = 1.8 GHz, Z_S = Z_{Sopt} , Z_L = Z_{Lopt}	G_{ma} 1)	-	14.0	-	dB
Insertion power gain I_C = 50 mA, V_{CE} = 2 V, f = 1.8 GHz, Z_S = Z_L = 50Ω	$\|S_{21}\|^2$	8.0	11.0	-	dB
Third order intercept point at output I_C = 50 mA, V_{CE} = 3 V, f = 1.8 GHz, Z_S = Z_{Sopt} , Z_L= Z_{Lopt}	IP_3	-	29	-	dBm
1dB Compression point I_C = 50 mA, V_{CE} = 3 V, f = 1.8 GHz, Z_S = Z_{Sopt}, Z_L= Z_{Lopt}	P_{-1dB}	-	19	-	dBm

1) $G_{ma} = \left|\frac{S21}{S12}\right| . \left(k - \sqrt{\left(k^2 - 1\right)}\right)$

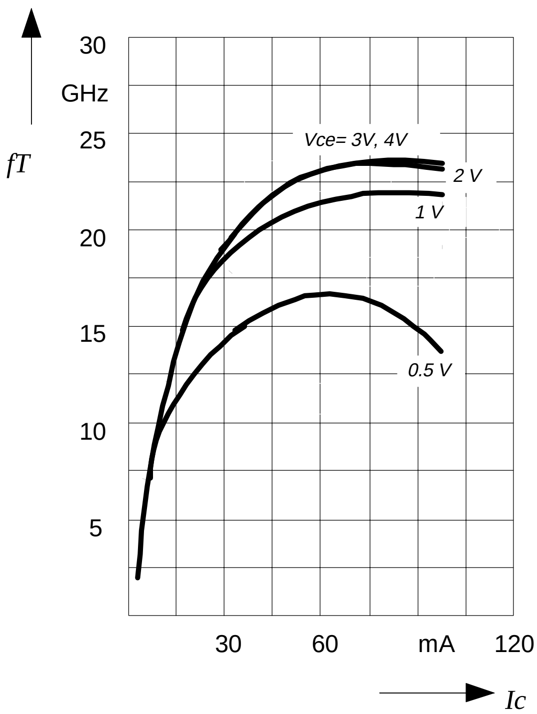
Total Power Dissipation
versus Soldering Point Temperature



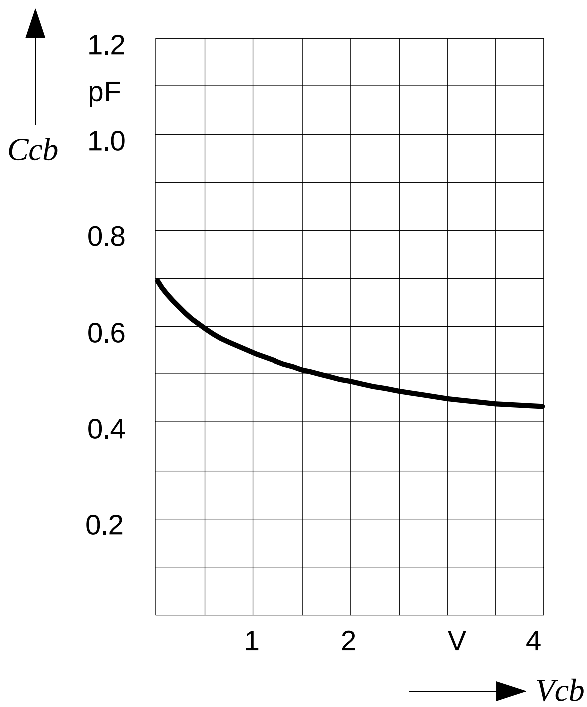
Permissible Pulse Power Dissipation
versus On-Time (V_{CE0max} = 4.5 V)



