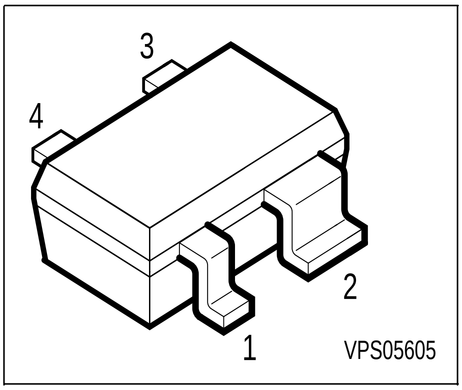
NPN Silicon RF Transistor



- 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 precaution!

Type	Marking	Ordering Code	Pin Configuration				Package
BFP 450	ANs	Q62702-F1590	1 = B	2 = E	3 = C	4 = E	SOT-343

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CEO}	4.5	V
Collector-base voltage	V_{CBO}	15	
Emitter-base voltage	V_{EBO}	1.5	
Collector current	I_C	100	mA
Base current	I_B	10	
Total power dissipation, $T_S \leq 96$ °C	P_{tot}	450	mW
Junction temperature	T_j	150	°C
Ambient temperature	T_A	-65 ...+150	
Storage temperature	T_{stg}	-65 ...+150	

Thermal Resistance

Parameter	Symbol	Value	Unit
Junction - soldering point [1)]	R_{thJS}	≤ 130	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	$V_{(BR)CEO}$	4.5	5	6.5	V
Collector-base cutoff current V_{CB} = 5 V, I_E = 0	I_{CBO}	-	-	600	nA
Emitter-base cutoff 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, f = 1 MHz	C_{cb}	-	0.48	0.75	pF
Collector-emitter capacitance V_{CE} = 2 V, f = 1 MHz	C_{ce}	-	1.33	-	
Emitter-base capacitance V_{EB} = 0.5 V, f = 1 MHz	C_{eb}	-	1.75	-	
Noise figure I_C = 10 mA, V_{CE} = 2 V, $Z_S = Z_{Sopt}$, f = 1.8 GHz	F	-	1.25	1.6	dB
Power gain 2) I_C = 50 mA, V_{CE} = 2 V, $Z_S = Z_{Sopt}$, $Z_L = Z_{Lopt}$, f = 1.8 GHz	G_{ma}	-	14	-	dB
Insertion power gain I_C = 50 mA, V_{CE} = 2 V, f = 1.8 GHz, $Z_S = Z_L = 50\Omega$	$\|S_{21}\|^2$	8	11	-	
Third order intersept point I_C = 50 mA, V_{CE} = 3 V, $Z_S=Z_{Sopt}$, $Z_L=Z_{Lopt}$, f = 1.8 GHz	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	-	

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} = 2V, I_C = 50mA								
0.01	0.143	-30.7	69.9	174.8	0.0018	85.2	0.904	-6.6
0.1	0.469	-121.7	51.98	125.6	0.0139	59.6	0.744	-64.2
0.5	0.681	-172.4	14.86	90.7	0.0289	51.4	0.466	-146.1
1	0.705	173.1	7.26	74.6	0.047	55.7	0.464	-172.2
2	0.73	154.7	3.42	55	0.08	51.2	0.491	163.6
3	0.752	139.5	2.22	38.4	0.1183	42	0.529	145.5
4	0.783	124.1	1.62	22.4	0.1461	30.3	0.587	131.9
5	0.797	112.5	1.23	8.8	0.1633	20.7	0.606	119.5
6	0.813	103.7	1.01	-2.9	0.1864	12.6	0.625	108.9

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} = 2V, I_C = 10mA								
0.9	0.9	15.5	0.29	175	2.7	0.054	0.98	16
1.8	1.25	11.8	0.47	-171	3	0.06	1.74	9.5
2.4	1.45	10.9	0.56	-159	3.5	0.07	2.23	6.8
3	1.7	8.5	0.62	-147	5.5	0.11	3.05	4.7
4	2.1	6.6	0.66	-127	15.5	0.31	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 (Gummel-Poon Model, Berkley-SPICE 2G.6 Syntax) :

