**NPN Silicon RF Transistor**

- For highest gain low noise amplifier

  at 1.8 GHz and 2 mA / 2 V

  Outstanding G_{ms} = 23 dB

  Noise Figure F = 0.95 dB

- For oscillators up to 15 GHz
- Transition frequency f_T = 45 GHz
- Gold metallization for high reliability
- **SIEGET ® 45 - Line**

  45 GHz f_T - **Line**

VPS05605
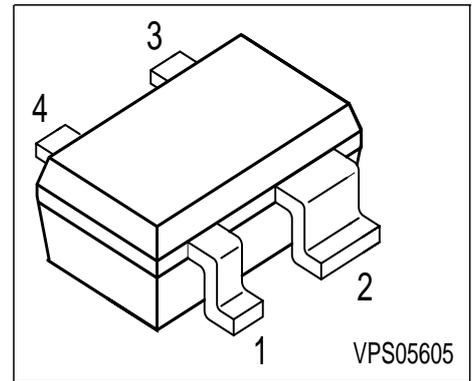
ESD: **E**lectro**s**tatic **d**ischarge sensitive device, observe handling precaution!

Type	Marking	Pin Configuration				Package
BFP520	APs	1 = B	2 = E	3 = C	4 = E	SOT343

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CEO}	2.5	V
Collector-base voltage	V_{CBO}	10	
Emitter-base voltage	V_{EBO}	1	
Collector current	I_C	40	mA
Base current	I_B	4	
Total power dissipation $T_S \leq 105\ °C$ [1]	P_{tot}	100	mW
Junction temperature	T_j	150	°C
Ambient temperature	T_A	-65 ... 150	
Storage temperature	T_{stg}	-65 ... 150	

Thermal Resistance

Junction - soldering point [2]	R_{thJS}	≤ 450	K/W

[1] T_S is measured on the collector lead at the soldering point to the pcb

[2] For calculation of R_{thJA} please refer to Application Note Thermal Resistance

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 V, I_C = 0	I_{EBO}	-	-	35	µA
DC current gain I_C = 20 mA, V_{CE} = 2 V	h_{FE}	70	110	200	-
AC characteristics (verified by random sampling)					
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	-	
Emitter-base capacitance V_{EB} = 0.5 V, f = 1 MHz	C_{eb}	-	0.35	-	
Noise figure I_C = 2 mA, V_{CE} = 2 V, $Z_S = Z_{Sopt}$, f = 1.8 GHz	F	-	0.95	-	dB
Power gain, maximum stable [1) I_C = 20 mA, V_{CE} = 2 V, $Z_S = Z_{Sopt}$, $Z_L = Z_{Lopt}$, f = 1.8 GHz	G_{ms}	-	23	-	
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, $Z_S = Z_{Sopt}$, $Z_L = Z_{Lopt}$,	IP_3				dBm
I_C = 20 mA		-	25	-	
I_C = 7 mA		-	17	-	
1dB compression point V_{CE} = 2 V, f = 1.8 GHz, $Z_S = Z_{Sopt}$, $Z_L = Z_{Lopt}$,	P_{-1dB}				
I_C = 20 mA		-	12	-	
I_C = 7 mA		-	5	-	

[1] $G_{ms} = |S_{21} / S_{12}|$

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	19.601	113.5	0.0351	66.5	0.6496	-46.1
2	0.2816	-123.8	11.021	84.9	0.0057	56.3	0.3818	-64.6
3	0.2251	-166.1	7.481	67.6	0.0788	49.2	0.2407	-73.6
4	0.2552	156.2	5.636	53.1	0.0994	41.5	0.1544	-95.3
5	0.3207	133.6	4.488	39.7	0.1177	32.9	0.0951	-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]	$|S_{21}|^2$ [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	16.11
1.8	0.95	20.1	0.49	30	19.1	0.38	1.55	15.14
2.4	1.07	16.1	0.45	41	18.1	0.36	1.61	14.07
3	1.31	14.5	0.41	54	16.5	0.33	1.71	13.13
4	1.35	11.6	0.26	82	12.5	0.25	1.61	11.49
5	1.71	9.5	0.14	128	9.1	0.18	1.85	9.87
6	1.95	8.1	0.12	151	8.1	0.16	1.95	8.28

