

**NPN Silicon Germanium RF Transistor\***

- High gain low noise RF transistor
- Provides outstanding performance for a wide range of wireless applications
- Ideal for CDMA and WLAN applications
- Outstanding noise figure  $F = 0.65$  dB at 1.8 GHz  
Outstanding noise figure  $F = 1.2$  dB at 6 GHz
- High maximum stable gain  
 $G_{ms} = 23$  dB at 1.8 GHz
- Gold metallization for extra high reliability
- 70 GHz  $f_T$ -Silicon Germanium technology
- Pb-free (RoHS compliant) package<sup>1)</sup>
- Qualified according AEC Q101

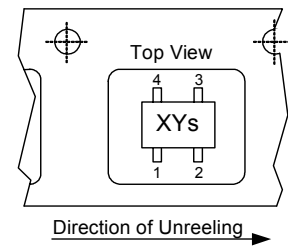
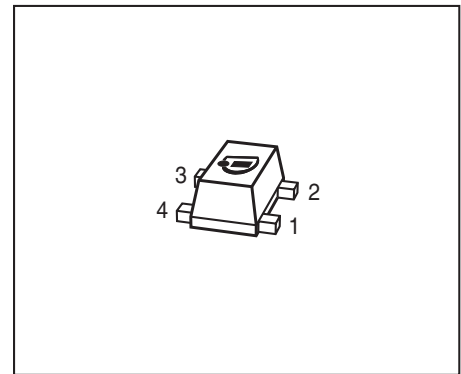
\* Short term description



**ESD (Electrostatic discharge) sensitive device, observe handling precaution!**

Type	Marking	Pin Configuration						Package
BFP640F	R4s	1=B	2=E	3=C	4=E	-	-	TSFP-4

<sup>1)</sup>Pb-containing package may be available upon special request



**Maximum Ratings**

Parameter	Symbol	Value	Unit
Collector-emitter voltage $T_A > 0^\circ\text{C}$ $T_A \leq 0^\circ\text{C}$	$V_{\text{CEO}}$	4 3.7	V
Collector-emitter voltage	$V_{\text{CES}}$	13	
Collector-base voltage	$V_{\text{CBO}}$	13	
Emitter-base voltage	$V_{\text{EBO}}$	1.2	
Collector current	$I_{\text{C}}$	50	mA
Base current	$I_{\text{B}}$	3	
Total power dissipation <sup>1)</sup> $T_S \leq 92^\circ\text{C}$	$P_{\text{tot}}$	200	mW
Junction temperature	$T_{\text{j}}$	150	$^\circ\text{C}$
Ambient temperature	$T_{\text{A}}$	-65 ... 150	
Storage temperature	$T_{\text{stg}}$	-65 ... 150	

**Thermal Resistance**

Parameter	Symbol	Value	Unit
Junction - soldering point <sup>2)</sup>	$R_{\text{thJS}}$	$\leq 290$	K/W

**Electrical Characteristics at  $T_A = 25^\circ\text{C}$ , unless otherwise specified**

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Collector-emitter breakdown voltage $I_{\text{C}} = 1 \text{ mA}, I_{\text{B}} = 0$	$V_{(\text{BR})\text{CEO}}$	4	4.5	-	V
Collector-emitter cutoff current $V_{\text{CE}} = 13 \text{ V}, V_{\text{BE}} = 0$	$I_{\text{CES}}$	-	-	30	$\mu\text{A}$
Collector-base cutoff current $V_{\text{CB}} = 5 \text{ V}, I_{\text{E}} = 0$	$I_{\text{CBO}}$	-	-	100	nA
Emitter-base cutoff current $V_{\text{EB}} = 0.5 \text{ V}, I_{\text{C}} = 0$	$I_{\text{EBO}}$	-	-	3	$\mu\text{A}$
DC current gain $I_{\text{C}} = 30 \text{ mA}, V_{\text{CE}} = 3 \text{ V}, \text{puls measured}$	$h_{\text{FE}}$	110	180	270	-

<sup>1)</sup>  $T_S$  is measured on the collector lead at the soldering point to the pcb

