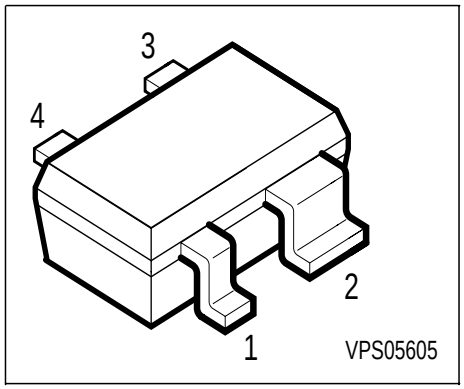
SIEMENS

SIEGET®45 BFP 520

NPN Silicon RF Transistor

Preliminary data



- For highest gain low noise amplifier at 1.8 GHz and 2 mA / 2 V
  Outstanding G_a = 20 dB
  Noise Figure F = 0.95 dB
- For oscillators up to 15 GHz
- Transition frequency f_T = 45 GHz
- Gold metalization for high reliability
- **SIEGET ® 45 - Line**
  Siemens **G**rounded **E**mitter **T**ransistor
  45 GHz f_T - **Line**

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

Type	Marking	Ordering Code	Pin Configuration				Package
BFP 520	APs	Q62702-F1794	1 = B	2 = E	3 = C	4 = E	SOT-343

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CEO}	2.5	V
Collector-base voltage	V_{CBO}	12	V
Emitter-base voltage	V_{EBO}	1	V
Collector current	I_C	40	mA
Base current	I_B	4	mA
Total power dissipation, $T_S \leq 105$ °C	P_{tot}	100	mW
Junction temperature	T_j	150	°C
Ambient temperature	T_A	-65 ...+150	°C
Storage temperature	T_{stg}	-65 ...+150	°C

Thermal Resistance

Junction - soldering point [1)]	R_{thJS}	≤ 450	K/W

1) TS is measured on the collector lead at the soldering point to the pcb

Electrical Characteristics at T_A = 25°C, unless otherwise specified.

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
DC characteristics					
Collector-emitter breakdown voltage I_C = 1 mA, I_B = 0	$V_{(BR)CEO}$	2.5	3	3.5	V
Collector-base cutoff current V_{CB} = 5 V, I_E = 0	I_{CBO}	-	-	200	nA
Emitter-base cutoff current V_{EB} = 1.5 V, I_C = 0	I_{EBO}	-	-	35	nA
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} = 2 V, f = 2 GHz	f_T	-	45	-	GHz
Collector-base capacitance V_{CB} = 2 V, f = 1 MHz	C_{cb}	-	0.06	-	pF
Collector-emitter capacitance V_{CE} = 2 V, f = 1 MHz	C_{ce}	-	0.3	-	pF
Emitter-base capacitance V_{EB} = 0.5 V, f = 1 MHz	C_{eb}	-	0.35	-	pF
Noise figure I_C = 2 mA, V_{CE} = 2 V, Z_S = Z_{Sopt} , f = 1.8 GHz	F	-	0.95	-	dB
Power gain [1] I_C = 20 mA, V_{CE} = 2 V, Z_S = Z_{Sopt}, Z_L = Z_{Lopt} , f = 1.8 GHz	G_{ms}	-	23	-	dB
Insertion power gain I_C = 20 mA, V_{CE} = 2 V, f = 1.8 GHz, Z_S = Z_L = 50Ω	$\|S_{21}\|^2$	-	21	-	dB
Third order intercept point at output V_{CE} = 2 V, f = 1.8 GHz, Z_S=Z_{Sopt}, Z_L=Z_{Lopt} , I_C = 20 mA I_C = 7 mA	IP_3	 - -	 25 17	 - -	dBm
1dB compression point V_{CE} = 2 V, f = 1.8 GHz, Z_S=Z_{Sopt}, Z_L=Z_{Lopt} , I_C = 20 mA I_C = 7 mA	P_{-1dB}	 - -	 12 5	 - -	dBm