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

|								
0.9	0.89	22.1	0.49	12	16.1	0.32	1.51	21.94
1.8	1.08	20.5	0.38	22	14.1	0.28	1.38	19.34
2.4	1.12	18.1	0.34	33	14.1	0.28	1.41	17.54
3	1.32	16.2	0.29	45	13.5	0.27	1.51	16.01
4	1.35	13.5	0.16	71	11.1	0.22	1.45	13.82
5	1.61	11.5	0.08	120	10.1	0.21	1.65	11.93
6	1.81	10.5	0.07	150	8.1	0.16	1.81	10.23

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 Infineon Technologies
distributor or sales office to obtain a Infineon Technologies Application Notes CD-ROM or see Internet:
http://www.infineon.com/silicondiscretes

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

Transistor Chip Data

IS =	15	aA	BF =	235	-	NF =	1	-
VAF =	25	V	IKF =	0.4	A	ISE =	25	fA
NE =	2	-	BR =	1.5	-	NR =	1	-
VAR =	2	V	IKR =	0.01	A	ISC =	20	fA
NC =	2	-	RB =	11	Ω	IRB =	-	A
RBM =	7.5	Ω	RE =	0.6		RC =	7.6	Ω
CJE =	235	fF	VJE =	0.958	V	MJE =	0.335	-
TF =	1.7	ps	XTF =	10	-	VTF =	5	V
ITF =	0.7	A	PTF =	50	deg	CJC =	93	fF
VJC =	0.661	V	MJC =	0.236	-	XCJC =	1	-
TR =	50	ns	CJS =	0	fF	VJS =	0.75	V
MJS =	0.333	-	XTB =	-0.25	-	EG =	1.11	eV
XTI =	0.035	-	FC =	0.5	-	TNOM	298	K

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		
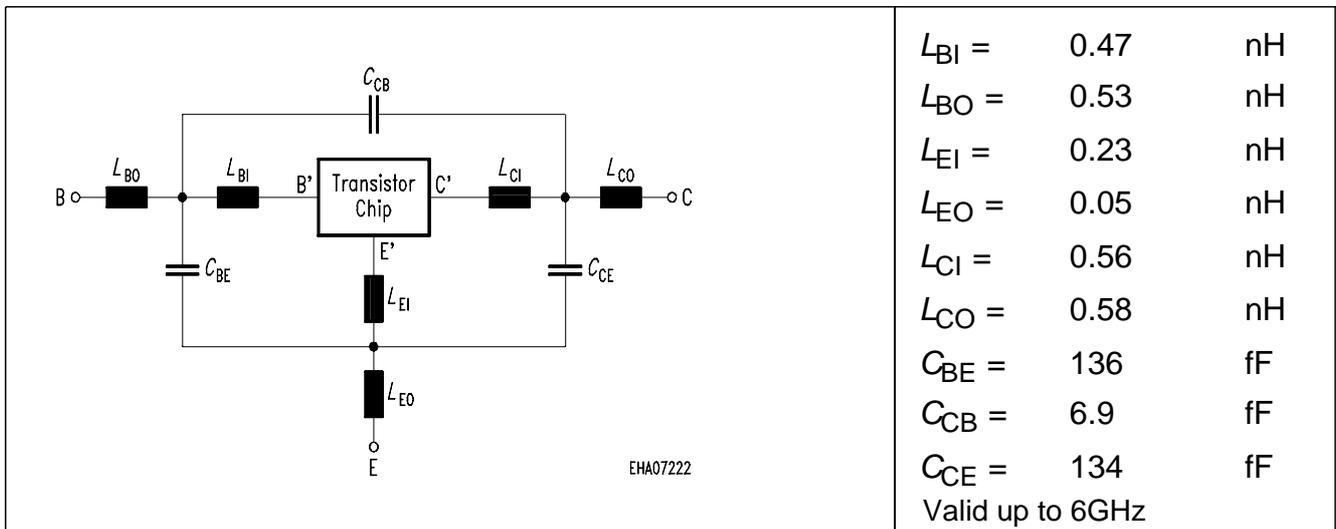
The SOT-343 package has two emitter leads. To avoid high complexity of the package equivalent circuit, both leads are combined in one electrical connection.

For examples and ready to use parameters please contact your local Infineon Technologies distributor or sales office to obtain a Infineon Technologies CD-ROM or see Internet:

http://www.infineon.com/silicondiscretes

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For non-linear simulation:

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

- Simulation of the package is not necessary for frequencies < 100MHz.
  For higher frequencies please add the wiring of the package equivalent circuit around the non-linear transistor.

Advantages of the common emitter configuration:

- 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.