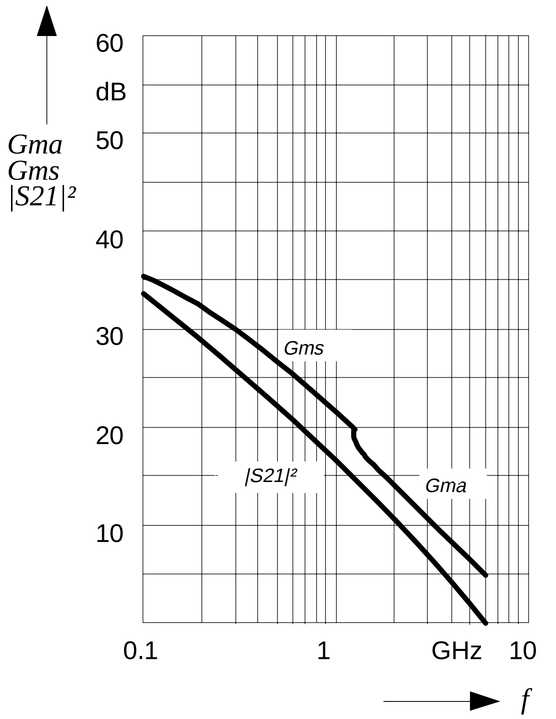
Transition Frequency
versus Collector Current
f = 1 GHz



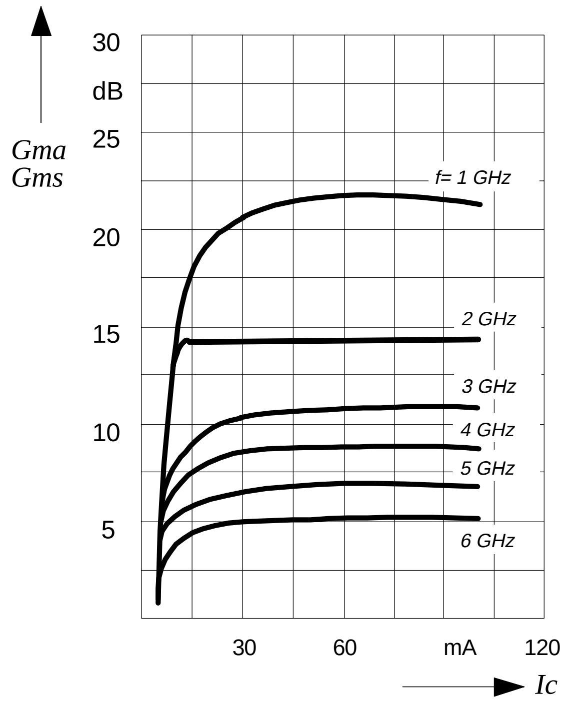
Collector-base Capacitance
versus Collector-base Voltage
V_{BE} = 0 V, f = 1MHz



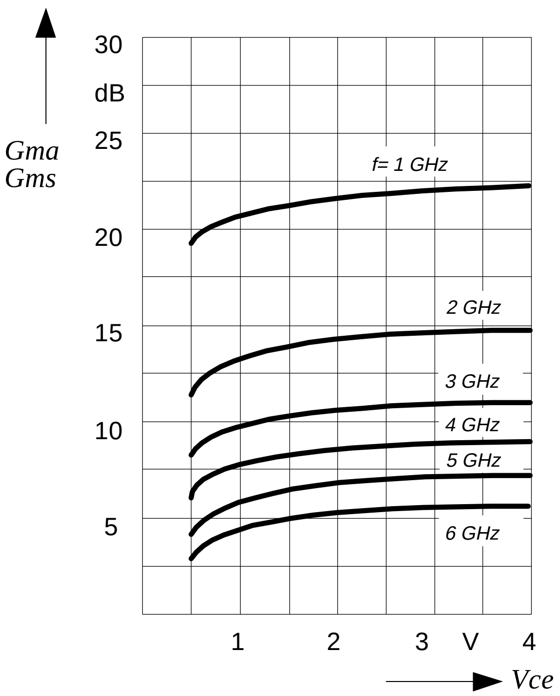
Power Gain
versus Frequency
V_{CE} = 2 V , I_C = 50 mA



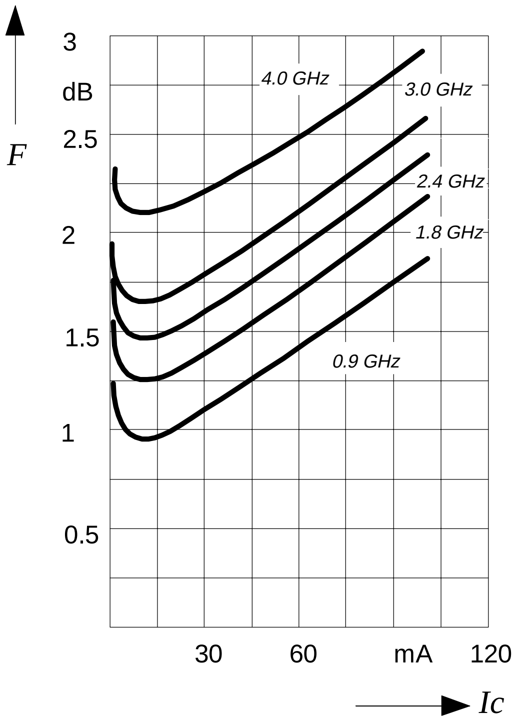
Power Gain
versus Collector Current
V_{CE} = 2 V