<sup>2)</sup> For calculation of  $R_{\text{thJA}}$  please refer to Application Note Thermal Resistance

**Electrical Characteristics at  $T_A = 25^\circ\text{C}$ , unless otherwise specified**

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
<b>AC Characteristics (verified by random sampling)</b>					
Transition frequency $I_C = 30\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $f = 1\text{ GHz}$	$f_T$	30	40	-	GHz
Collector-base capacitance $V_{CB} = 3\text{ V}$ , $f = 1\text{ MHz}$ , $V_{BE} = 0$ , emitter grounded	$C_{cb}$	-	0.09	0.2	pF
Collector emitter capacitance $V_{CE} = 3\text{ V}$ , $f = 1\text{ MHz}$ , $V_{BE} = 0$ , base grounded	$C_{ce}$	-	0.18	-	
Emitter-base capacitance $V_{EB} = 0.5\text{ V}$ , $f = 1\text{ MHz}$ , $V_{CB} = 0$ , collector grounded	$C_{eb}$	-	0.5	-	
Noise figure $I_C = 5\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $f = 1.8\text{ GHz}$ , $Z_S = Z_{Sopt}$ $I_C = 5\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $f = 6\text{ GHz}$ , $Z_S = Z_{Sopt}$	$F$	-	0.65 1.2	-	dB
Power gain, maximum stable <sup>1)</sup> $I_C = 30\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $Z_S = Z_{Sopt}$ , $Z_L = Z_{Lopt}$ , $f = 1.8\text{ GHz}$	$G_{ms}$	-	23	-	dB
Power gain, maximum available <sup>1)</sup> $I_C = 30\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $Z_S = Z_{Sopt}$ , $Z_L = Z_{Lopt}$ , $f = 6\text{ GHz}$	$G_{ma}$	-	12	-	dB
Transducer gain $I_C = 30\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $Z_S = Z_L = 50\ \Omega$ , $f = 1.8\text{ GHz}$ $f = 6\text{ GHz}$	$ S_{21e} ^2$	-	20.5 10	-	dB
Third order intercept point at output <sup>2)</sup> $V_{CE} = 3\text{ V}$ , $I_C = 30\text{ mA}$ , $Z_S = Z_L = 50\ \Omega$ , $f = 1.8\text{ GHz}$	$IP_3$	-	27.5	-	dBm
1dB Compression point at output $I_C = 30\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $Z_S = Z_L = 50\ \Omega$ , $f = 1.8\text{ GHz}$	$P_{-1dB}$	-	13.5	-	

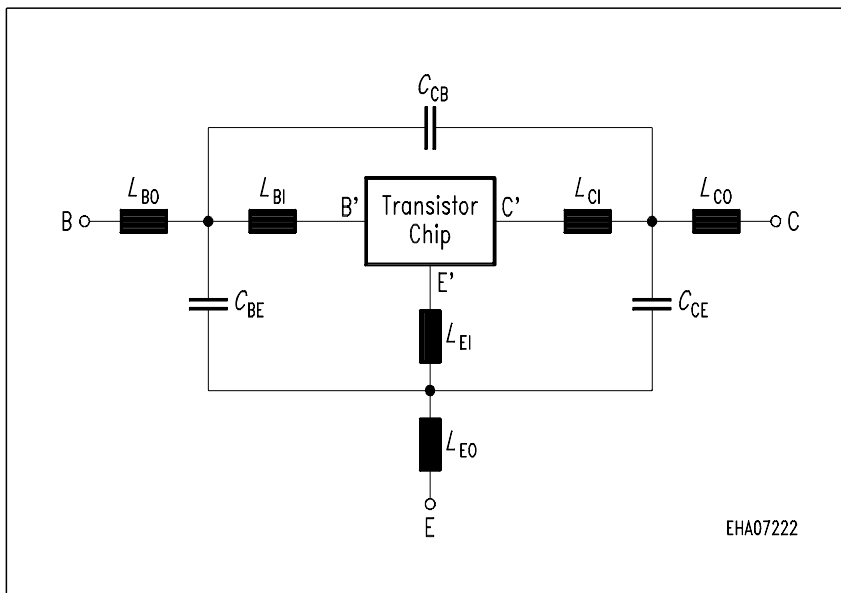
$$^1G_{ma} = |S_{21e} / S_{12e}| (k - (k^2 - 1)^{1/2}), G_{ms} = |S_{21e} / S_{12e}|$$