1) $G_{ms} = |S_{21} / S_{12}|$ 2) $G_{ma} = |S_{21} / S_{12}| (k-(k^2-1)^{1/2})$

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	0.7244	-0.7	32.273	178.6	0.0007	69.4	0.9052	1.2
0.1	0.7251	-8.4	31.637	171.4	0.0041	92.8	0.9363	-4.4
0.5	0.6368	-40.7	27.293	140.7	0.0194	75.9	0.8523	-26.7
1	0.4768	-73.6	19.6	113.5	0.0351	66.5	0.6496	-46
2	0.2816	-123.8	11.02	84.9	0.00574	56.3	0.3818	-64.6
3	0.225	-166	7.48	67.6	0.0788	49.2	0.2407	-73.6
4	0.2552	156.2	5.636	53	0.0994	41.5	0.1544	-95.3
5	0.3207	133.6	4.488	39.7	0.1177	32.9	0.095	-128.9
6	0.3675	118.7	3.683	27.5	0.1343	24.7	0.0545	177.6

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 = 2 mA								
0.9	0.72	21.5	0.64	14	21.5	0.43	1.75	16.1
1.8	0.95	20	0.49	30	19	0.38	1.55	15.14
2.4	1.07	16	0.45	41	18	0.36	1.6	14.07
3	1.3	14.5	0.4	54	16.5	0.33	1.7	13.13
4	1.35	11.6	0.26	82	12.5	0.25	1.6	11.49
5	1.7	9.5	0.14	128	9	0.18	1.85	9.87
6	1.95	8	0.12	151	8	0.16	1.95	8.28
V_{CE} = 2 V, I_C = 5 mA								
0.9	0.89	22	0.49	12	16	0.32	1.5	21.94
1.8	1.08	20.5	0.38	22	14	0.28	1.38	19.34
2.4	1.12	18	0.34	33	14	0.28	1.4	17.54
3	1.32	16.2	0.29	45	13.5	0.27	1.5	16.01
4	1.35	13.5	0.156	71	11	0.22	1.45	13.82
5	1.6	11.5	0.08	120	10	0.2	1.65	11.93
6	1.8	10.5	0.07	150	8	0.16	1.8	10.23

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 (Gummel-Poon Model, Berkley-SPICE 2G.6 Syntax) :

Transistor Chip Data

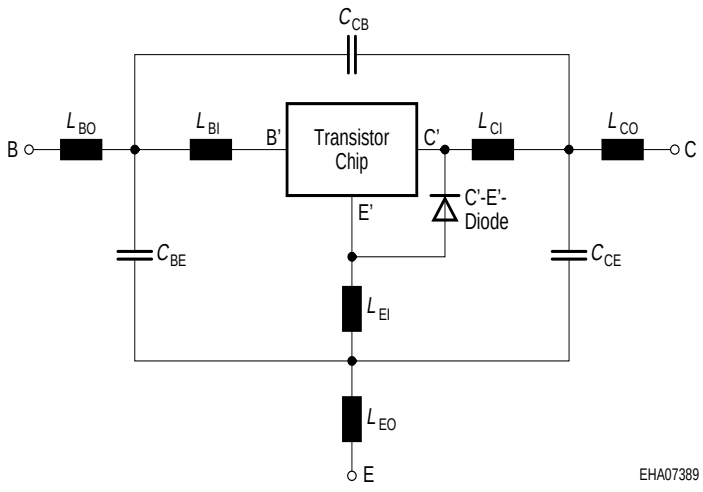
IS =	tbd	aA	BF =	tbd	-	NF =	tbd	-
VAF =	tbd	V	IKF =	tbd	A	ISE =	tbd	fA
NE =	tbd	-	BR =	tbd	-	NR =	tbd	-
VAR =	tbd	V	IKR =	tbd	A	ISC =	tbd	fA
NC =	tbd	-	RB =	tbd	Ω	IRB =	tbd	mA
RBM =	tbd	Ω	RE =	tbd	Ω	RC =	tbd	Ω
CJE =	tbd	fF	VJE =	tbd	V	MJE =	tbd	-
TF =	tbd	ps	XTF =	tbd	-	VTF =	tbd	V
ITF =	tbd	mA	PTF =	tbd	deg	CJC =	tbd	fF
VJC =	tbd	V	MJC =	tbd	-	XCJC =	tbd	-
TR =	tbd	ns	CJS =	tbd	fF	VJS =	tbd	V
MJS =	tbd	-	XTB =	tbd	-	EG =	tbd	eV
XTI =	tbd	-	FC =	tbd	-	TNOM	tbd	K

