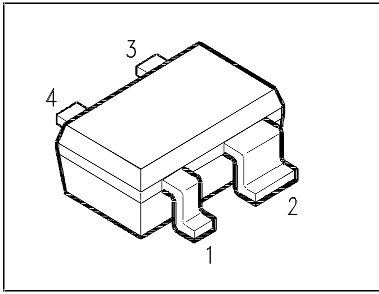
NPN Silicon RF Transistor



- For High Gain Low Noise Amplifiers
- For Oscillators up to 10 GHz
- Noise Figure F = 1.05 dB at 1.8 GHz
  Outstanding G_{ms} = 20 dB at 1.8 GHz
- Transition Frequency f_T = 25 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)
BFP420	AMs	Q62702-F1591	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	35	mA
Base current	I_B	3	mA
Total power dissipation, Ts ≤ 107°C 2)3)	P_{tot}	160	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)	$R_{th\ JS}$	270	K/W

1) For detailed information see chapter Package

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 ≤ 80°C: P_{tot} = 250 mW due to thermical characteristics.

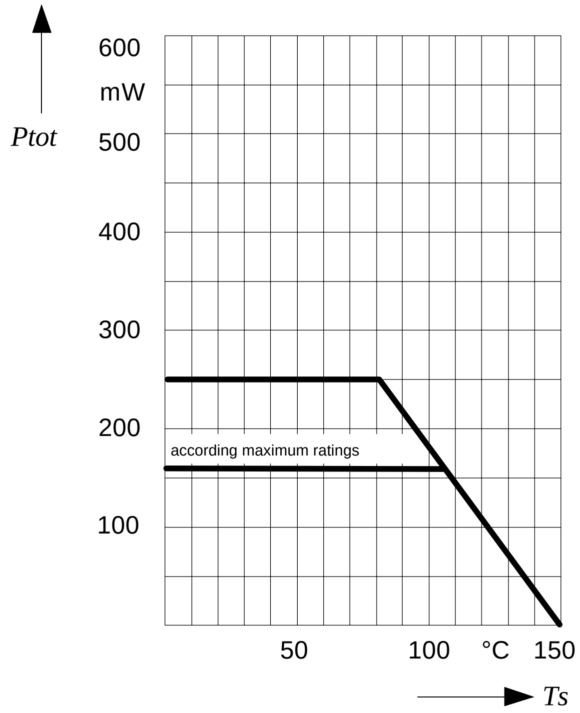
Electrical Characteristics

at T_A = 25 °C, unless otherwise specified.

