

## NPN High-frequency low-noise transistor

### Description

The 2SC4228 is an ultra-high-frequency low-noise transistor using planar NPN silicon epitaxial bipolar technology. It features high power gain and low noise characteristics. Due to its ultra-small SOT-323 package, it is particularly suited for high-density surface-mount applications. It is primarily used in VHF and UHF low-noise amplifiers.

### Features

High gain: $S_{21}$ typically 5.5 dB	@ $V_{CE}=3V$ , $I_C=5mA$ , $f=2GHz$
Low noise: NF typical 2.0 dB	@ $V_{CE}=3V$ , $I_C=5mA$ , $f=2GHz$
Gain-bandwidth product: $fT$ typical 8 GHz	@ $V_{CE}=3V$ , $I_C=5mA$ , $f=2GHz$

### Limit parameters ( $T_A=25^\circ C$ )

Parameter	Symbol	Value	Unit
Collector-base breakdown voltage	$V_{CBO}$	20	V
Collector-emitter breakdown voltage	$V_{CEO}$	10	V
Emitter-base breakdown voltage	$V_{EBO}$	1.5	V
Collector current	$I_C$	35	mA
Power Dissipation	$P_C$	150	mW
Junction temperature	$T_j$	150	$^\circ C$
Storage temperature	$T_{stg}$	-65 ~ +150	$^\circ C$

### hFE position

Binning	A	B	C	D	E
Label	R43	R44	R45		
hFE	60-100	90-140	130-180	170-250	250-300

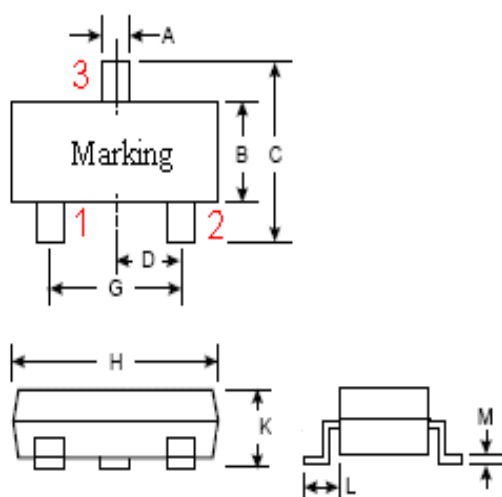
## Electrical Characteristics (T<sub>A</sub>=25°C)

Parameter	符号	最小	典型	最大	单位	测试条件
Collector basebreakdownvoltage	V <sub>CB0</sub>	20			V	I <sub>C</sub> =1.0μA
collector base leakage current	I <sub>CBO</sub>			0.1	μA	V <sub>CB</sub> =10V
emitter base leakage current	I <sub>EBO</sub>			0.1	μA	V <sub>EB</sub> =1V
DC gain	h <sub>FE</sub>	60	150	300		V <sub>CE</sub> =3V,I <sub>C</sub> =5mA
gain bandwidth product	f <sub>T</sub>		8	8.5	GHz	V <sub>CE</sub> =3V,I <sub>C</sub> =5mA,f=2GHz
Output feedback capacitor	C <sub>re</sub>		0.65	1.0	pF	V <sub>CB</sub> =10V,I <sub>E</sub> =0mA,f=1MHz
power gain	S <sub>21e</sub>   <sup>2</sup>		5.5		dB	V <sub>CE</sub> =3V,I <sub>C</sub> =5mA,f=2GHz
noise factor	NF		2.0		dB	V <sub>CE</sub> =3V,I <sub>C</sub> =5mA,f=2GHz

