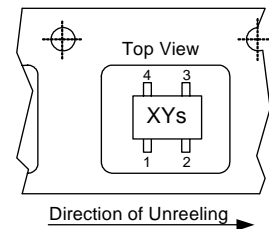
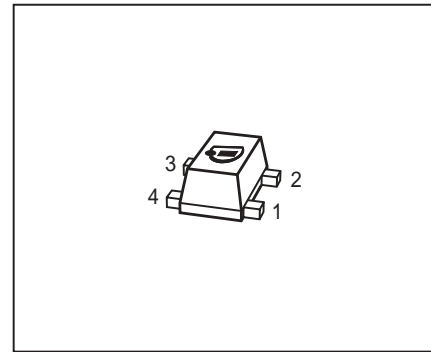


**NPN Silicon Germanium RF Transistor\***

- High gain low noise RF transistor
- Small package 1.4 x 0.8 x 0.59 mm
- Outstanding noise figure  $F = 0.7$  dB at 1.8 GHz  
Outstanding noise figure  $F = 1.3$  dB at 6 GHz
- Maximum stable gain  
 $G_{ms} = 21$  dB at 1.8 GHz  
 $G_{ma} = 10$  dB at 6 GHz
- Gold metallization for extra high reliability
- 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
BFP620F	R2s	1=B	2=E	3=C	4=E	-	-	TSFP-4

**Maximum Ratings**

Parameter	Symbol	Value	Unit
Collector-emitter voltage	$V_{CEO}$		V
$T_A > 0$ °C		2.3	
$T_A \leq 0$ °C		2.1	
Collector-emitter voltage	$V_{CES}$	7.5	
Collector-base voltage	$V_{CBO}$	7.5	
Emitter-base voltage	$V_{EBO}$	1.2	
Collector current	$I_C$	80	mA
Base current	$I_B$	3	
Total power dissipation <sup>2)</sup>	$P_{tot}$	185	mW
$T_S \leq 96$ °C			
Junction temperature	$T_j$	150	°C
Ambient temperature	$T_A$	-65 ... 150	
Storage temperature	$T_{stg}$	-65 ... 150	

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

<sup>2)</sup> $T_S$  is measured on the collector lead at the soldering point to the pcb

**Thermal Resistance**

Parameter	Symbol	Value	Unit
Junction - soldering point <sup>1)</sup>	$R_{thJS}$	≤ 290	K/W

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

Parameter	Symbol	Values			Unit
		min.	typ.	max.	

**DC Characteristics**

Collector-emitter breakdown voltage $I_C = 1 \text{ mA}, I_B = 0$	$V_{(BR)CEO}$	2.3	2.8	-	V
Collector-emitter cutoff current $V_{CE} = 7.5 \text{ V}, V_{BE} = 0$	$I_{CES}$	-	-	10	$\mu\text{A}$
Collector-base cutoff current $V_{CB} = 5 \text{ V}, I_E = 0$	$I_{CBO}$	-	-	100	nA
Emitter-base cutoff current $V_{EB} = 0.5 \text{ V}, I_C = 0$	$I_{EBO}$	-	-	3	$\mu\text{A}$
DC current gain $I_C = 50 \text{ mA}, V_{CE} = 1.5 \text{ V}$ , pulse measured	$h_{FE}$	110	180	270	-

<sup>1)</sup>For calculation of  $R_{thJA}$  please refer to Application Note Thermal Resistance