Transistor Chip Data

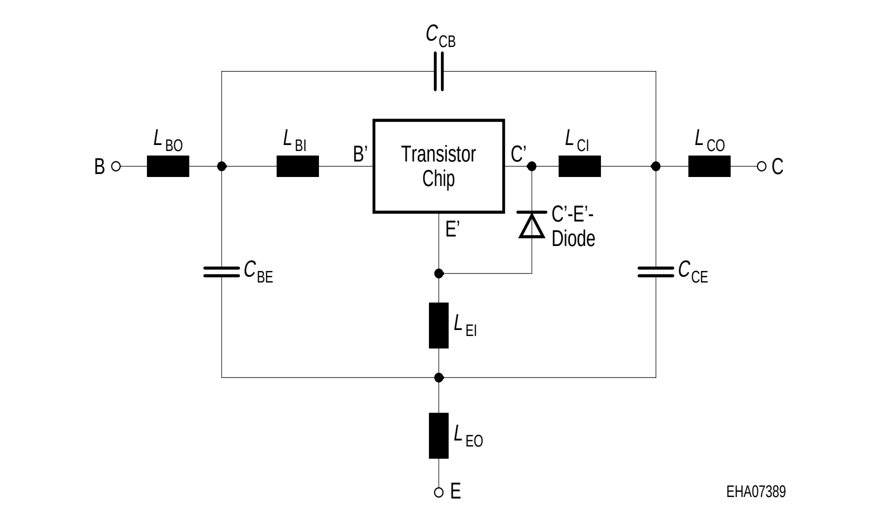
IS =	0.13125	fA	BF =	76.123	-	NF =	0.79652	-
VAF =	24.165	V	IKF =	0.58905	A	ISE =	28.341	pA
NE =	1.5563	-	BR =	21.254	-	NR =	1.2966	-
VAR =	13.461	V	IKR =	0.25878	A	ISC =	0.012292	A
NC =	0.70543	-	RB =	2.1659	Ω	IRB =	0.013181	mA
RBM =	5.403	Ω	RE =	0.45346		RC =	0.50084	Ω
CJE =	3.2276	fF	VJE =	0.95292	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	F	VJS =	0.75	V
MJS =	0	-	XTB =	0	-	EG =	1.11	eV
XTI =	3	-	FC =	0.91274	-	TNOM	300	K

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

IS =	25	fA	N =	1.05	-	RS =	5	Ω

All parameters are ready to use, no scalling is necessary

Package Equivalent Circuit:



L_{BI} =	0.31	nH
L_{BO} =	0.63	nH
L_{EI} =	0.2	nH
L_{EO} =	0.05	nH
L_{CI} =	0.29	nH
L_{CO} =	0.68	nH
C_{BE} =	208	fF
C_{CB} =	3.2	fF
C_{CE} =	213	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:

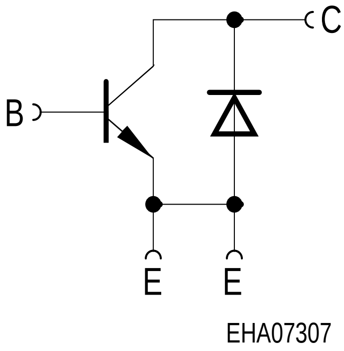
- Use transistor chip parameters in Berkeley SPICE 2G.6 syntax for all simulators.

- 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:

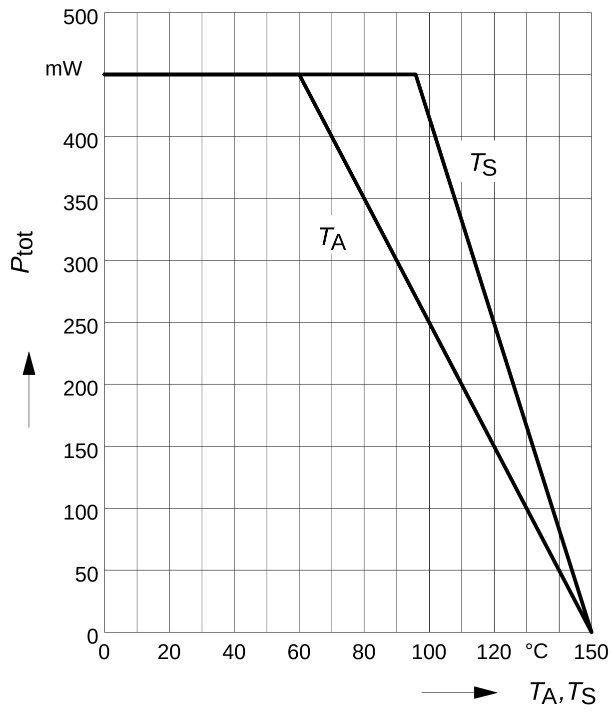
- Higher gain because of lower emitter inductance.
- Power is dissipated via the grounded emitter leads, because the chip is mounted on copper emitter leadframe.

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

The AC characteristics are verified by random sampling.