<sup>2)</sup>IP3 value depends on termination of all intermodulation frequency components.  
Termination used for this measurement is  $50\ \Omega$  from 0.1 MHz to 6 GHz

**SPICE Parameter (Gummel-Poon Model, Berkley-SPICE 2G.6 Syntax):**
**Transistor Chip Data:**

IS =	0.22	fA	BF =	450	-	NF =	1.025	-
VAF =	1000	V	IKF =	0.15	A	ISE =	21	fA
NE =	2	-	BR =	55	-	NR =	1	-
VAR =	2	V	IKR =	3.8	mA	ISC =	400	fA
NC =	1.8	-	RB =	3.129	$\Omega$	IRB =	1.522	mA
RBM =	2.707	$\Omega$	RE =	0.6	-	RC =	3.061	$\Omega$
CJE =	227.6	fF	VJE =	0.8	V	MJE =	0.3	-
TF =	1.8	ps	XTF =	10	-	VTF =	1.5	V
ITF =	0.4	A	PTF =	0	deg	CJC =	67.43	fF
VJC =	0.6	V	MJC =	0.5	-	XCJC =	1	-
TR =	0.2	ns	CJS =	93.4	fF	VJS =	0.6	V
MJS =	0.27	-	XTB =	-1.42	-	EG =	1.078	eV
XTI =	3	-	FC =	0.8	-	TNOM	298	K
AF =	2	-	KF =	7.291E-11	-			
TITF1	-0.0065	-	TITF2	1.0E-5	-			