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

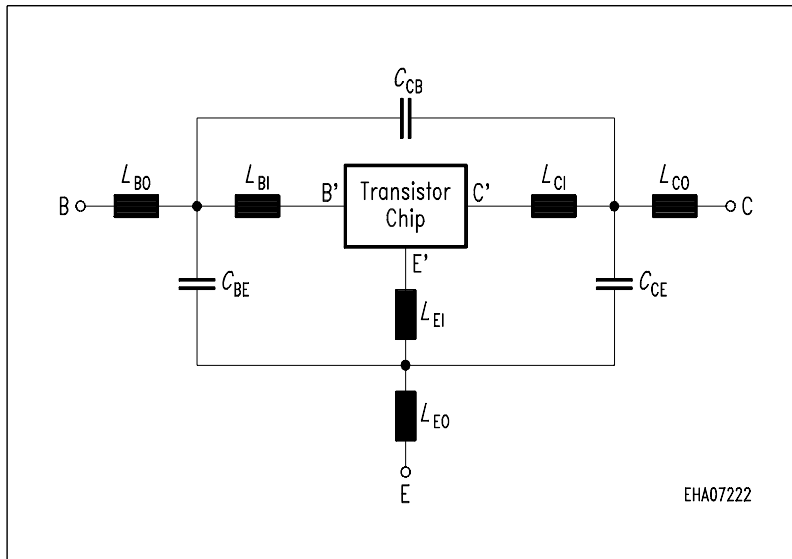
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
<b>AC Characteristics (verified by random sampling)</b>					
Transition frequency $I_C = 50\text{ mA}$ , $V_{CE} = 1.5\text{ V}$ , $f = 1\text{ GHz}$	$f_T$	-	65	-	GHz
Collector-base capacitance $V_{CB} = 2\text{ V}$ , $f = 1\text{ MHz}$ , $V_{BE} = 0$ , emitter grounded	$C_{cb}$	-	0.12	0.2	pF
Collector emitter capacitance $V_{CE} = 2\text{ V}$ , $f = 1\text{ MHz}$ , $V_{BE} = 0$ , base grounded	$C_{ce}$	-	0.2	-	
Emitter-base capacitance $V_{EB} = 0.5\text{ V}$ , $f = 1\text{ MHz}$ , $V_{CB} = 0$ , collector grounded	$C_{eb}$	-	0.45	-	
Noise figure $I_C = 5\text{ mA}$ , $V_{CE} = 1.5\text{ V}$ , $f = 1.8\text{ GHz}$ , $Z_S = Z_{Sopt}$ $I_C = 5\text{ mA}$ , $V_{CE} = 1.5\text{ V}$ , $f = 6\text{ GHz}$ , $Z_S = Z_{Sopt}$	$F$	-	0.7 1.3	-	dB
Power gain, maximum stable <sup>1)</sup> $I_C = 50\text{ mA}$ , $V_{CE} = 1.5\text{ V}$ , $Z_S = Z_{Sopt}$ , $Z_L = Z_{Lopt}$ , $f = 1.8\text{ GHz}$	$G_{ms}$	-	21	-	dB
Power gain, maximum available <sup>1)</sup> $I_C = 50\text{ mA}$ , $V_{CE} = 1.5\text{ V}$ , $Z_S = Z_{Sopt}$ , $Z_L = Z_{Lopt}$ , $f = 6\text{ GHz}$	$G_{ma}$	-	10	-	dB
Transducer gain $I_C = 50\text{ mA}$ , $V_{CE} = 1.5\text{ V}$ , $Z_S = Z_L = 50\ \Omega$ , $f = 1.8\text{ GHz}$ $f = 6\text{ GHz}$	$ S_{21e} ^2$	-	19.5 9.5	-	dB
Third order intercept point at output <sup>2)</sup> $V_{CE} = 2\text{ V}$ , $I_C = 50\text{ mA}$ , $Z_S = Z_L = 50\ \Omega$ , $f = 1.8\text{ GHz}$	$IP_3$	-	25	-	dBm
1dB Compression point at output $I_C = 50\text{ mA}$ , $V_{CE} = 2\text{ V}$ , $Z_S = Z_L = 50\ \Omega$ , $f = 1.8\text{ GHz}$	$P_{-1dB}$	-	14	-	

<sup>1)</sup>  $G_{ma} = |S_{21e}| / |S_{12e}| (k - (k^2 - 1)^{1/2})$ ,  $G_{ms} = |S_{21e}| / |S_{12e}|$ 
<sup>2)</sup>  $IP_3$  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 =	425	-	NF =	1.025	-
VAF =	1000	V	IKF =	0.25	A	ISE =	21	fA
NE =	2	-	BR =	50	-	NR =	1	-
VAR =	2	V	IKR =	10	mA	ISC =	18	pA
NC =	2	-	RB =	3.129	$\Omega$	IRB =	1.522	mA
RBM =	2.707	$\Omega$	RE =	0.6	-	RC =	2.364	$\Omega$
CJE =	250.7	fF	VJE =	0.75	V	MJE =	0.3	-
TF =	1.43	ps	XTF =	10	-	VTF =	1.5	V
ITF =	2.4	A	PTF =	0	deg	CJC =	124.9	fF
VJC =	0.6	V	MJC =	0.5	-	XCJC =	1	-
TR =	0.2	ns	CJS =	128.1	fF	VJS =	0.52	V
MJS =	0.5	-	NK =	-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.