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

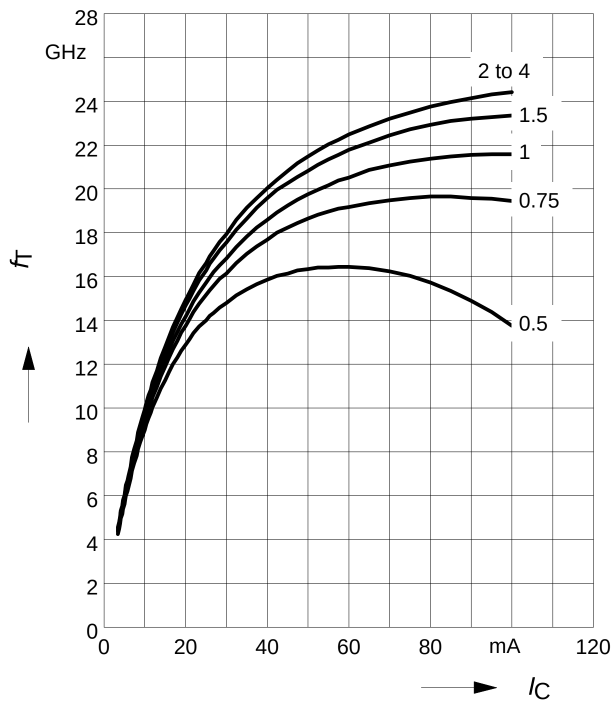
* Package mounted on epoxy



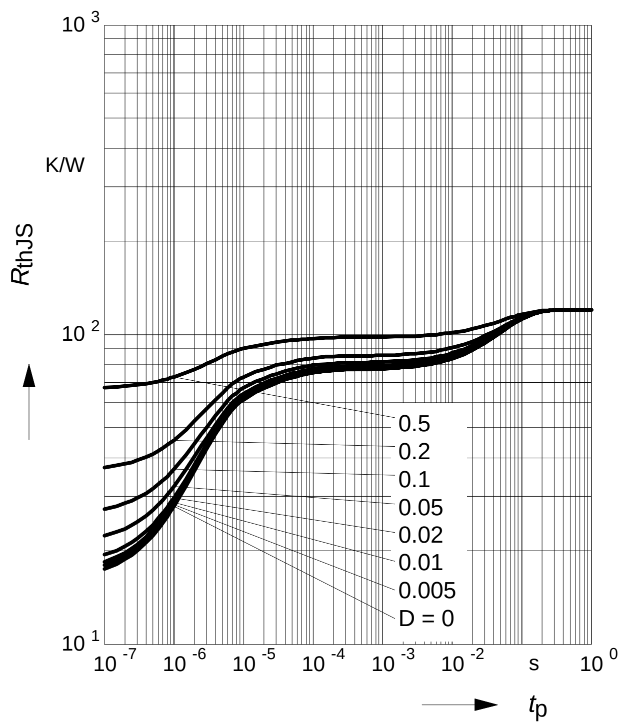
Transition frequency $f_T = f(I_C)$

f = 1 GHz

V_{CE} = parameter in V

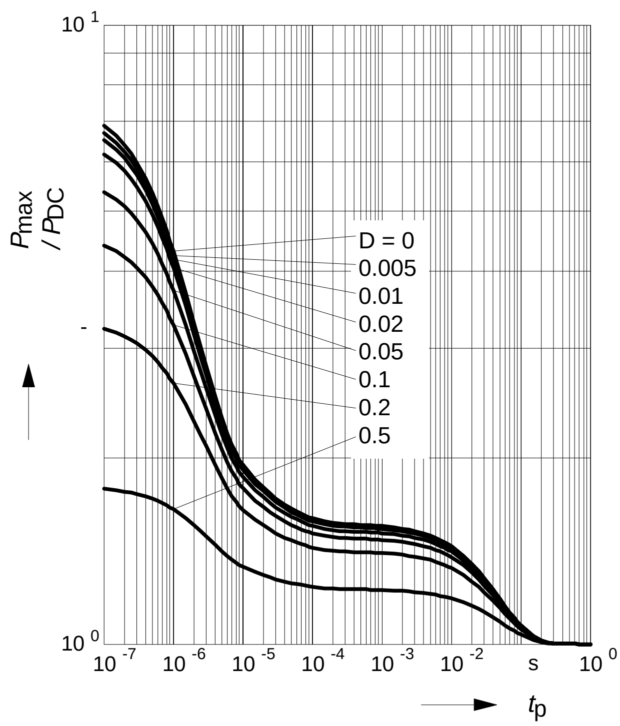


Permissible Pulse Load $R_{thJS} = f(t_p)$

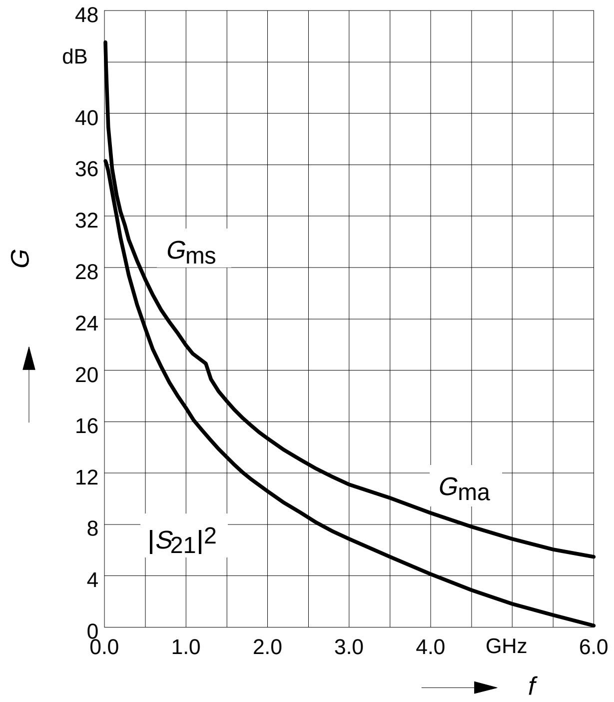