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

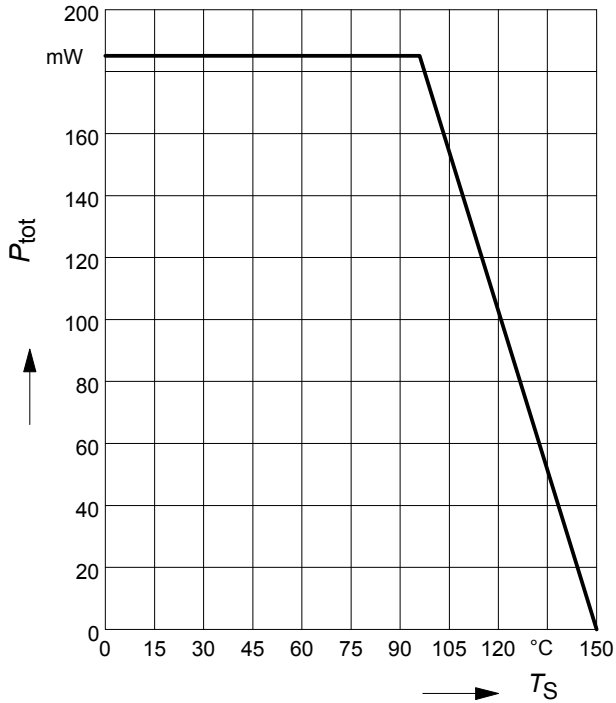
**Package Equivalent Circuit:**


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>

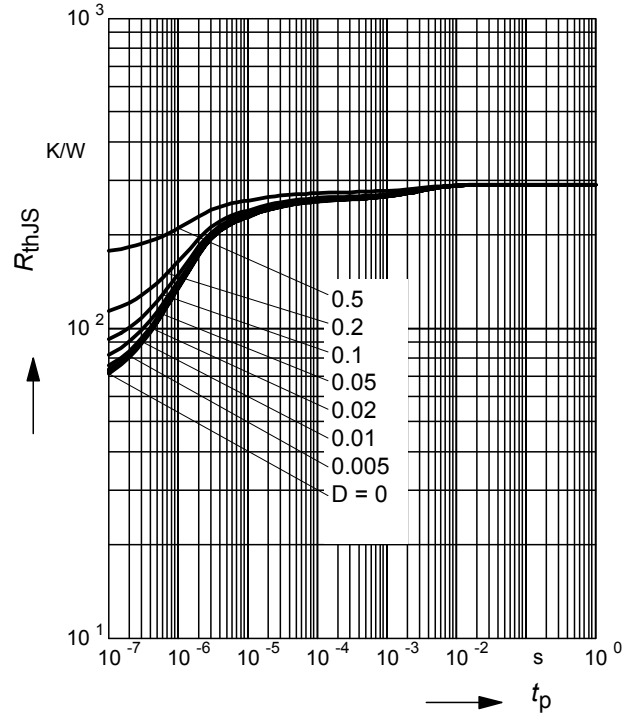
LBO =	0.22	nH
LEO =	0.28	nH
LCO =	0.22	nH
LBI =	0.42	nH
LEI =	0.26	nH
LCI =	0.35	nH
CBE =	34	fF
CBC =	2	fF
CCE =	33	fF
KBO-EO =	0.1	-
KBO-CO =	0.01	-
KEO-CO =	0.11	-
KCI-EI =	0.2	-
KBI-CI =	-0.08	-
KBI-EI =	-0.05	-
RLBI =	0.15	$\Omega$
RLEI =	0.11	$\Omega$
RLCI =	0.13	$\Omega$