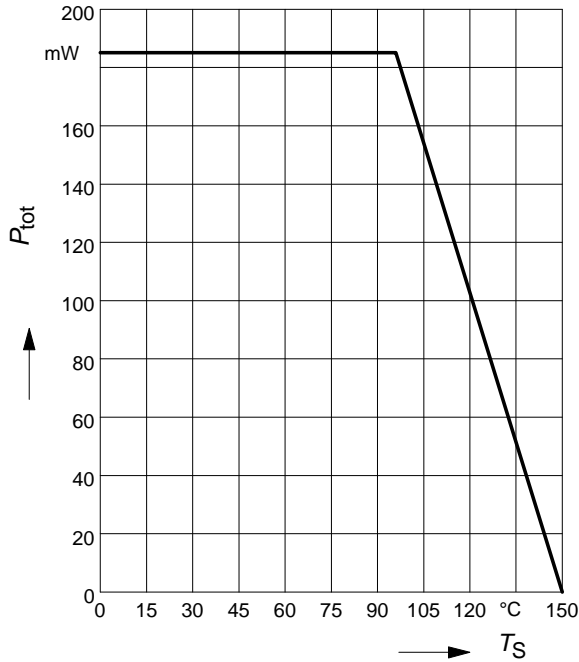
**Package Equivalent Circuit:**


To avoid high complexity of the package equivalent circuit, both emitter leads of TSFP-4 are combined in one electrical connection.  $R_{LxI}$  are series resistors for the inductances  $L_{xI}$  and  $K_{xa-yb}$  are the coupling coefficients between the inductances  $L_{xa}$  and  $L_{yb}$ .

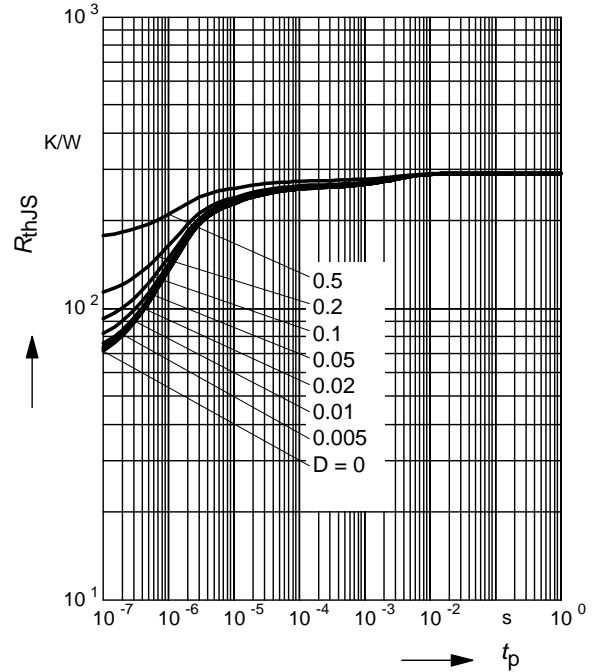
$L_{B0}$ =	0.22	nH
$L_{E0}$ =	0.28	nH
$L_{C0}$ =	0.22	nH
$K_{B0-E0}$ =	0.1	-
$K_{B0-C0}$ =	0.01	-
$K_{E0-C0}$ =	0.11	-
$C_{BE}$ =	34	fF
$C_{BC}$ =	2	fF
$C_{CE}$ =	33	fF
$L_{BI}$ =	0.42	nH
$R_{LBI}$ =	0.15	$\Omega$
$L_{EI}$ =	0.26	nH
$R_{LEI}$ =	0.11	$\Omega$
$L_{CI}$ =	0.35	nH
$R_{LI}$ =	0.13	$\Omega$
$K_{BI-EI}$ =	-0.05	-
$K_{BI-CI}$ =	-0.08	-
$K_{EI-CI}$ =	0.2	-