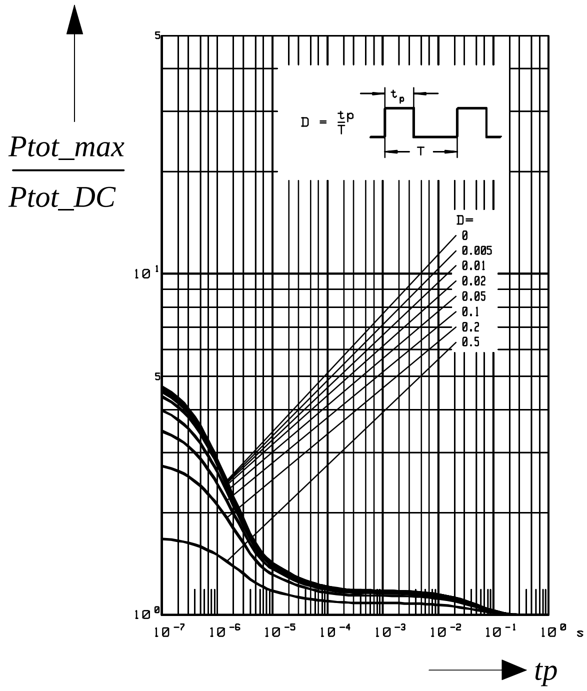
Parameter	Symbol	Value			Unit
		min.	typ.	max.	
DC Characteristics					
Collector-emitter breakdown voltage I_C = 1 mA	$V_{(BR)CEO}$	4.5	5	6.5	V
Collector-cutoff current V_{CB} = 5 V, I_E = 0	I_{CBO}	-	-	200	nA
Emitter base cuttoff current V_{EB} = 1.5 V, I_C = 0	I_{EBO}	-	-	35	µA
DC current gain I_C = 20 mA, V_{CE} = 4 V	h_{FE}	50	80	150	
AC Characteristics					
Transition frequency I_C = 30 mA, V_{CE} = 3 V, f = 2 GHz	f_T	20	25	-	GHz
Collector-base capacitance V_{CB} = 2 V, V_{BE} = v_{be} = 0, f = 1 MHz	C_{cb}	-	0.15	0.24	pF
Collector-emitter capacitance V_{CE} = 2 V, V_{BE} = v_{be} = 0, f = 1 MHz	C_{ce}	-	0.41	-	pF
Emitter-base capacitance V_{EB} = 0.5 V, V_{CB} = v_{cb} = 0, f = 1 MHz	C_{eb}	-	0.55	-	pF
Noise figure I_C = 5 mA, V_{CE} = 2 V, f = 1.8 GHz, $Z_S = Z_{Sopt}$	F	-	1.05	1.4	dB
Power gain I_C = 20 mA, V_{CE} = 2 V, f = 1.8 GHz, $Z_S = Z_{Sopt}$, $Z_L = Z_{Lopt}$	G_{ms} 1)	-	20	-	dB
Insertion power gain I_C = 20 mA, V_{CE} = 2 V, f = 1.8 GHz, $Z_S = Z_L = 50\Omega$	$\|S_{21}\|^2$	14	17	-	dB
Third order intercept point at output I_C = 20 mA, V_{CE} = 2 V, f = 1.8 GHz, $Z_S = Z_{Sopt}$, $Z_L = Z_{Lopt}$	IP_3	-	22	-	dBm
1dB Compression point I_C = 20 mA, V_{CE} = 2 V, f = 1.8 GHz, $Z_S = Z_{Sopt}$, $Z_L = Z_{Lopt}$	P_{-1dB}	-	12	-	dBm

1) $G_{ms} = \left|\frac{S21}{S12}\right|$

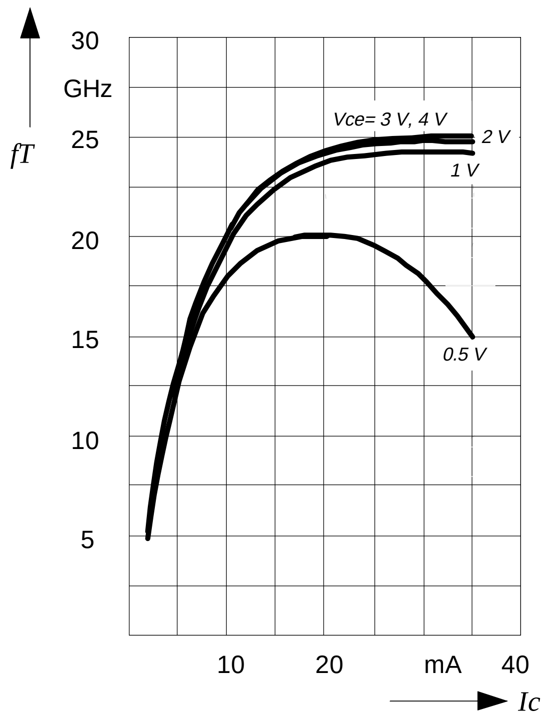
Total Power Dissipation
versus Soldering Point Temperature



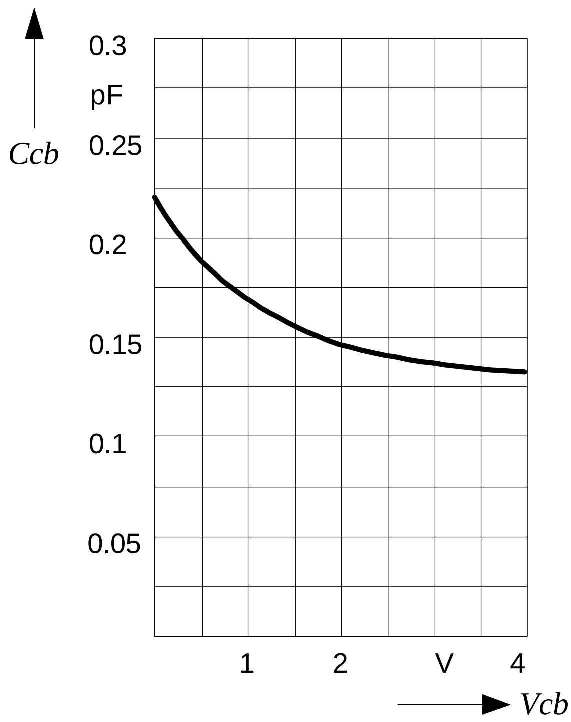
Permissible Pulse Power Dissipation
versus On-Time (V_{CE0max} = 4.5 V)