## Package

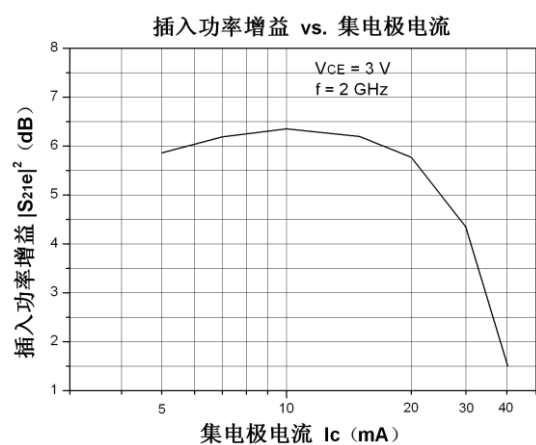
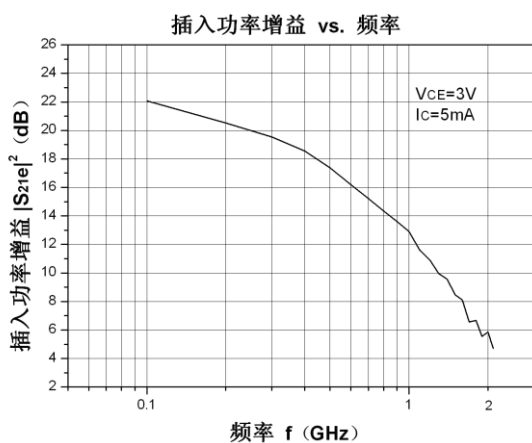
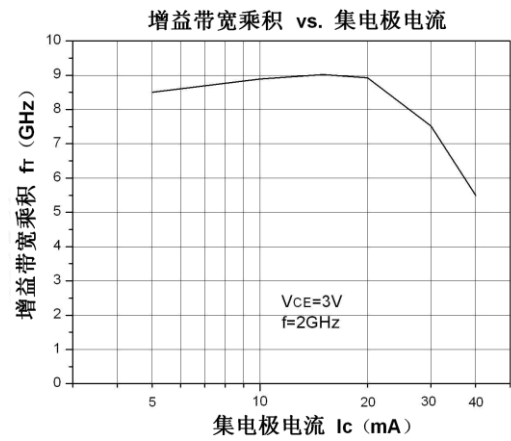
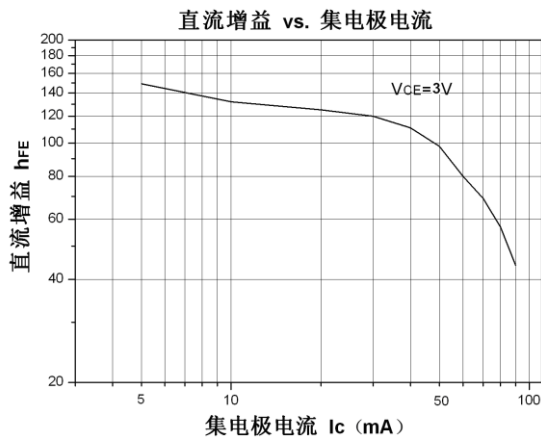
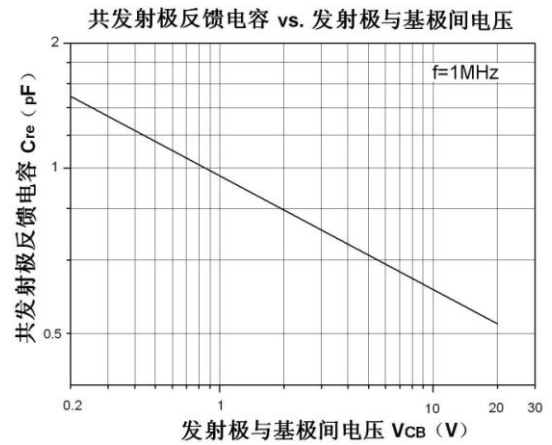
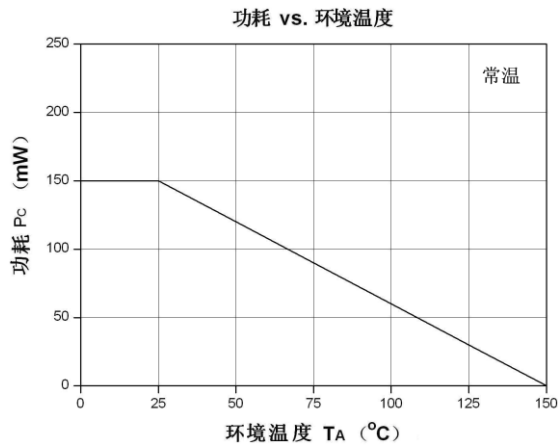
SOT-323