Valid up to 6GHz

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

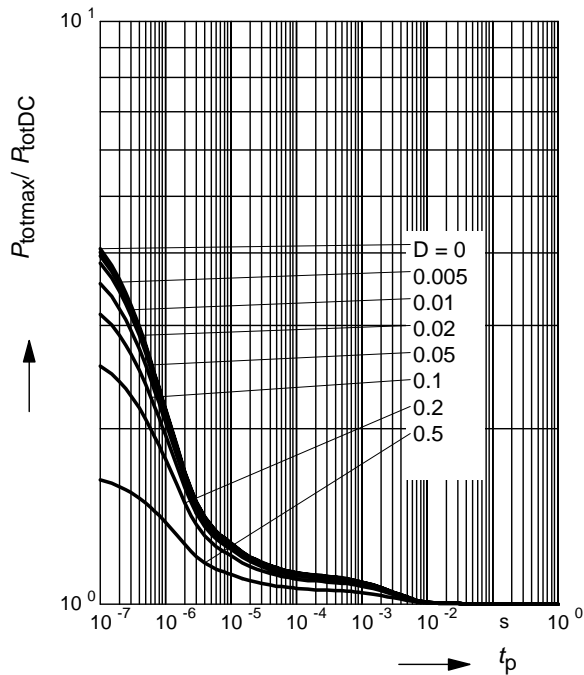


Permissible Pulse Load  $R_{thJS} = f(t_p)$



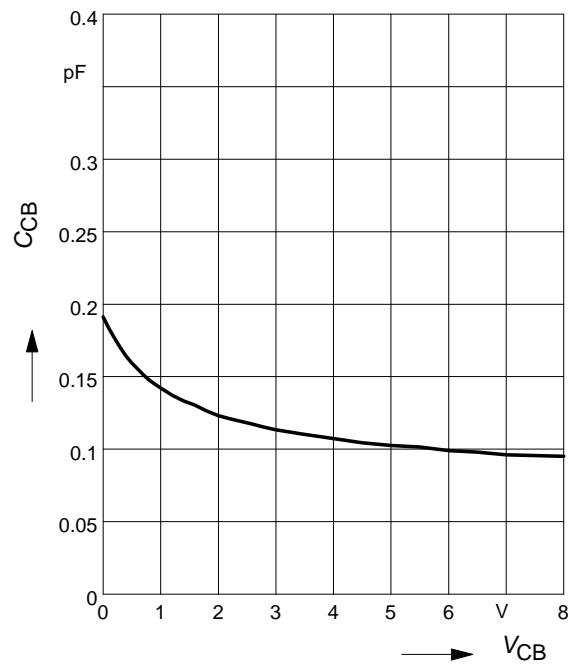
Permissible Pulse Load