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

IS =	tbd	fA	N =	tbd	-	RS =	tbd	Ω

All parameters are ready to use, no scalling is necessary

Package Equivalent Circuit:



L_{BI} =	0.47	nH
L_{BO} =	0.53	nH
L_{EI} =	0.23	nH
L_{EO} =	0.05	nH
L_{CI} =	0.56	nH
L_{CO} =	0.58	nH
C_{BE} =	136	fF
C_{CB} =	6.9	fF
C_{CE} =	134	fF

Valid up to 6GHz

The SOT-343 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 Satellitentechnik (IMST)

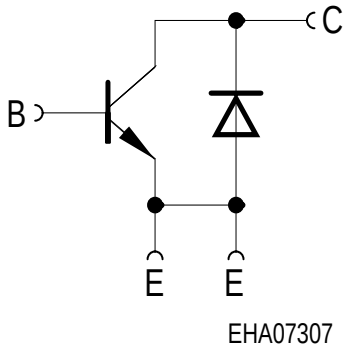
For examples and ready to use parameters please contact your local Siemens distributor or sales office to obtain a Siemens CD-ROM or see Internet: http://www.siemens.de/Semiconductor/products/35/35.htm

For non-linear simulation:

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

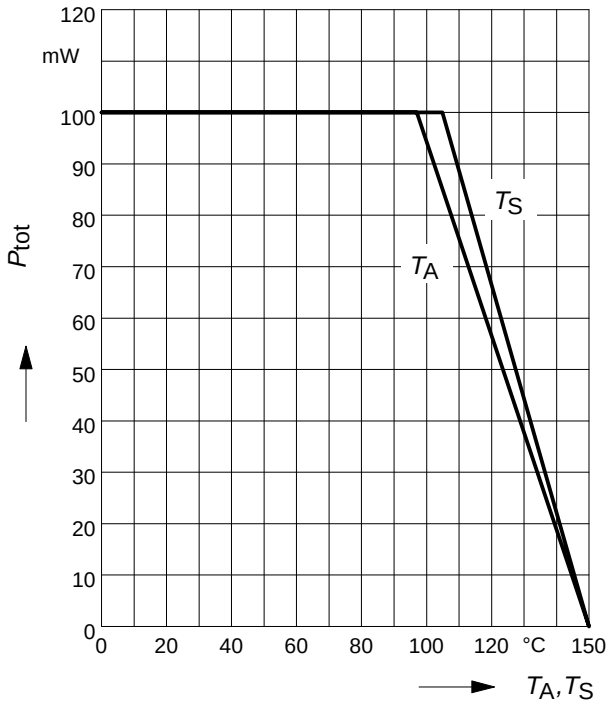
- Higher gain because of lower emitter inductance.
- Power is dissipated via the grounded emitter leads, because the chip is mounted on copper emitter leadframe.

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

The AC characteristics are verified by random sampling.