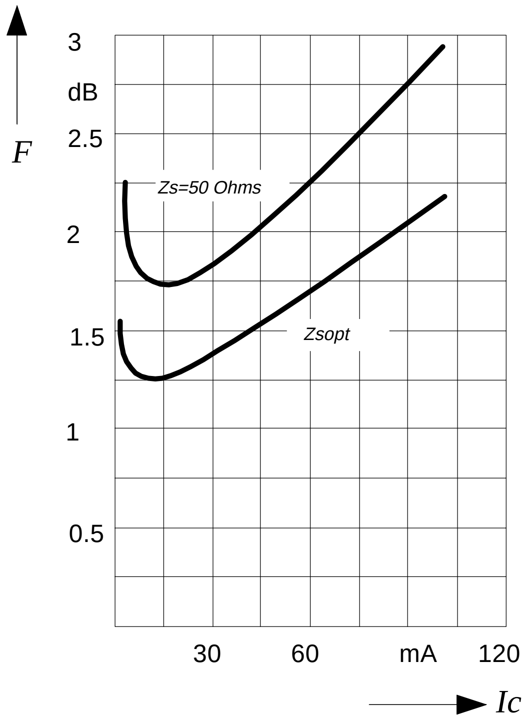
Power Gain
versus Collector Voltage
I_C= 50 mA



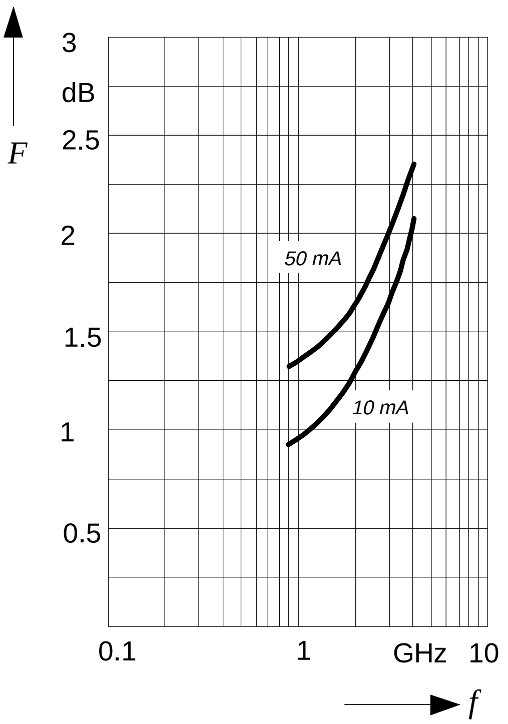
Noise Figure
versus Collector Current
V_{CE} = 2 V, $Z_S = Z_{Sopt}$



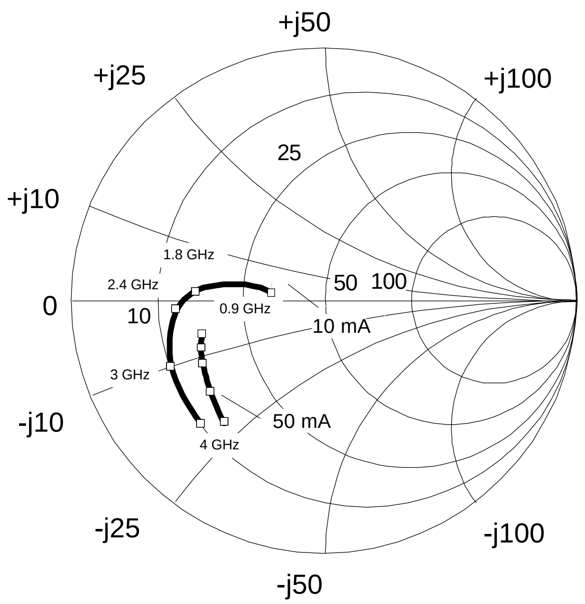
Noise Figure
versus Collector Current
V_{CE} = 2 V, f = 1,8 GHz