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



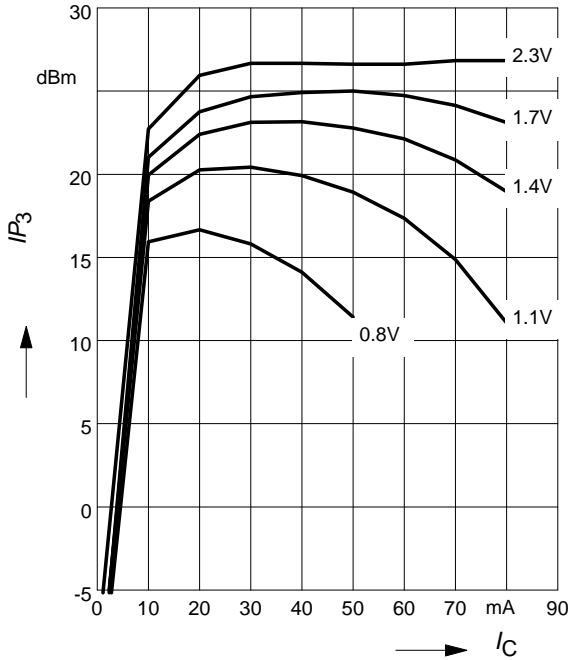
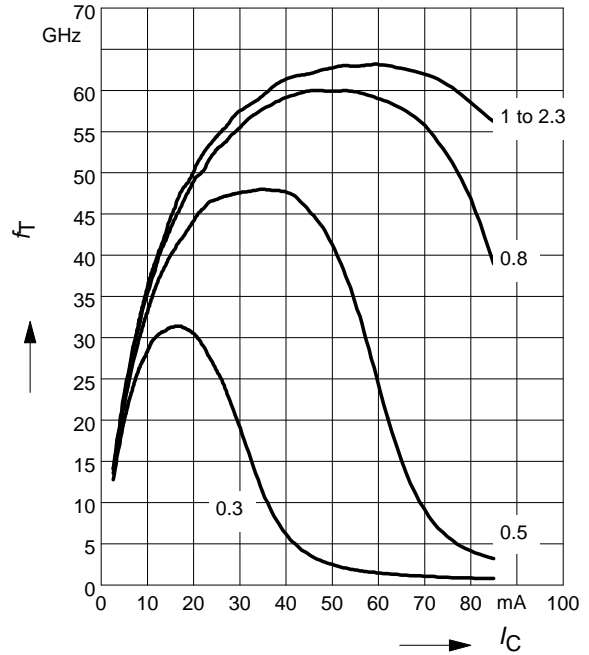
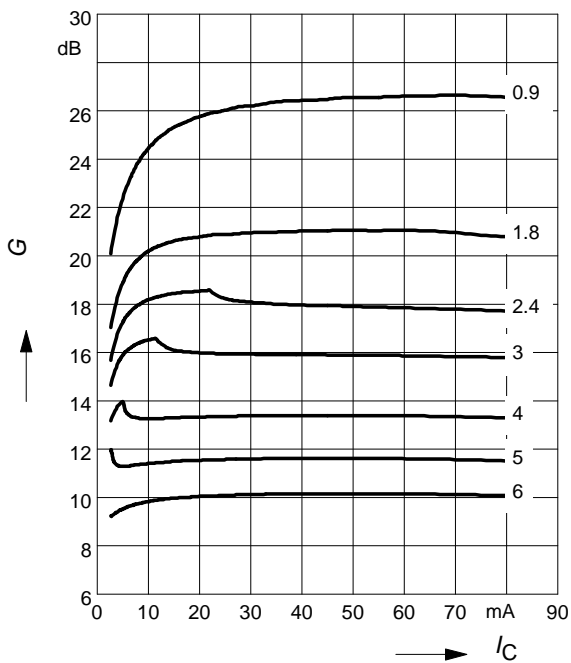
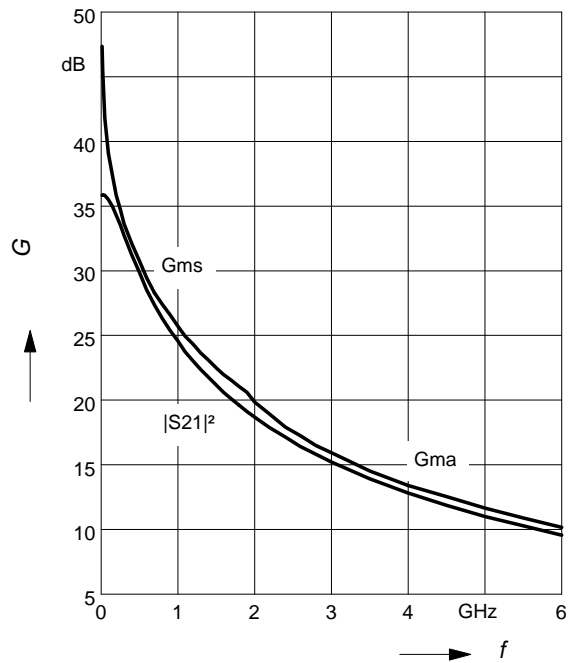
Collector-base capacitance  $C_{cb} = f(V_{CB})$