Valid up to 6GHz

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

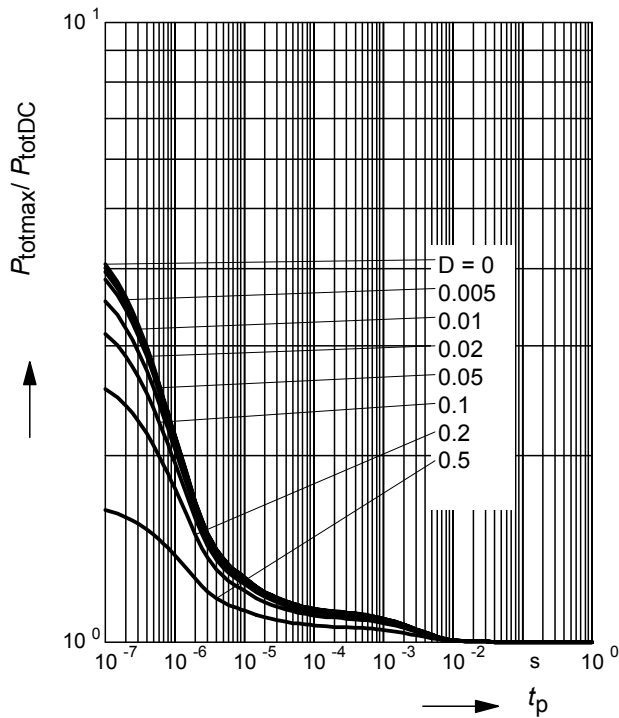


**Permissible Pulse Load  $R_{thJS} = f(t_p)$**



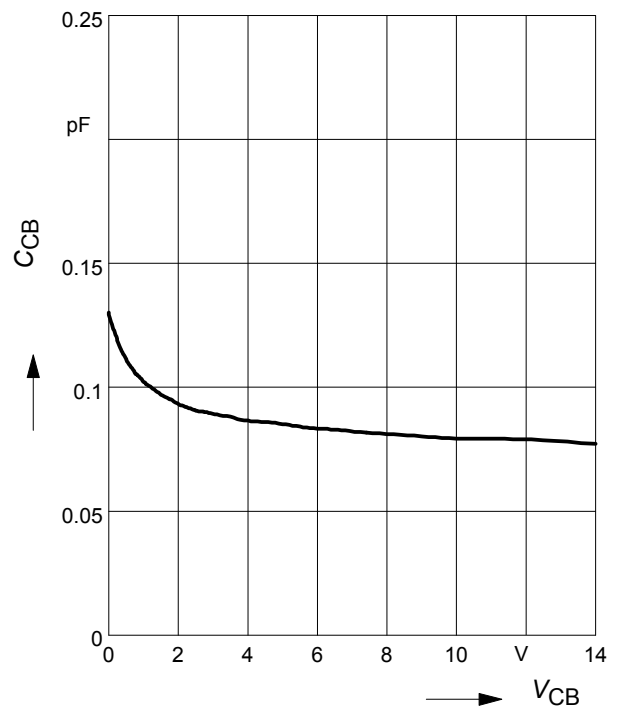
**Permissible Pulse Load**

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



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

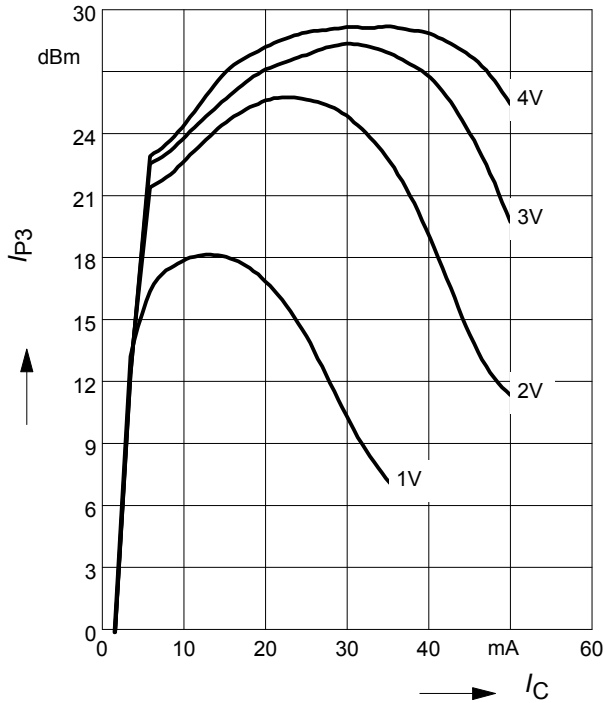
$f = 1\text{MHz}$



**Third order Intercept Point  $IP_3=f(I_C)$**

(Output,  $Z_S=Z_L=50\Omega$ )