Total power dissipation $P_{tot} = f(T_A^*, T_S)$

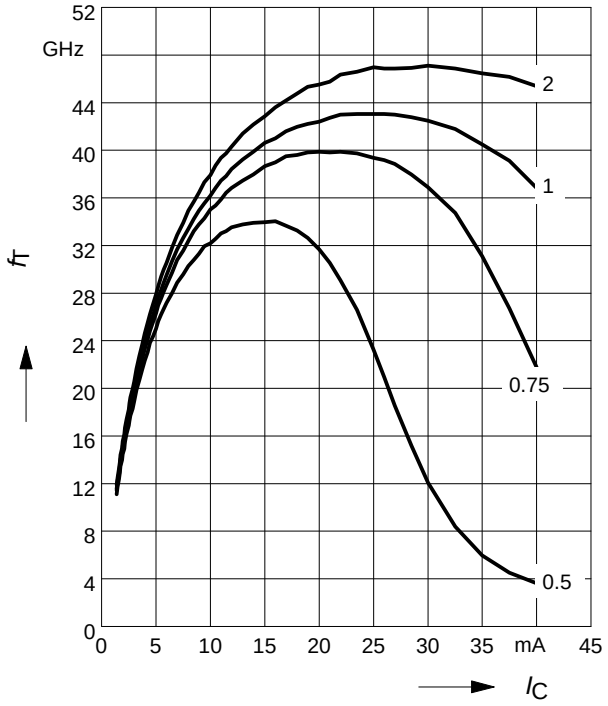
* Package mounted on epoxy



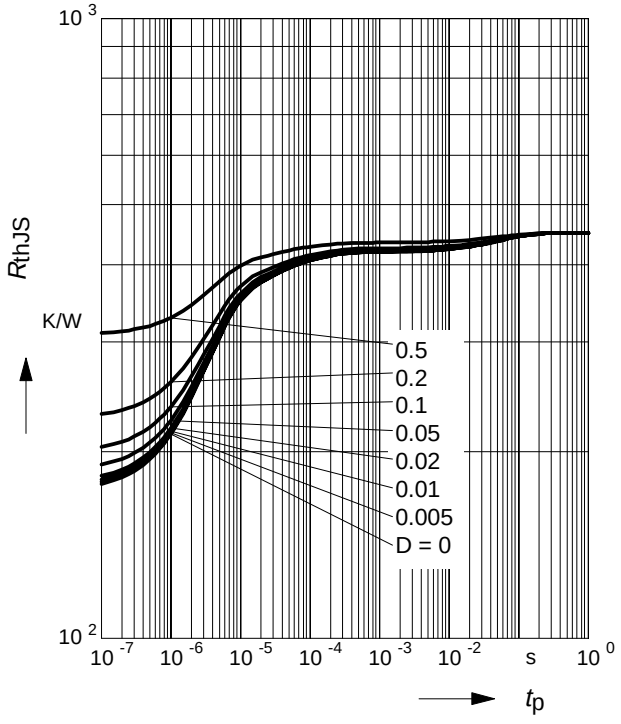
Transition frequency $f_T = f(I_C)$

f = 2 GHz

V_{CE} = parameter in V

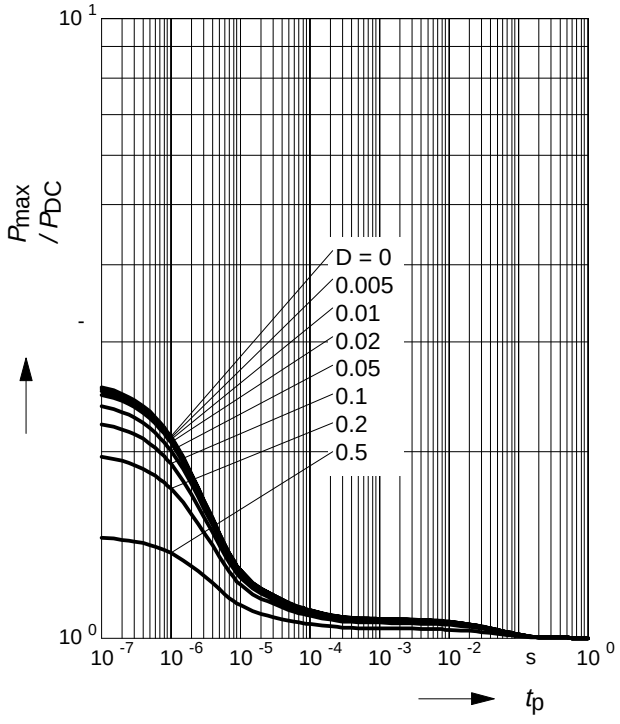