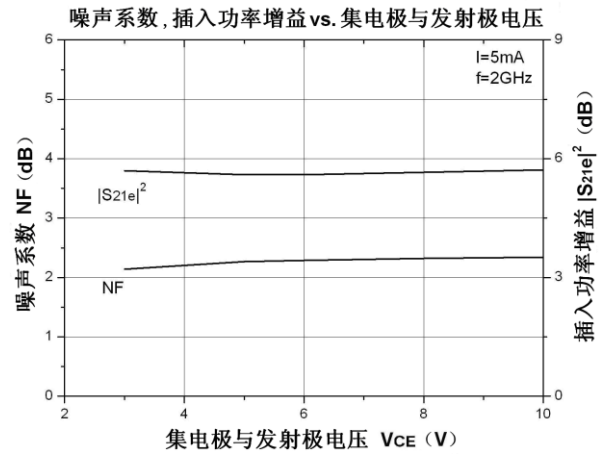
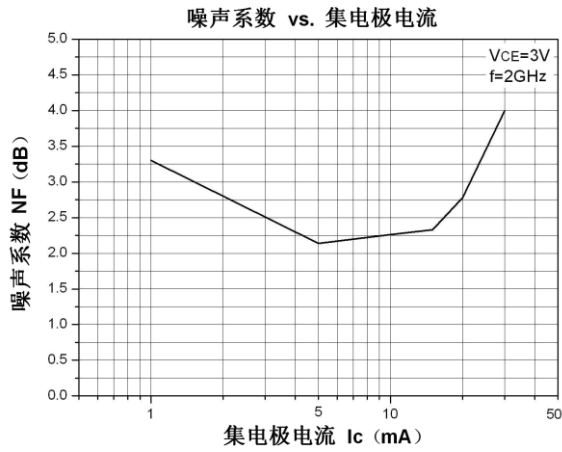
Pin definition: 1: Base 2: Emitter 3: Collector



Symbol	Min (mm)	Max (mm)
A	0.200	0.400
B	1.150	1.350
C	2.150	2.450
D	0.650	
G	1.200	1.400
H	2.000	2.200
K	0.900	1.100
L	0.525	
M	0.080	0.150