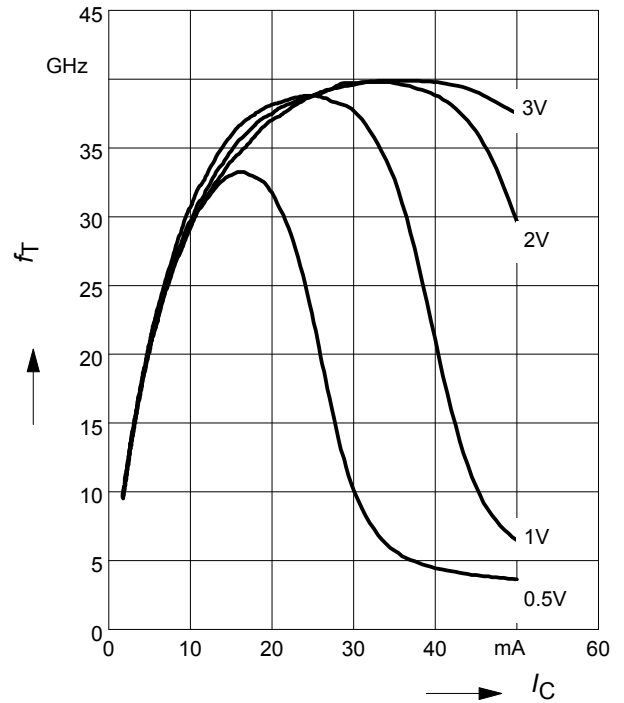
$V_{CE}$  = parameter,  $f = 1.8$  GHz



**Transition frequency  $f_T=f(I_C)$**

$f = 1$  GHz

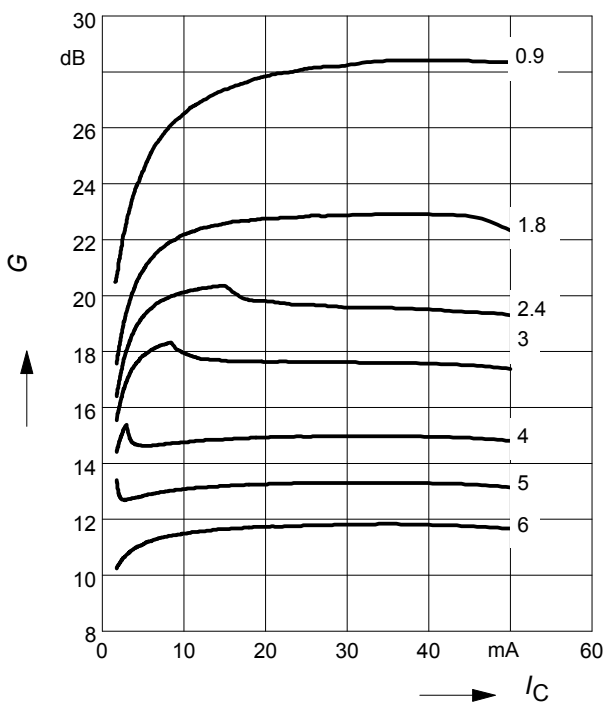
$V_{CE}$  = parameter



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

$V_{CE} = 3V$

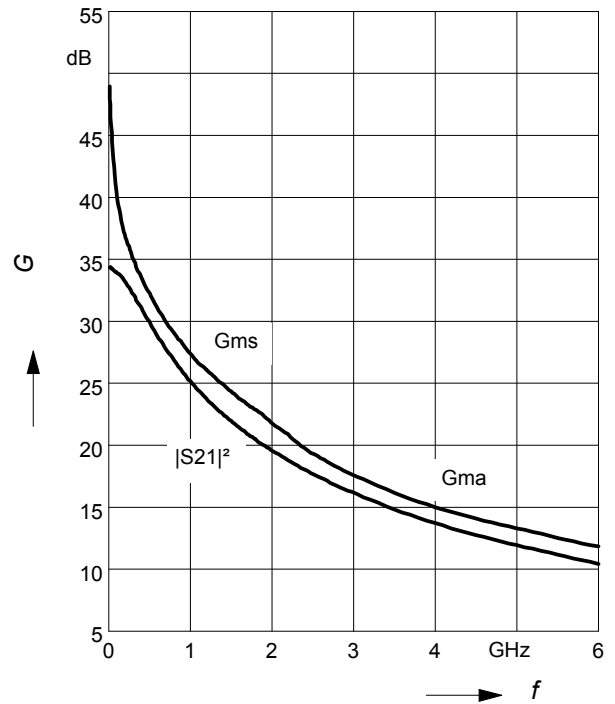
$f$  = parameter



**Power Gain  $G_{ma}, G_{ms} = f(f)$**

$|S_{21}|^2 = f(f)$

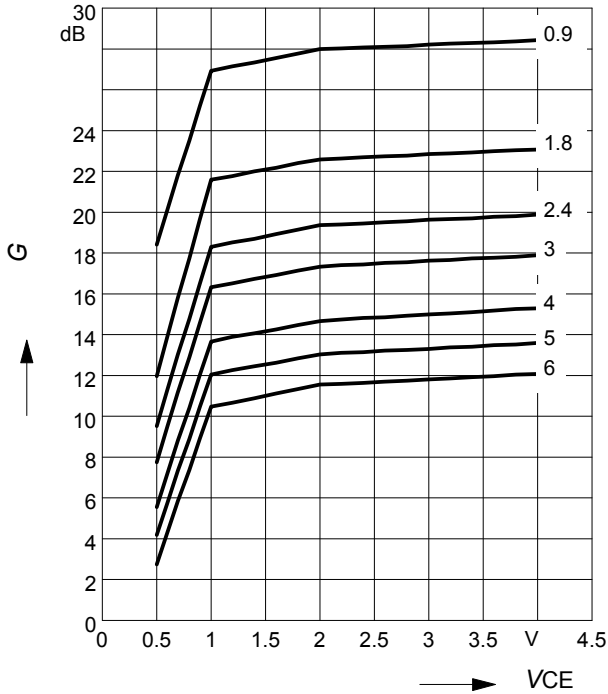
$V_{CE} = 3V, I_C = 30mA$