Permissible Pulse Load $R_{thJS} = f(t_p)$



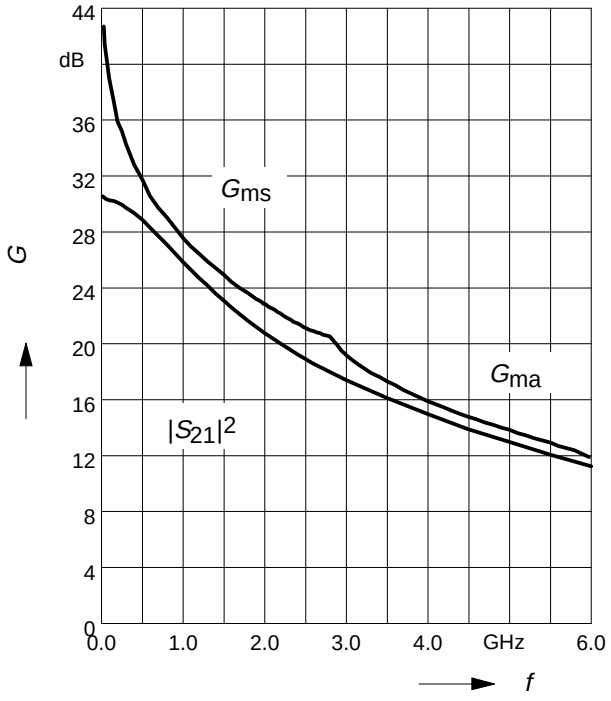
Permissible Pulse Load

$P_{totmax}/P_{totDC} = f(t_p)$



Power gain G_{ma}, G_{ms}, $|S_{21}|^2 = f(f)$

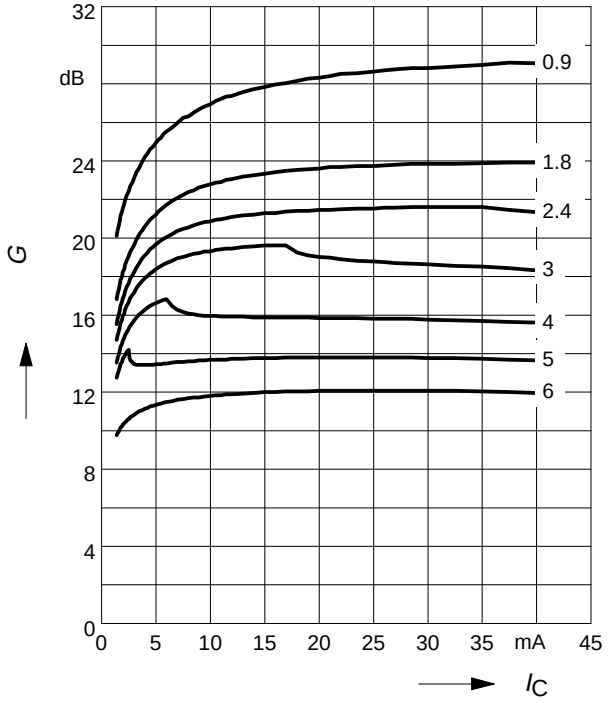
V_{CE} = 2V, I_C = 20 mA



Power gain G_{ma}, $G_{ms} = f(I_C)$