Total power dissipation $P_{tot} = f(T_S)$
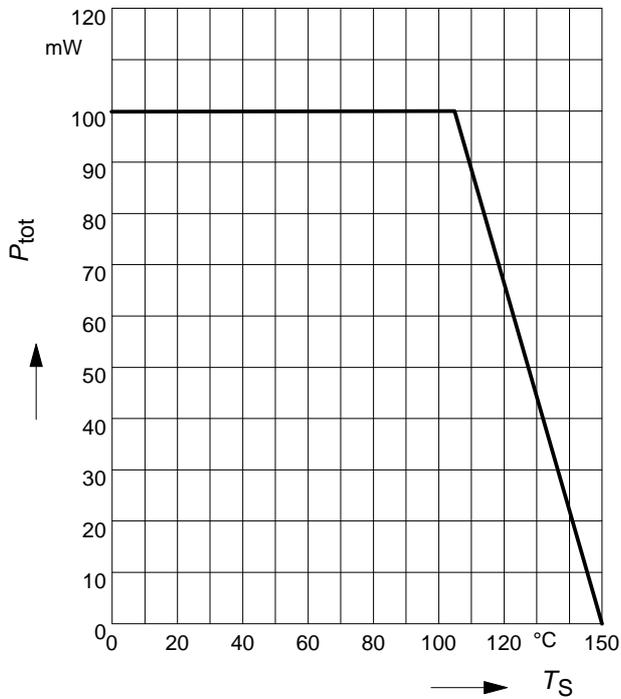
Transition frequency $f_T = f(I_C)$

$f = 2$ GHz

V_{CE} = parameter in V
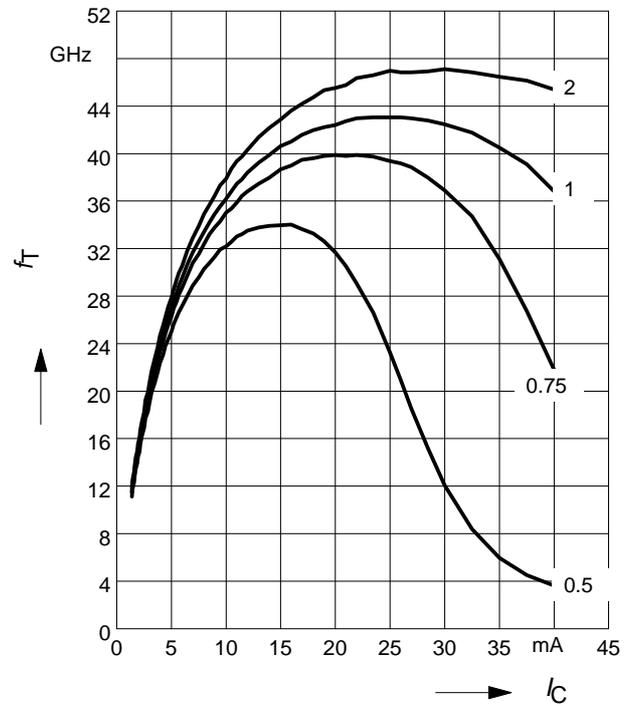
Permissible Pulse Load $R_{thJS} = f(t_p)$
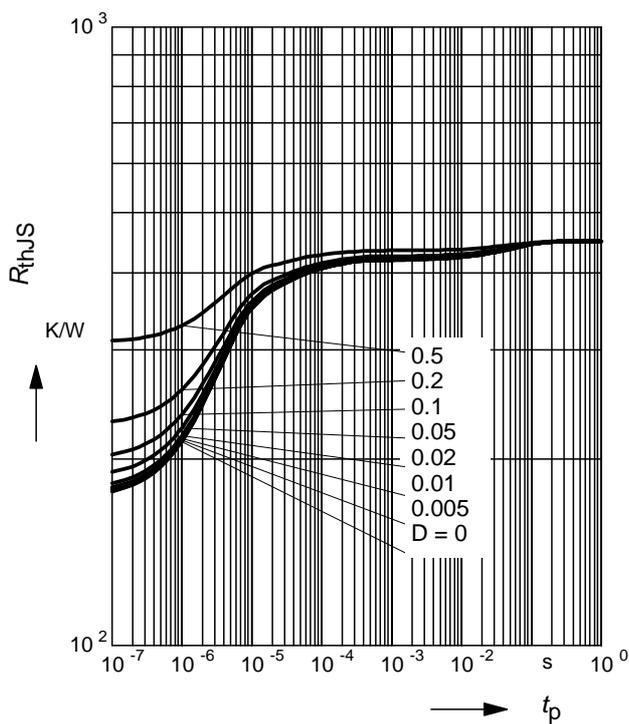
Permissible Pulse Load