## Typical characteristic curves ( $T_A = 25\text{ }^\circ\text{C}$ )



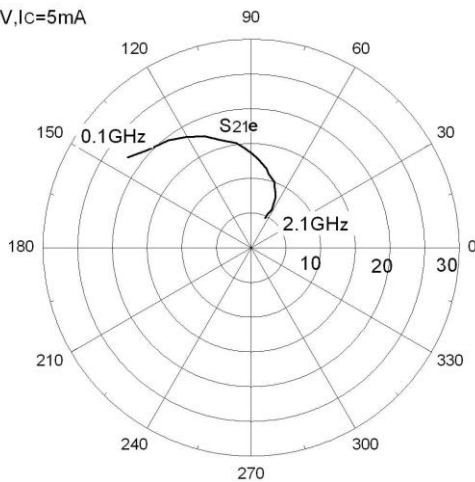


## SMITH

Test conditions:  $V_{CE}=3V$ ,  $I_c=5mA$

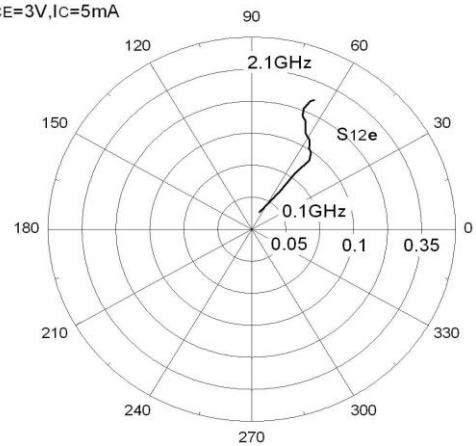
### $S_{21e}$ -FREQUENCY

条件:  $V_{CE}=3V, I_c=5mA$



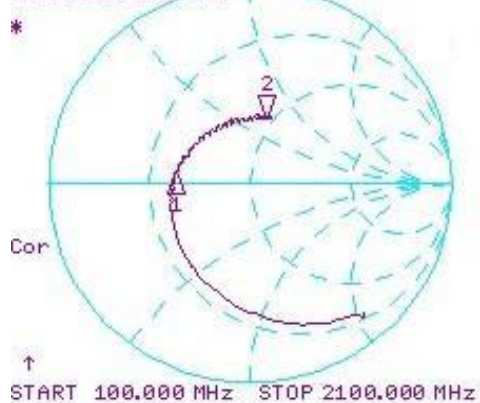
### $S_{12e}$ -FREQUENCY

条件:  $V_{CE}=3V, I_c=5mA$



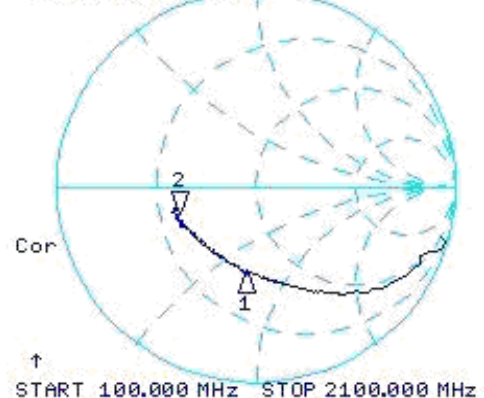
### $S_{11e}$ -FREQUENCY

Z: 45.533  $\Omega$  34.387  $\Omega$  2.7364 nH  
2 000.000 000 MHz



### $S_{22e}$ -FREQUENCY

Z: 20.903  $\Omega$  -7.1650  $\Omega$  11.106 pF  
2 000.000 000 MHz



## Scattering parameters ( S-PARAMETER)

 Test conditions:  $V_{CE}=3V$ ,  $I_C=5mA$ ,  $Z_0=50\Omega$ 

test frequency	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.1	0.855	-48.801	12.710	143.87	0.025	67.576	0.966	-14.735
0.2	0.763	-66.883	10.616	136.77	0.041	62.939	0.854	-33.989
0.3	0.655	-88.554	9.497	127.74	0.060	62.861	0.726	-48.126
0.4	0.567	-106.56	8.465	120.78	0.071	60.028	0.638	-57.838
0.5	0.514	-122.96	7.400	112.79	0.077	56.08	0.574	-65.518
0.6	0.470	-137.89	6.452	106.21	0.086	51.689	0.525	-72.426
0.7	0.432	-152.05	5.762	98.138	0.095	53.654	0.490	-79.297
0.8	0.411	-164.33	5.220	93.86	0.097	53.803	0.462	-85.2
0.9	0.384	-176.4	4.788	86.638	0.102	56.147	0.445	-91.2
1	0.380	170.73	4.416	85.732	0.105	54.511	0.436	-98.459
1.1	0.352	160.05	3.802	79.059	0.115	58.39	0.418	-103.85
1.2	0.348	149.81	3.511	76.588	0.116	58.262	0.406	-109.92
1.3	0.331	140.8	3.147	70.039	0.125	62.108	0.399	-115.82
1.4	0.335	130.41	3.011	69.561	0.134	63.053	0.394	-122.38
1.5	0.320	123.19	2.654	65.367	0.140	67.835	0.393	-125.76
1.6	0.330	112.5	2.543	67.393	0.152	64.829	0.395	-134.48
1.7	0.323	105.92	2.130	62.177	0.163	69.09	0.397	-137.99
1.8	0.337	95.571	2.155	61.964	0.187	67.97	0.393	-146.38
1.9	0.318	89.396	1.893	61.427	0.187	72.16	0.406	-149.87
2	0.344	77.432	1.962	63.618	0.218	67.927	0.424	-160.91
2.1	0.346	71.601	1.719	64.762	0.229	67.533	0.438	-162.29