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

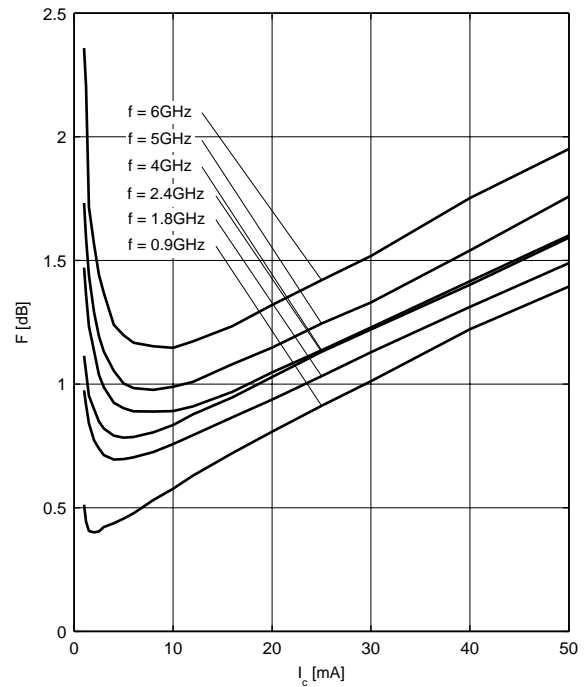
$I_C = 30\text{mA}$

$f = \text{parameter}$



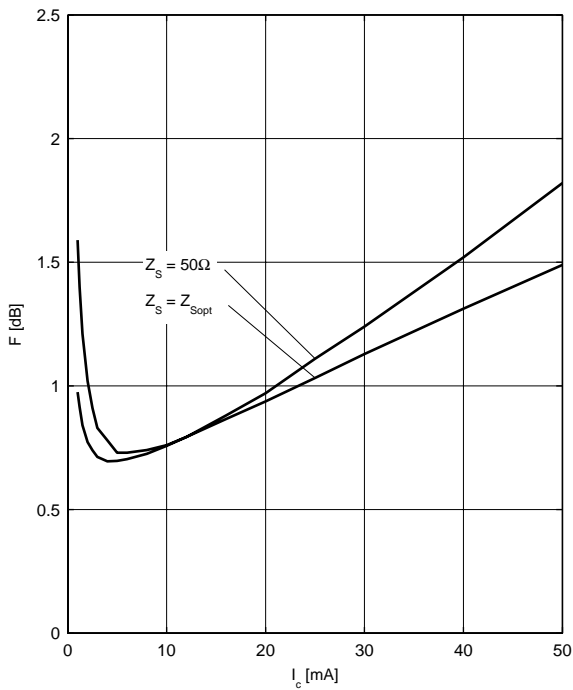
**Noise figure  $F = f(I_C)$**

$V_{CE} = 3\text{V}$ ,  $Z_S = Z_{Sopt}$



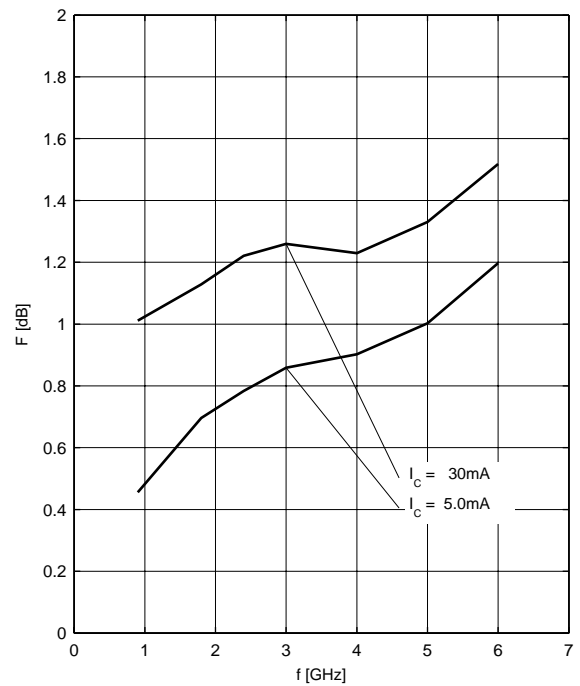
**Noise figure  $F = f(I_C)$**

$V_{CE} = 3\text{V}$ ,  $f = 1.8\text{GHz}$



**Noise figure  $F = f(f)$**

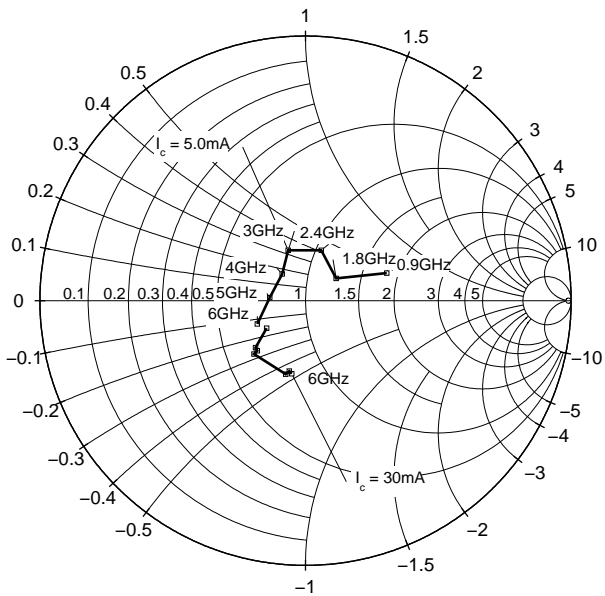
$V_{CE} = 3\text{V}$ ,  $Z_S = Z_{Sopt}$