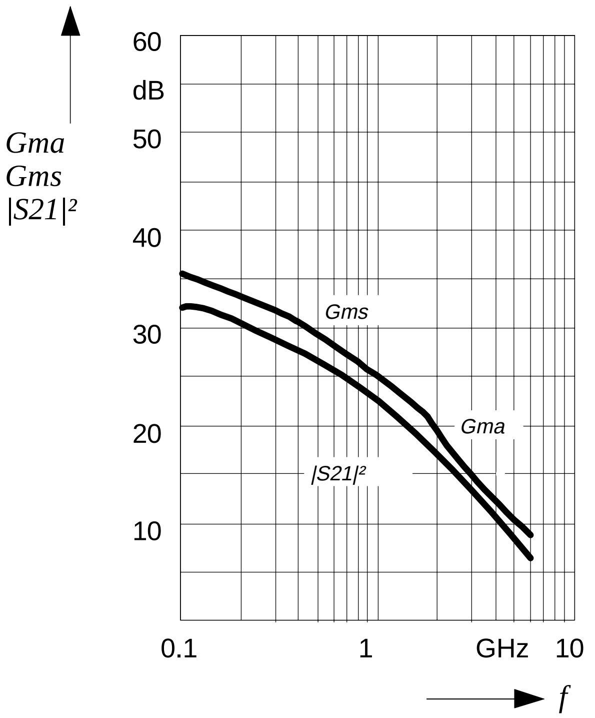
Transition Frequency
versus Collector Current
f = 2 GHz



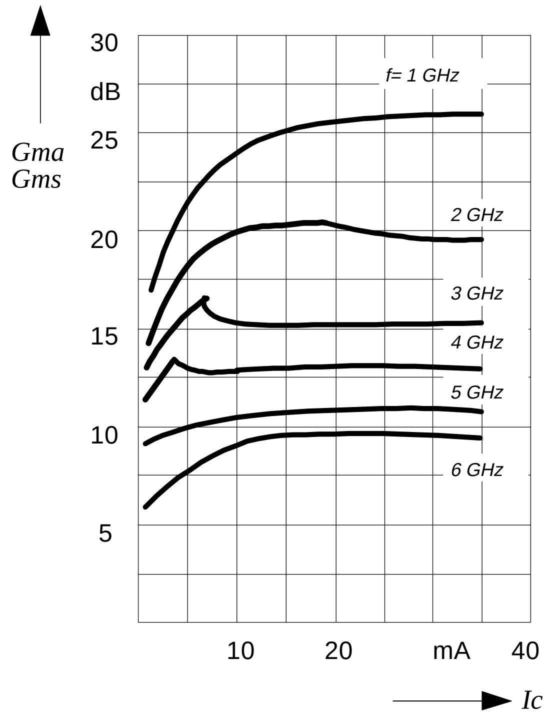
Collector-base Capacitance
versus Collector-base Voltage
V_{BE} = 0 V, f = 1MHz



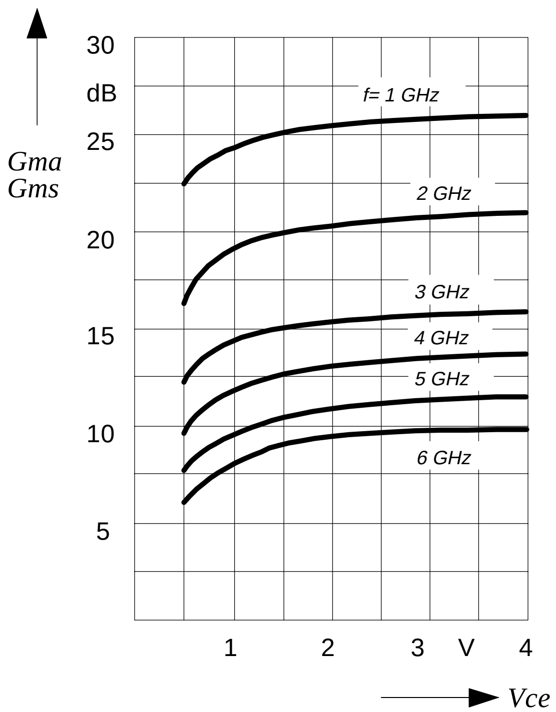
Power Gain
versus Frequency
V_{CE} = 2 V , I_C = 20 mA