$f = 1\text{MHz}$



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

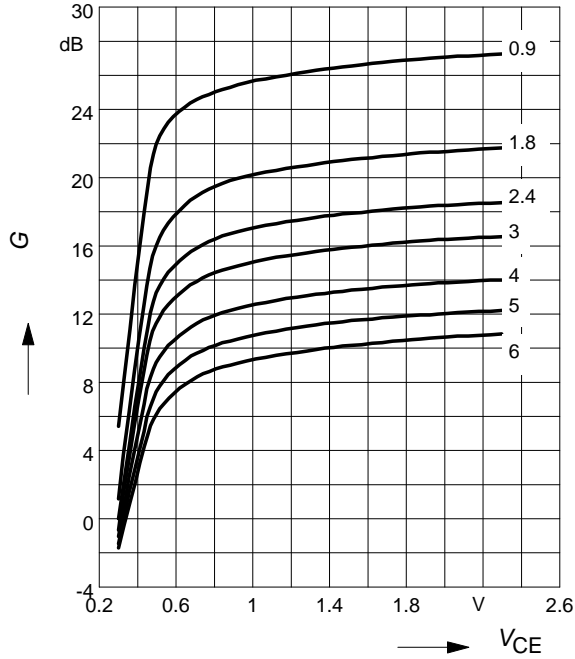
 (Output,  $Z_S=Z_L=50\Omega$ )