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

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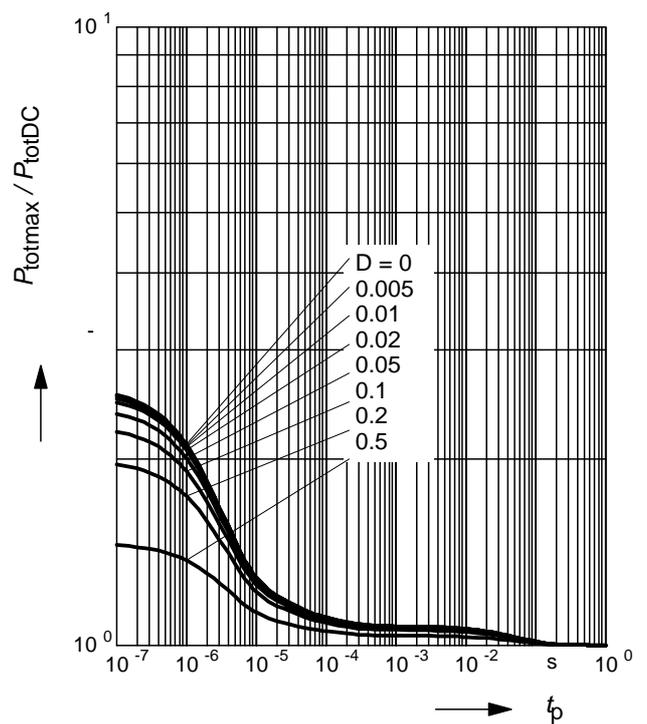
Power gain G_{ma}, G_{ms}, $|S_{21}|^2 = f(f)$

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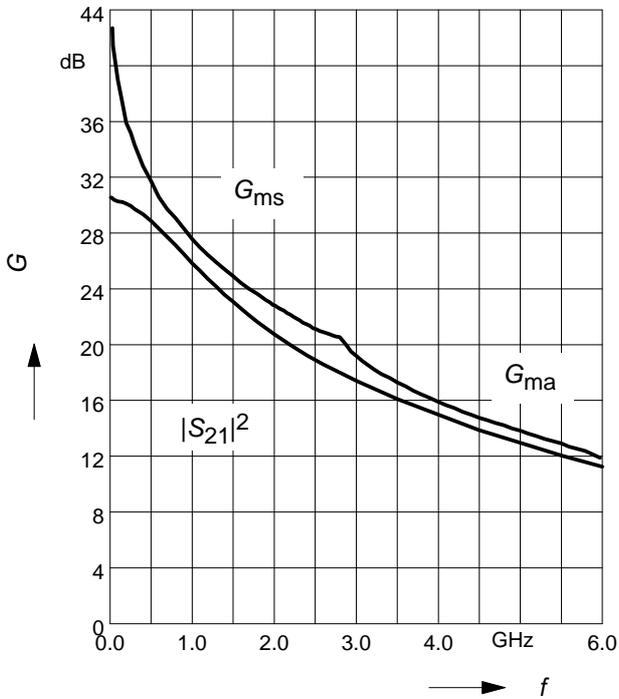