Permissible Pulse Load

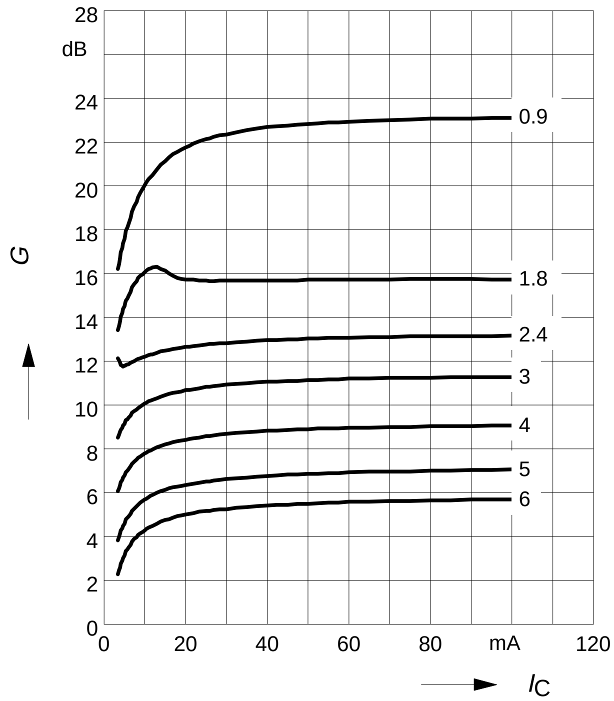
$P_{totmax}/P_{totDC} = f(t_p)$



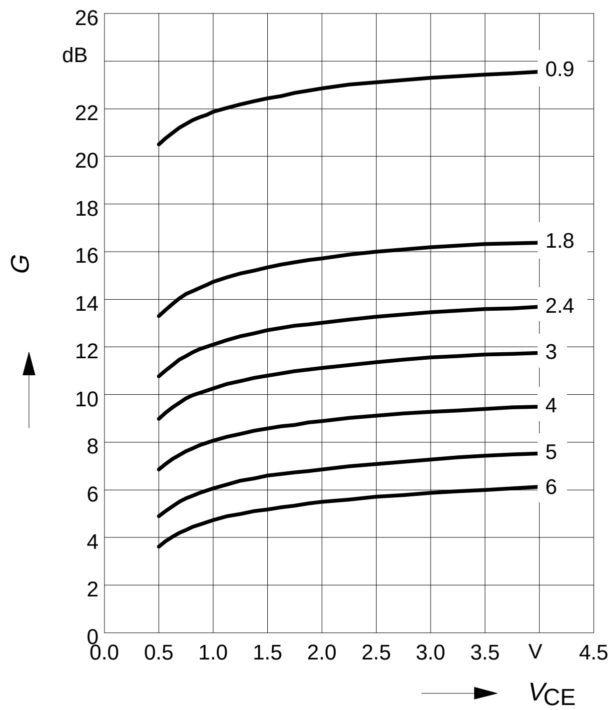
Power gain G_{ma}, G_{ms}, $|S_{21}|^2 = f(f)$
V_{CE} = 2V, I_C = 50 mA



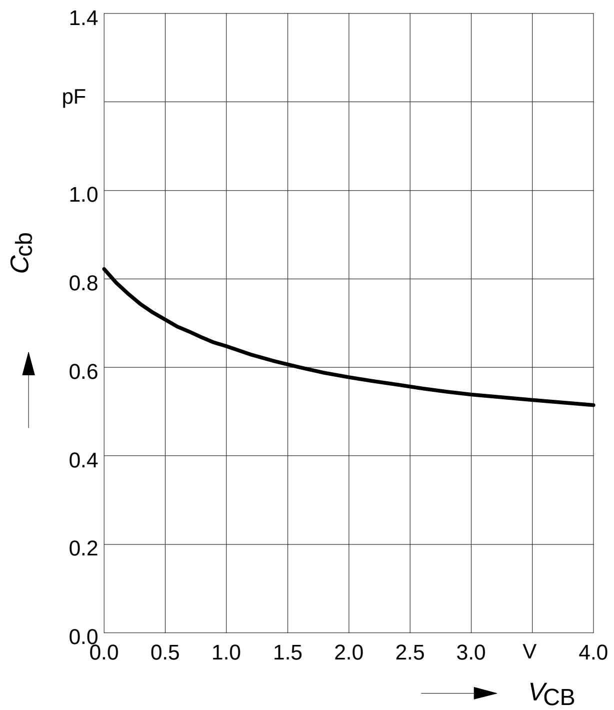
Power gain G_{ma}, $G_{ms} = f(I_C)$
V_{CE} = 2V
f = parameter in GHz