Noise Figure versus Frequency
V_{CE} = 2 V, I_C = 10 mA / 50 mA,
$Z_S = Z_{Sopt}$



Source Impedance for min.
Noise Figure versus Frequency
V_{CE} = 2 V, I_C = 10 mA / 50 mA



Common Emitter S-Parameters

f	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
V_{CE} = 2 V, I_C = 50 mA								
0.01	0.088	-45.0	58.79	175.5	0.0023	90.2	0.914	-5.7
0.1	0.439	-121.7	47.12	140.5	0.0145	61.6	0.789	-58.0
0.5	0.702	-171.3	14.72	93.1	0.0296	47.0	0.510	-142.9
1.0	0.731	172.9	7.30	75.6	0.0441	50.7	0.494	-170.6
2.0	0.757	154.2	3.44	55.4	0.0757	47.7	0.529	164.8
3.0	0.778	138.3	2.25	37.9	0.1067	38.5	0.554	148.8
4.0	0.802	123.2	1.63	21.8	0.1307	27.9	0.604	133.4
5.0	0.821	111.6	1.26	7.7	0.1503	17.5	0.627	118.6
6.0	0.825	101.9	1.03	-6.1	0.1668	8.1	0.659	110.2
V_{CE} = 2 V, I_C = 20 mA								
0.01	0.382	-9.4	40.77	176.5	0.0025	84.6	0.963	-4.5
0.1	0.490	-78.8	35.36	147.5	0.0202	64.0	0.857	-43.2
0.5	0.696	-158.3	13.06	96.8	0.0413	34.7	0.483	-124.2
1.0	0.730	179.7	6.60	76.7	0.0507	36.0	0.429	-157.8
2.0	0.759	157.7	3.12	54.3	0.0743	37.6	0.458	172.9
3.0	0.780	140.7	2.04	35.6	0.1001	32.5	0.486	152.2
4.0	0.804	124.7	1.47	18.5	0.1225	24.6	0.544	139.3
5.0	0.826	112.9	1.14	3.5	0.1413	16.0	0.575	124.2
6.0	0.830	102.8	0.93	-10.8	0.1575	7.8	0.618	115.7

Common Emitter Noise Parameters

f	F_{min} 1)	G_a 1)	Γ_{opt}		R_N	r_n	$F_{50\Omega}$ 2)	$\|S_{21}\|^2$ 2)
GHz	dB	dB	MAG	ANG	Ω	-	dB	dB
V_{CE} = 2 V, I_C = 10 mA								
0.9	0.90	15.5	0.20	171.0	5.0	0.10	0.98	16.0
1.8	1.25	11.8	0.50	179.2	2.3	0.04	1.74	9.5
2.4	1.45	10.9	0.57	-175.5	2.0	0.04	2.23	6.8
3.0	1.62	8.5	0.62	-158.0	3.5	0.07	2.81	4.7
4.0	2.10	6.6	0.67	-139.0	14.5	0.29	4.49	1.9

1) Input matched for minimum noise figure, output for maximum gain

2) $Z_S=Z_L=50\Omega$

For more and detailed S- and Noise-parameters please contact your local Siemens distributor or sales office to obtain a SIEMENS Application Notes CD-ROM or see Internet: http://www.siemens.de/Semiconductor/products/35/35.htm

SPICE Parameters:

Transistor Chip Data T503 (Berkeley-SPICE 2G.6 Syntax):