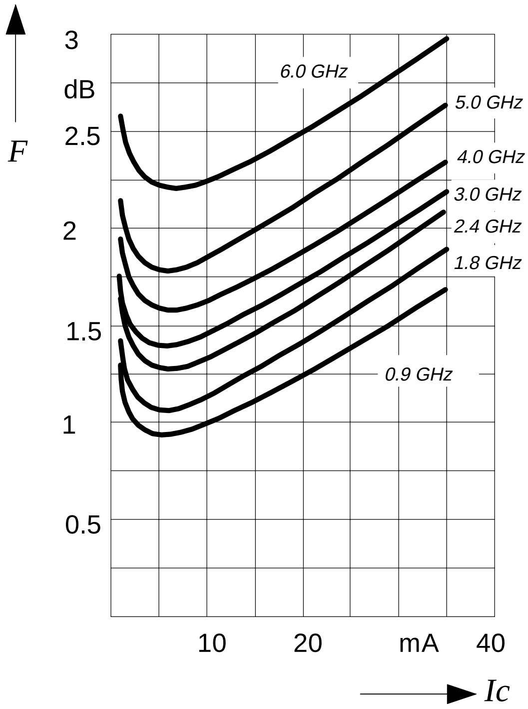
Power Gain
versus Collector Current
V_{CE} = 2 V



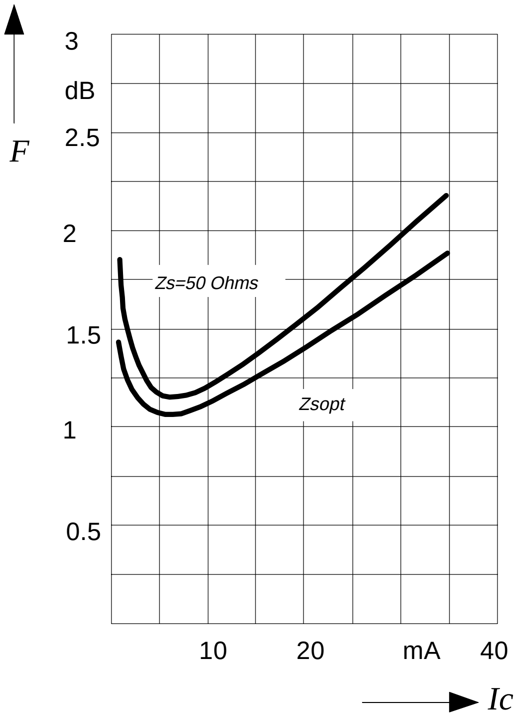
Power Gain
versus Collector Voltage
I_C = 20 mA



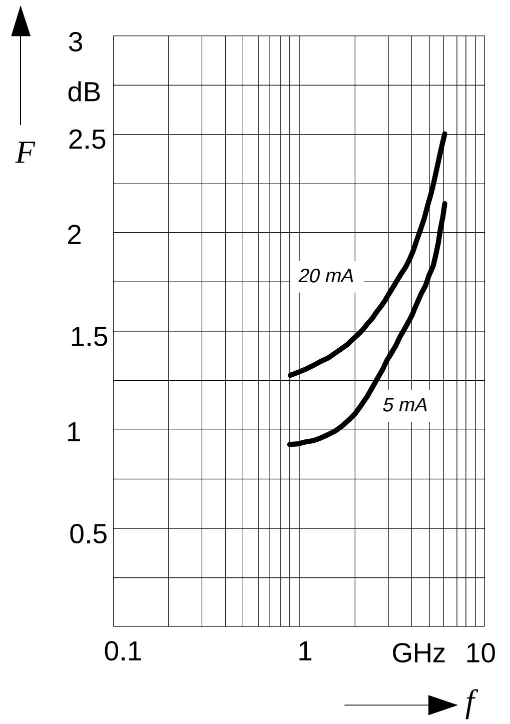
Noise Figure
versus Collector Current
V_{CE} = 2 V, Z_S = Z_{Sopt}