V_{CE} = 2V

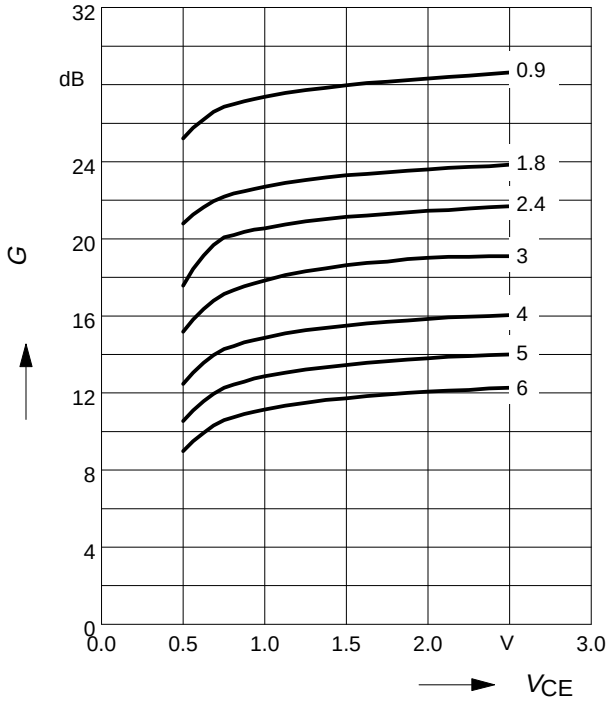
f = parameter in GHz



Power gain G_{ma}, $G_{ms} = f(V_{CE})$

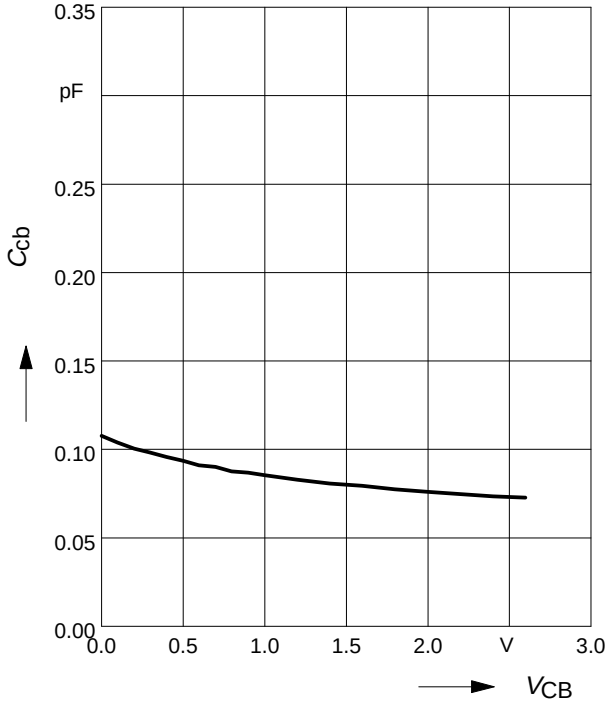
I_C = 20 mA

f = parameter in GHz



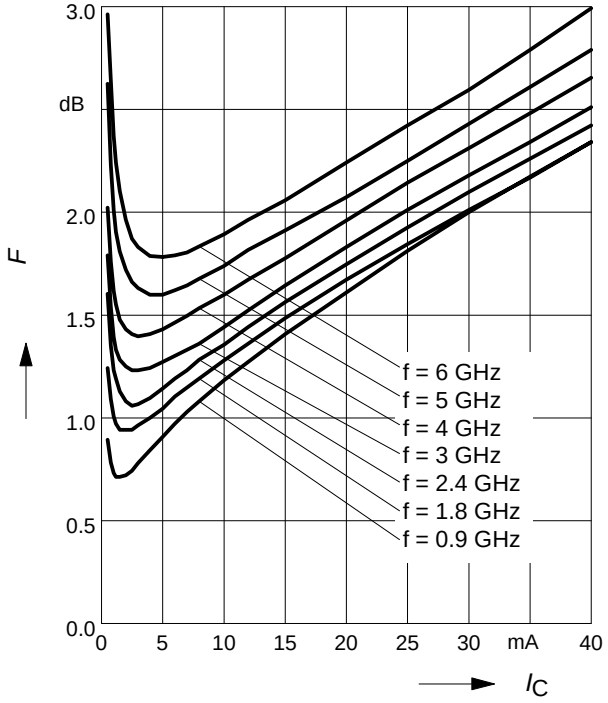
Collector-base capacitance $C_{cb} = f(V_{CB})$