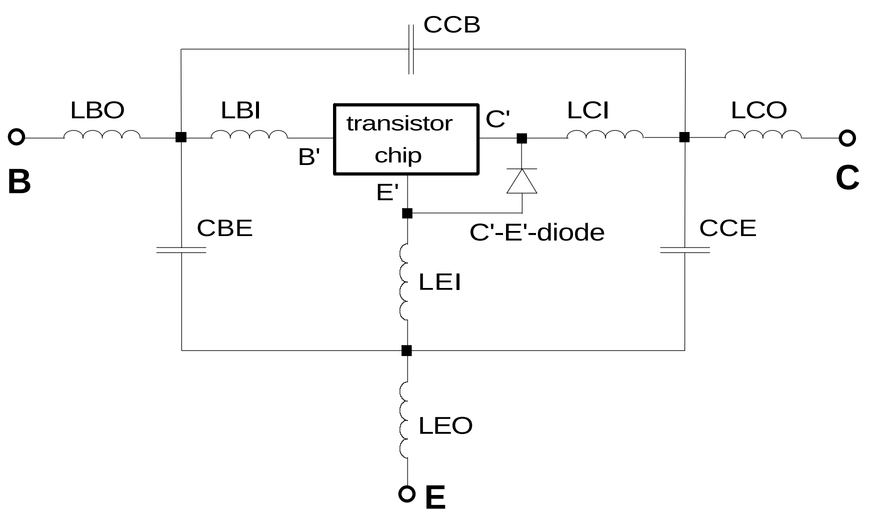
IS =	0.13125	fA	BF =	76.123	-	NF =	0.79652	-
VAF =	24.165	V	IKF =	0.58905	A	ISE =	28.341	fA
NE =	1.5563	-	BR =	21.254	-	NR =	1.2966	-
VAR =	13.461	V	IKR =	0.25878	A	ISC =	0.012292	fA
NC =	0.70543	-	RB =	2.1659	OHM	IRB =	0.013181	mA
RBM =	5.403	OHM	RE =	0.45346	OHM	RC =	0.50084	OHM
CJE =	3.2276	fF	VJE =	0.95292	V	MJE =	0.48672	-
TF =	7.5068	ps	XTF =	0.69972	-	VTF =	0.66148	V
ITF =	0.017655	mA	PTF =	0	deg	CJC =	1049.5	fF
VJC =	1.1487	V	MJC =	0.50644	-	XCJC =	0.28285	-
TR =	2.6912	ns	CJS =	0	fF	VJS =	0.75	V
MJS =	0	-	XTB =	0	-	EG =	1.11	eV
XTI =	3.0	-	FC =	0.91274	-	Tnom =	300	K

C'-E'- Diode Data (Berkeley-SPICE 2G.6 Syntax):

IS =	25.0	fA	N =	1.05	-	RS =	5.0	Ω

All parameters are ready to use, no scaling is necessary.

Package Equivalent Circuit:



SOT343-4:

LBI = 0.31 nH
LBO = 0.63 nH
LEI = 0.20 nH
LEO = 0.05 nH
LCI = 0.29 nH
LCO = 0.68 nH
CBE = 208 fF
CCE = 213 fF
CCB = 3.2 fF

valid up to 6 GHz

The SOT343 package has two emitter leads. To avoid high complexity of the package equivalent circuit, both leads are combined in one electrical connection.

Extracted on behalf of SIEMENS Small Signal Semiconductors by:
Institut für Mobil- und Satellitenfunktechnik (IMST)

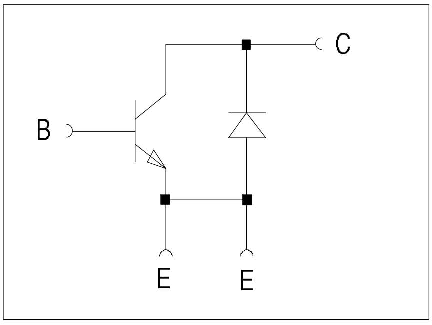
For more examples and ready to use parameters please contact your local Siemens distributor or sales office to obtain a SIEMENS Application Notes CD-ROM or see Internet: http://www.siemens.de/Semiconductor/products/35/35.htm

For non-linear simulation:

- Use transistor chip parameters in Berkeley SPICE 2G.6 syntax for all simulators.
- If you need simulation of the reverse characteristics, add the diode with the C'-E'-diode data between collector and emitter.
- Simulation of the package is not necessary for frequencies < 100 MHz.
  For higher frequencies add the wiring of the package equivalent circuit around the non-linear transistor and diode model.

Note:

- This transistor is constructed in a common emitter configuration. This feature causes an additional, reverse biased diode between emitter and collector, which does not effect normal operation.



Transistor Schematic Diagram

The common emitter configuration shows the following advantages:

- Higher gain because of lower emitter inductance.
- Power is dissipated via the grounded emitter leads, because the chip is mounted on the copper emitter leadframe.

Please note, that the broadest lead is the emitter lead.

- The AC-Characteristics are verified by random sampling.