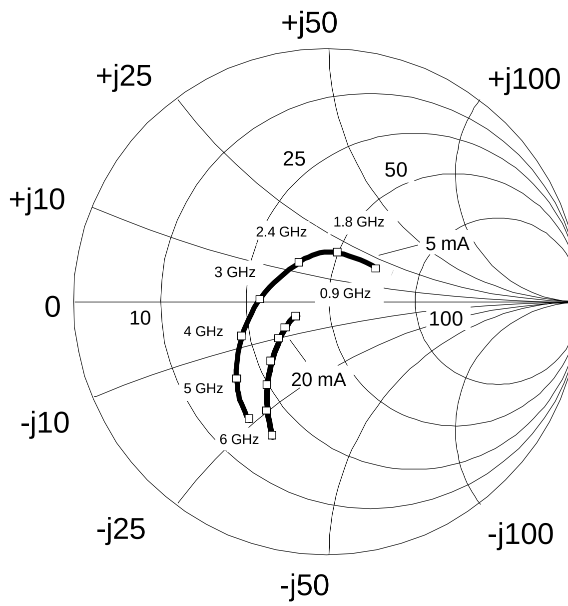
Noise Figure
versus Collector Current
V_{CE} = 2 V, f = 1.8 GHz



Noise Figure versus Frequency
V_{CE} = 2 V, I_C = 5 mA / 20 mA,
Z_S = Z_{Sopt}



Source Impedance for min.
Noise Figure versus Frequency
V_{CE} = 2 V, I_C = 5 mA / 20 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 = 20 mA								
0.01	0.452	-2.3	37.62	178.3	0.0011	94.4	0.956	-0.6
0.1	0.447	-25.1	36.30	164.7	0.0068	82.5	0.941	-12.4
0.5	0.386	-101.1	23.41	121.0	0.0262	61.7	0.632	-47.2
1.0	0.378	-146.2	13.99	96.0	0.0395	57.8	0.395	-63.9
2.0	0.405	173.5	7.18	70.8	0.0664	54.0	0.222	-87.3
3.0	0.446	149.4	4.77	52.6	0.0949	47.1	0.133	-111.3
4.0	0.501	130.0	3.52	36.8	0.1206	38.5	0.133	-158.5
6.0	0.599	104.8	2.27	8.2	0.1646	18.9	0.196	142.0
8.0	0.700	78.5	1.51	-20.8	0.1800	-2.4	0.289	99.3
9.0	0.758	67.6	1.25	-34.4	0.1820	-13.0	0.379	84.1
10.0	0.800	62.0	1.04	-43.5	0.1800	-19.3	0.465	76.6
V_{CE} = 2 V, I_C = 5 mA								
0.01	0.790	-1.0	15.14	179.2	0.0012	83.4	0.988	-0.7
0.1	0.786	-11.6	14.98	171.8	0.0092	84.1	0.982	-6.5
0.5	0.702	-55.7	12.86	140.1	0.0398	62.8	0.857	-29.8
1.0	0.589	-99.1	9.63	112.6	0.0603	46.5	0.647	-48.6
2.0	0.507	-156.0	5.60	79.4	0.0798	34.6	0.401	-70.3
3.0	0.511	168.5	3.84	57.1	0.0957	29.8	0.267	-84.2
4.0	0.549	142.0	2.87	38.5	0.1121	25.1	0.207	-110.5
5.0	0.604	123.9	2.26	22.1	0.1285	19.4	0.150	-137.3
6.0	0.633	110.0	1.86	6.7	0.1442	13.1	0.173	-169.8

Common Emitter Noise Parameters

f	F_{min} 1)	G_a 1)	Γ_{opt}		R_N	r_n	$F_{50\Omega}$ 2)	$\lvert S_{21}\rvert^2$ 2)
GHz	dB	dB	MAG	ANG	Ω	-	dB	dB
V_{CE} = 2 V, I_C = 5 mA								
0.9	0.90	20.5	0.28	41.0	8.7	0.17	1.02	20.3
1.8	1.05	15.2	0.20	82.0	6.7	0.13	1.11	15.8
2.4	1.25	13.0	0.20	124.0	5.5	0.11	1.32	13.5
3.0	1.38	12.1	0.22	-175.0	5.0	0.10	1.48	11.6
4.0	1.55	10.3	0.33	-157.0	5.5	0.11	1.83	9.1
5.0	1.75	8.6	0.45	-142.0	5.0	0.10	2.20	7.0
6.0	2.20	6.4	0.53	-123.0	15.0	0.30	3.30	5.3