V_{BE} = 0, f = 1MHz



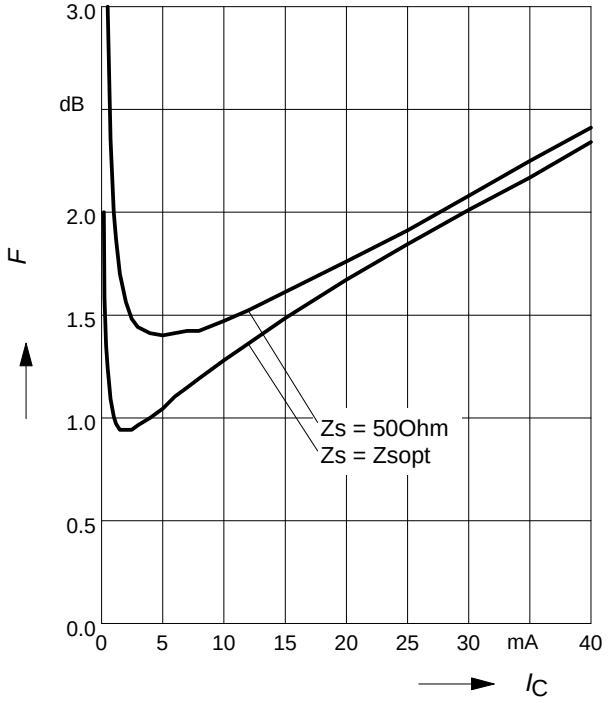
Noise figure $F = f(I_C)$

V_{CE} = 2 V, $Z_S = Z_{Sopt}$



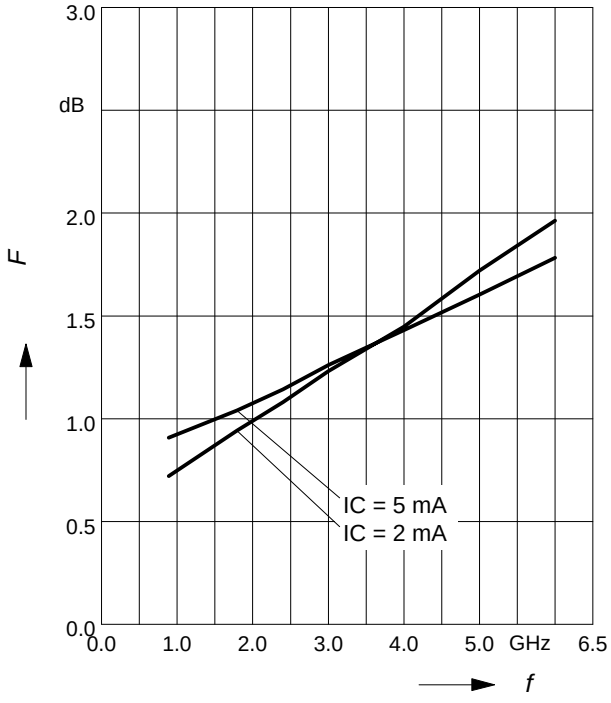
Noise figure $F = f(I_C)$

V_{CE} = 2 V, f = 1.8 GHz



Noise figure $F = f(f)$

V_{CE} = 2 V, $Z_S = Z_{Sopt}$



Source impedance for min.

Noise Figuren vers. Frequency

V_{CE} = 2 V, I_C = 2 mA / 5 mA