Power gain G_{ma}, $G_{ms} = f(I_C)$

$V_{CE} = 2V$

f = parameter in GHz
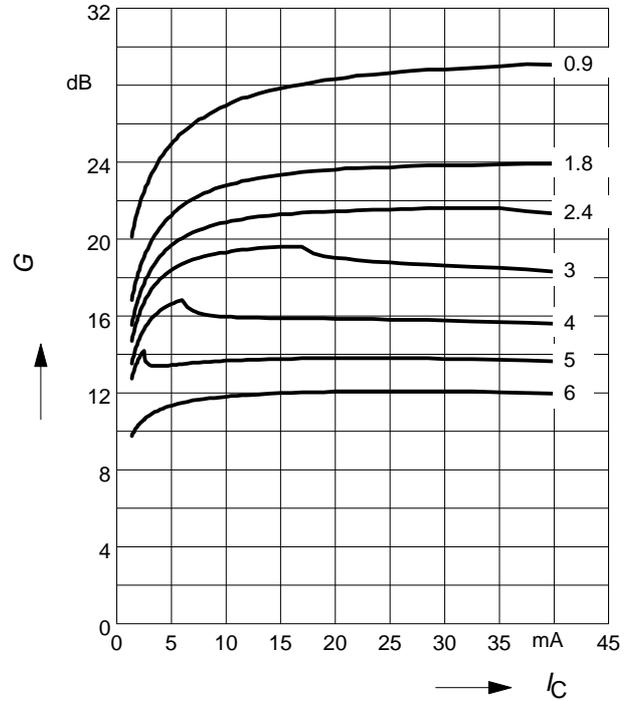

Power gain G_{ma}, $G_{ms} = f(V_{CE})$

$I_C = 20$ mA

f = parameter in GHz
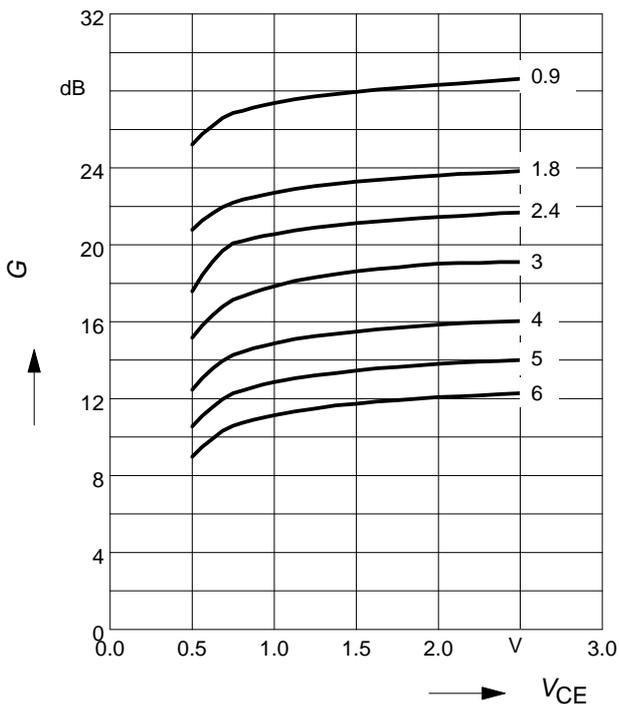
**Collector-base capacitance** $C_{cb} = f(V_{CB})$

$f = 1$MHz

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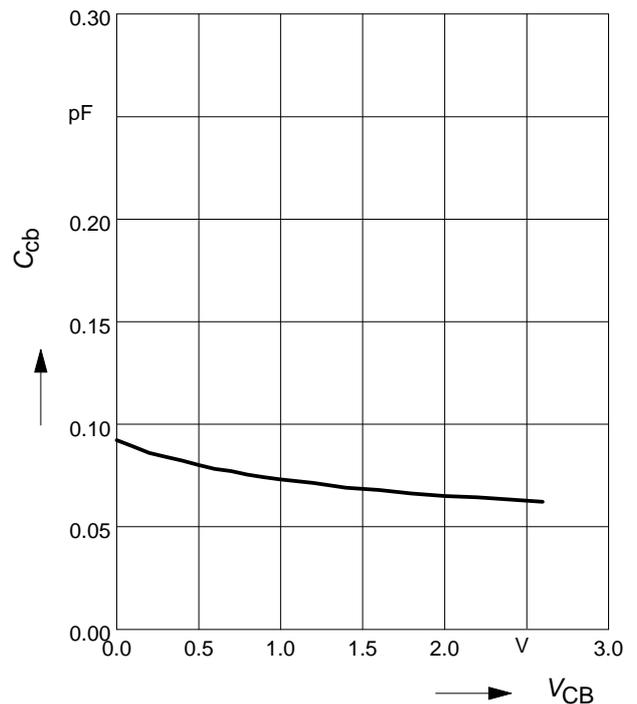
Noise figure $F = f(I_C)$