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

2) Z_S=Z_L=50Ω

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 T502 (Berkeley-SPICE 2G.6 Syntax):

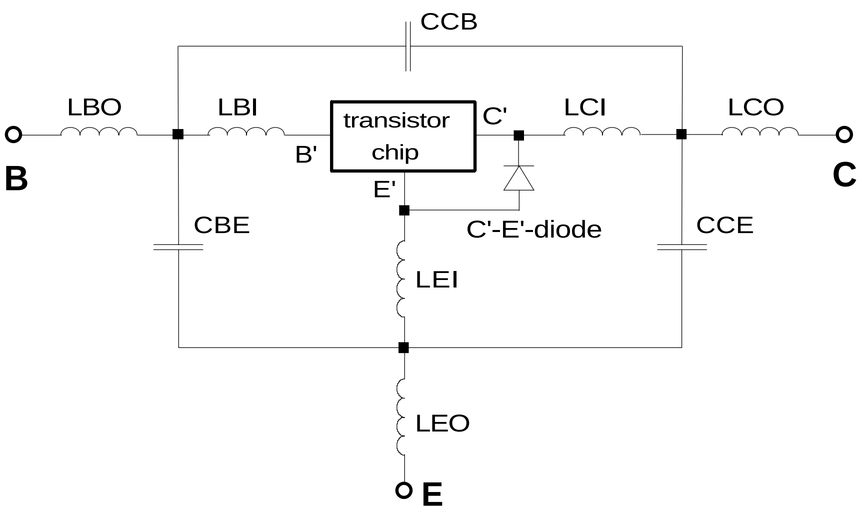
IS =	0.20045	fA	BF =	72.534	-	NF =	1.2432	-
VAF =	28.383	V	IKF =	0.48731	A	ISE =	19.049	fA
NE =	2.0518	-	BR =	7.8287	-	NR =	1.3325	-
VAR =	19.705	V	IKR =	0.69141	A	ISC =	0.019237	fA
NC =	1.1724	-	RB =	3.4849	OHM	IRB =	0.72983	mA
RBM =	8.5757	OHM	RE =	0.31111	OHM	RC =	0.10105	OHM
CJE =	1.8063	fF	VJE =	0.8051	V	MJE =	0.46576	-
TF =	6.7661	ps	XTF =	0.42199	-	VTF =	0.23794	V
ITF =	1.0	mA	PTF =	0	deg	CJC =	234.53	fF
VJC =	0.81969	V	MJC =	0.30232	-	XCJC =	0.3	-
TR =	2.3249	ns	CJS =	0	fF	VJS =	0.75	V
MJS =	0	-	XTB =	0	-	EG =	1.11	eV
XTI =	3.0	-	FC =	0.73234	-	Tnom =	300	K

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

IS =	3.5	fA	N =	1.02	-	RS =	10	Ω

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

Package Equivalent Circuit:



SOT343-3:

LBI = 0.47 nH
LBO = 0.53 nH
LEI = 0.23 nH
LEO = 0.05 nH
LCI = 0.56 nH
LCO = 0.58 nH
CBE = 136 fF
CCE = 134 fF
CCB = 6.9 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)

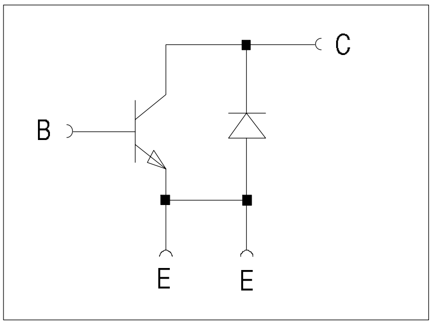
For more examples and ready to use parameters please contact your local Siemens distributor or sales office to obtain a SIEMENS Application Notes CD-ROM or see Internet: http://www.siemens.de/Semiconductor/products/35/35.htm

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.