**Source impedance** for min.

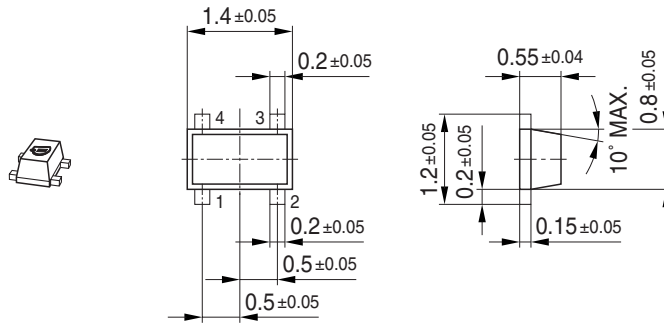
noise figure vs. frequency

$V_{CE} = 3\text{ V}$ ,  $I_C = 5\text{ mA}/30\text{ mA}$

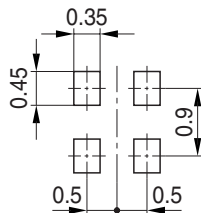




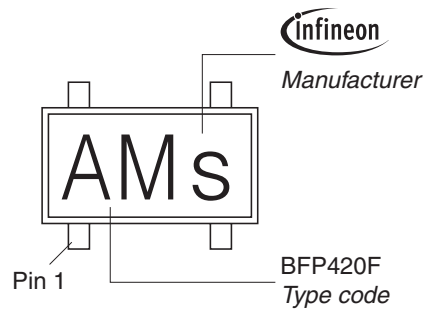
Package Outline



Foot Print

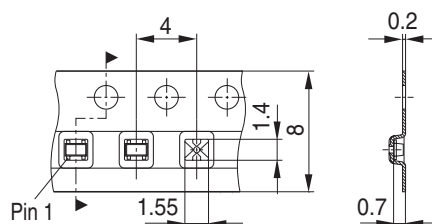


Marking Layout (Example)



Standard Packing

Reel ø180 mm = 3.000 Pieces/Reel  
 Reel ø330 mm = 10.000 Pieces/Reel



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