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

**Transition frequency  $f_T=f(I_C)$** 
 $f = 1\text{GHz}$ 
 $V_{CE}$  = Parameter in V

**Power gain  $G_{ma}, G_{ms} = f(I_C)$** 
 $V_{CE} = 1.5\text{V}$ 
 $f$  = Parameter in GHz

**Power Gain  $G_{ma}, G_{ms} = f(f)$** 
 $|S_{21}|^2 = f(f)$ 
 $V_{CE} = 1.5\text{V}, I_C = 50\text{mA}$ 


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

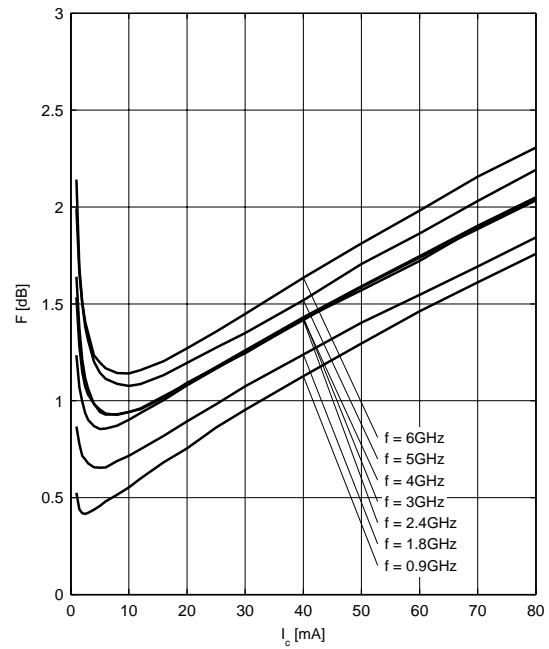
$I_C = 50\text{mA}$

$f = \text{Parameter in GHz}$



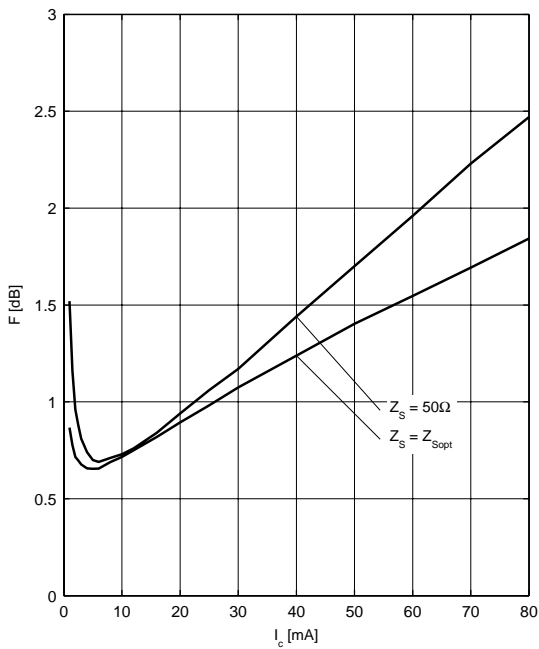
**Noise figure  $F = f(I_C)$**

$V_{CE} = 1.5\text{V}$ ,  $Z_S = Z_{Sopt}$



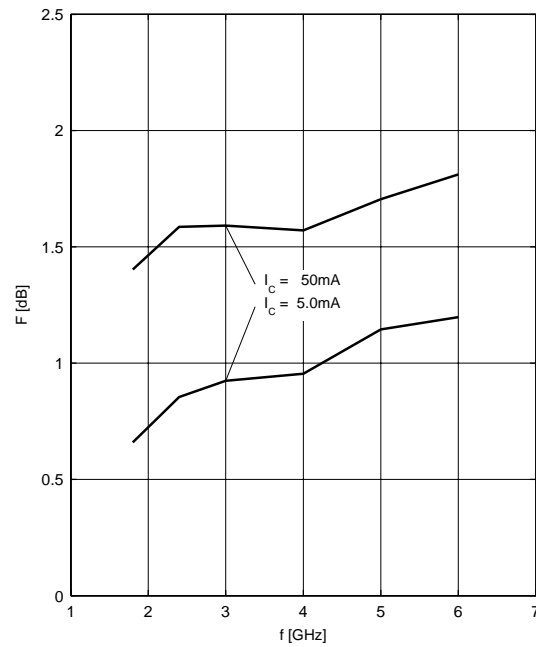
**Noise figure  $F = f(I_C)$**

$V_{CE} = 1.5\text{V}$ ,  $f = 1.8\text{GHz}$



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

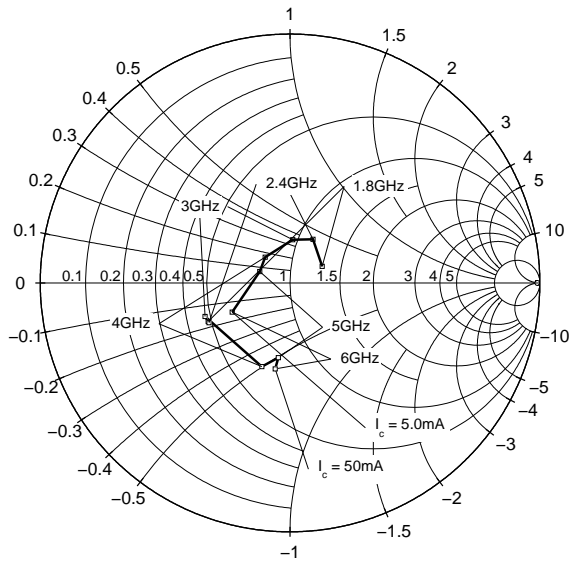
$V_{CE} = 1.5\text{V}$ ,  $Z_S = Z_{Sopt}$



Source impedance for min.

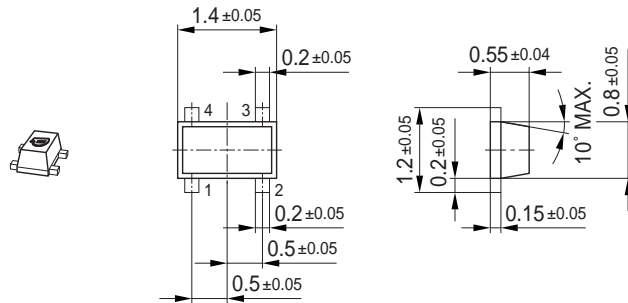
noise figure vs. frequency

$V_{CE} = 1.5V$ ,  $I_C = 5.0mA/50.0mA$

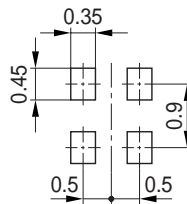




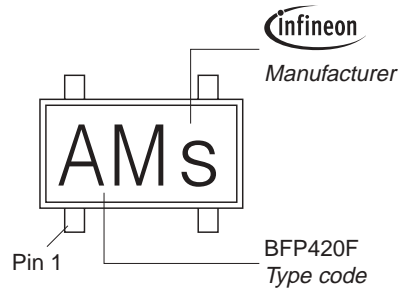
Package Outline



Foot Print

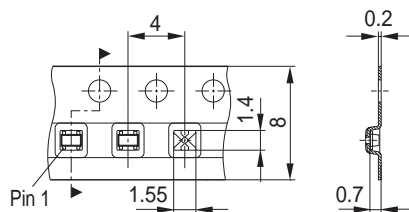


Marking Layout (Example)



Standard Packing

Reel  $\varnothing$ 180 mm = 3.000 Pieces/Reel  
 Reel  $\varnothing$ 330 mm = 10.000 Pieces/Reel



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