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

dB

F

f = 6 GHz
f = 5 GHz
f = 4 GHz
f = 3 GHz
f = 2.4 GHz
f = 1.8 GHz
f = 0.9 GHz

I_C
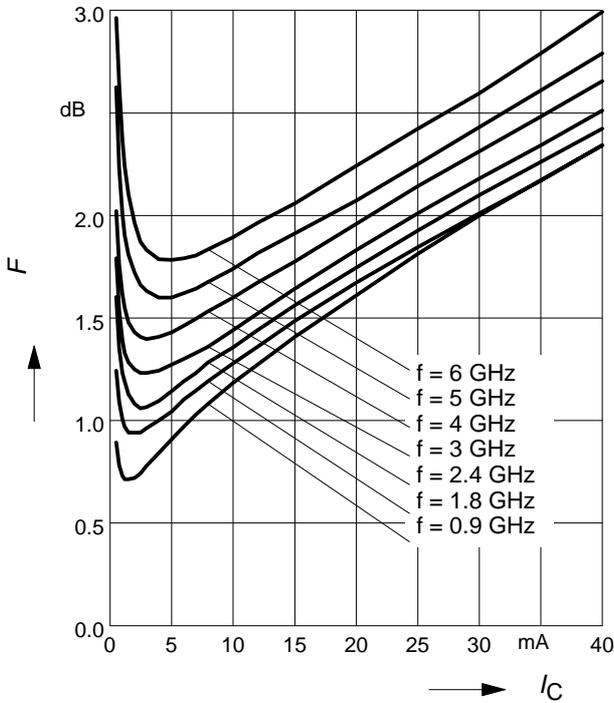
Noise figure $F = f(I_C)$

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

dB

F

Zs = 50Ohm
Zs = Zsopt

I_C
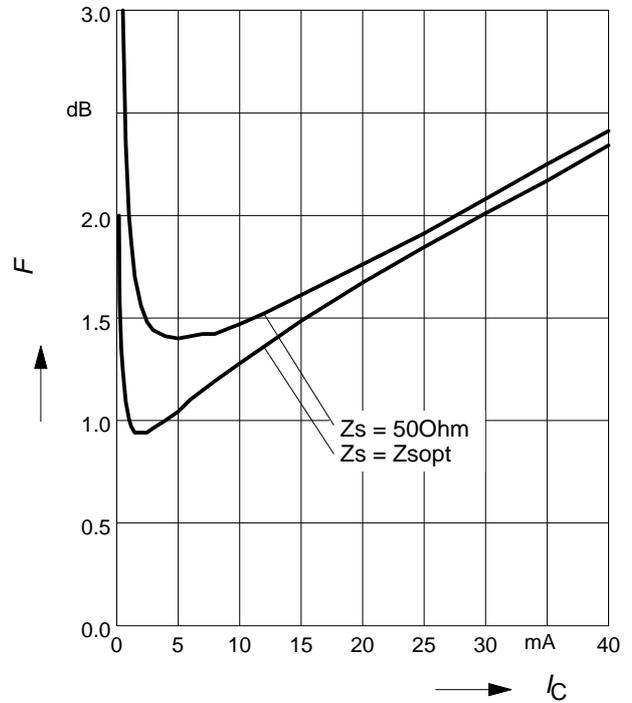
Noise figure $F = f(f)$

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

dB

F

IC = 5 mA
IC = 2 mA

f
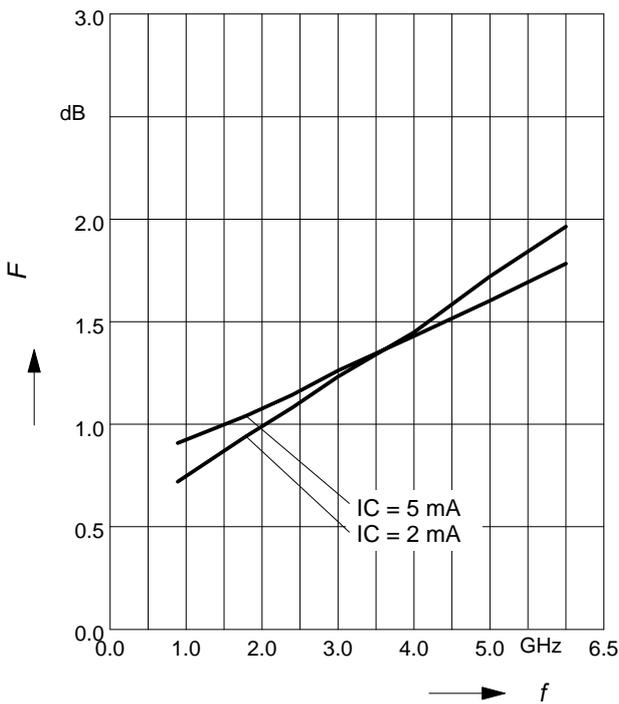
Source impedance for min.

noise figure vs. Frequency

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

+j50
+j25
+j100
+j10
3GHz
4GHz
1.8GHz
5GHz
0.9GHz
6GHz
0
10   25   50   100   0.45GHz
2mA
5mA
-j10
-j25
-j100
-j50

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