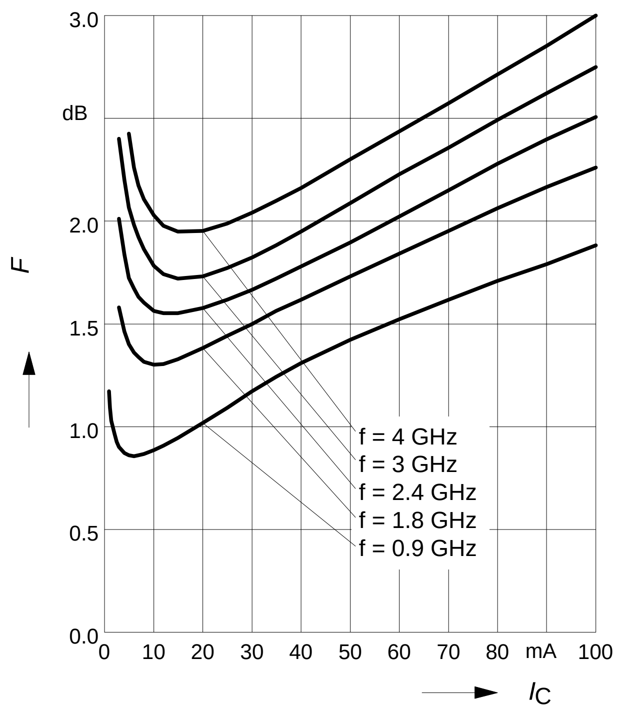
Power gain G_{ma}, $G_{ms} = f(V_{CE})$
I_C = 50 mA
f = Parameter in GHz



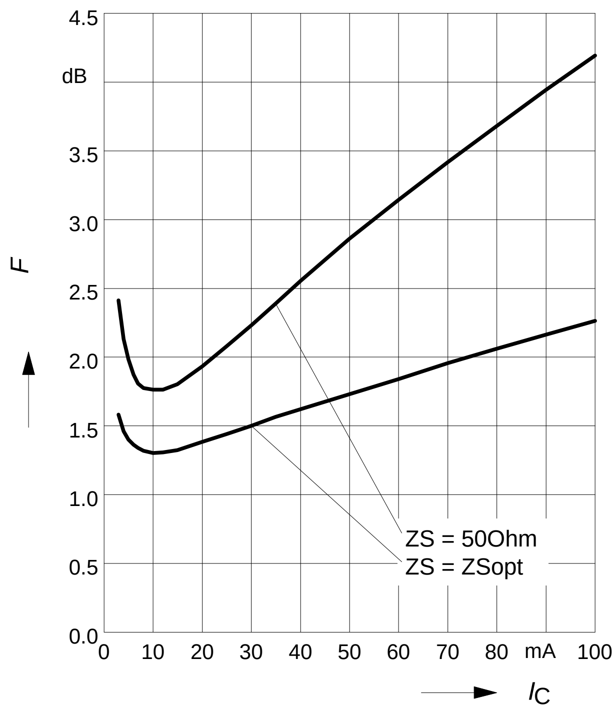
Collector-base capacitance $C_{cb} = f(V_{CB})$
V_{BE} = 0, f = 1MHz



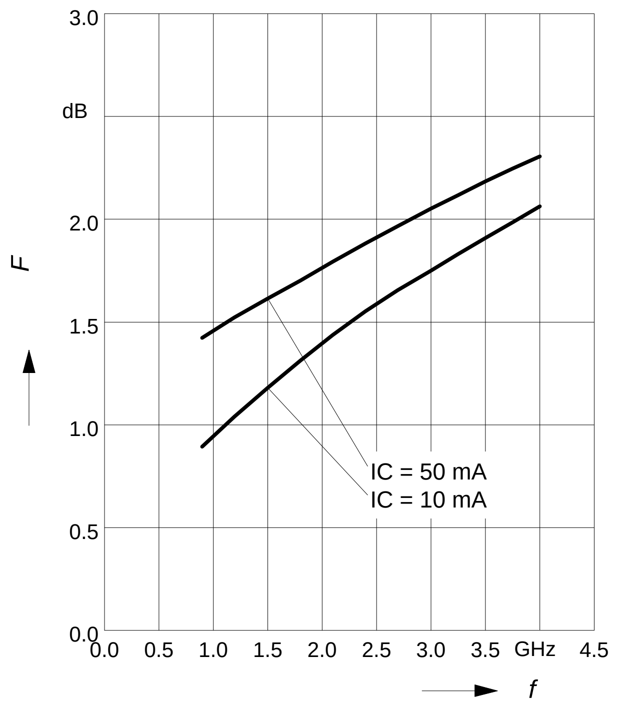
Noise figure $F = f(I_C)$
$V_{CE} = 2$ V, $Z_S = Z_{Sopt}$



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